

AATS ANNUAL MEETING 2018



AMERICAN ASSOCIATION
FOR THORACIC SURGERY
A Century of Modeling Excellence

PRESIDENT
Duke E. Cameron
PROGRAM CHAIRS
John D. Puskas
Luca A. Vricella
Glenn J. Whitman
Stephen C. Yang

SATURDAY AND SUNDAY SYMPOSIA

April 28 - May 1, 2018

San Diego Convention Center
San Diego, CA, USA

In Collaboration With



AMERICAN SOCIETY OF
EXTRACORPOREAL TECHNOLOGY
Lead - Collaborate - Educate - Care
56th International Conference

www.aats.org

Welcome to the AATS 2018
Saturday Courses and Sunday Symposia
In Collaboration with the
American Society of Extracorporeal Technology

SATURDAY COURSES | APRIL 28

Your Saturday all-access registration grants you admittance to all of the sessions taking place on Saturday from 8:00 AM to 5:00 PM in the San Diego Convention Center.

Session	Time	Room, Level 2, San Diego Convention Center
Adult Cardiac Skills: Coronary ♦	8:00 AM – 12:00 PM	Ballroom 20A
Adult Cardiac Skills: Mitral Valve ♦	8:00 AM – 12:00 PM	Ballroom 20D
Congenital Skills ♦	8:00 AM – 5:00 PM	Room 30ABC
General Thoracic Skills	8:00 AM – 5:00 PM	Room 24ABC
Cardiothoracic Transplant and Mechanical Circulatory Support of Heart and Lung Failure ♦	8:00 AM – 5:00 PM	Room 28ABC
Surgical Ethics Course ♦	8:00 AM – 3:00 PM	Room 28DE
Adult Cardiac Skills: Aortic Root ♦	1:00 PM – 3:00 PM	Room 25ABC
Adult Cardiac Skills: Atrial Fibrillation ♦	1:00 PM – 3:00 PM	Ballroom 20D
Adult Cardiac Skills: Transcatheter Valve Therapies ♦	1:00 PM – 3:00 PM	Ballroom 20A
Survival Guide: Your First Night on Call	1:00 PM – 5:00 PM	Rooms 23B and 23C
Enhanced Recovery after Cardiac Surgery	1:00 PM – 5:00 PM	Room 29AB
Protecting the Brain During Heart Surgery	3:15 PM – 5:15 PM	Ballroom 20A

SUNDAY AATS/STS POSTGRADUATE SYMPOSIA | APRIL 29

Your Sunday all-access registration grants you admittance to all of the sessions taking place on Sunday from 7:30 AM to 3:00 PM in the San Diego Convention Center.

Session	Time	Room, Level 2, San Diego Convention Center
AATS Innovation Summit	7:30 AM – 11:30 AM	Room 29AB
AATS/STS Adult Cardiac Surgery Symposium ♦	7:30 AM – 3:00 PM	Ballroom 20A
AATS/STS Congenital Heart Disease Symposium ♦	7:30 AM – 3:00 PM	Room 30ABC
AATS/STS General Thoracic Surgery Symposium	7:30 AM – 3:00 PM	Room 25ABC
Interprofessional Cardiothoracic Team Symposium ♦	7:30 AM – 5:00 PM	Room 28DE
Cardiothoracic Careers College (CCC)	7:30 AM – 3:00 PM	Room 29CD

AATS/AmSECT Welcome Reception | 5:15 PM – 7:15 PM in the Exhibit Hall, Level 1, San Diego Convention Center

Join us as we officially celebrate the opening of this year's AATS 98th Annual Meeting and AmSECT 56th International Conference. Visit with our valued exhibitors and supporters in the Exhibit Hall where you will learn cutting edge techniques and discover groundbreaking new products while networking with other attendees.

The Exhibit Hall offers several exciting learning opportunities:

- AATS Learning Center features cutting edge Case Videos of novel procedures and surgical techniques, as well as highlights of the 2018 AATS Aortic Symposium and 2017 AATS Mitral Conclave
- AATS Resident Poster Competition
- AATS Perioperative and Team Based Care Poster Competition
- Industry sponsored Surgical Suites

AATS/AmSECT Planning Committee

*David H. Adams

+Ron Angona

*Duke E. Cameron

*Thomas A. D'Amico

Marci Damiano

*Ralph J. Damiano, Jr.

*Abe DeAnda, Jr.

+Tim Dickinson

*J. William Gaynor

+Bob Groom

*Viktor Hraska

Katherine J. Hoercher

*David R. Jones

Mort Kern

David E. Lizotte, Jr.

*Susan Moffat-Bruce

**Daniela Molena

*Marc R. Moon

*John D. Puskas

*James A. Quintessenza

+Jim Reagor

+Jeff Riley

*Ashish S. Shah

+Kenneth Shann

*Thoralf M. Sundt, III

*Vaughn A. Starnes

*Wilson Y. Szeto

*Vinod H. Thourani

**Betty Tong

*Luca A. Vricella

+Rich Walczak

*Y. Joseph Woo

*Glenn J. Whitman

*Stephen C. Yang

Accreditation Information

Statement of Need

Cardiovascular disease and cancer are the leading causes of mortality and morbidity around the globe. Major advances in these conditions continue to be made at a rapid pace. Improvements in diagnostic techniques as well as interventional approaches to treatment, both surgical and percutaneous, challenge the clinical practitioner to remain current. Increasingly sophisticated technology to accomplish these aims is being developed and introduced into clinical practice. Exciting advances in basic and clinical science offer opportunities for participation in scientific studies and clinical trials. All of these elements create a significant educational need for the practicing cardiothoracic surgeon. The AATS Annual Meeting fills this need through a combination of lectures, original scientific presentations and discussion forums.

Educational Objectives

At the conclusion of the AATS Annual Meeting, through comprehensive lectures and discussions, participants will be able to:

- Identify the latest techniques and current research specifically related to Adult Cardiac Surgery, Congenital Heart Disease, General Thoracic Surgery and Perioperative Care.
- Select appropriate surgical procedures and other interventions for their own patients based upon results presented.
- Incorporate the basic science developments and emerging technologies and techniques across the spectrum of cardiothoracic surgery.
- Communicate current practice management necessary for the effective and safe delivery of patient care.
- Translate expanded knowledge into practice for the improvement of patient outcomes and satisfaction.

Target Audience

The AATS Annual Meeting is specifically designed to meet the educational needs of:

- Cardiothoracic Surgeons
- Physicians in related specialties including Cardiothoracic Anesthesia, Critical Care, Cardiology, Pulmonology, Radiology, Gastroenterology, Thoracic Oncology and Vascular Surgery
- Fellows and Residents in Cardiothoracic and General Surgical training programs
- Health Care Professionals involved in the care of cardiothoracic surgical patients including Physician Assistants, Nurse Practitioners, Nurses, Surgical Assistants and Perfusionists
- Medical students with an interest in cardiothoracic surgery

AATS would like to thank the following companies for their education support:

Abbott	Gore & Associates
Edwards Lifesciences	Siemens Healthineers

AATS would like to thank the following companies for their marketing support:

Abbott	LivaNova
Covalon Technologies	LSI Solutions
Edwards Lifesciences	Medtronic
Intuitive Surgical	Surgical Theater
Johnson & Johnson Medical	Vascutek
Devices Companies	Zimmer Biomet

Continuing Medical Education (CME) Accreditation

The American Association for Thoracic Surgery is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.

The American Association for Thoracic Surgery designates this live educational activity for a maximum of **31.25 AMA PRA Category 1 Credits™**.

Physicians should only claim credit commensurate with the extent of their participation in the activity.



American Academy of Physician Assistants (AAPA) Accreditation

This program has been reviewed and is approved for a maximum of 66.5 AAPA Category 1 CME credits by the AAPA Review Panel. PAs should claim only those credits actually spent participating in the CME activity.

This program was planned in accordance with AAPA CME Standards for Live Programs and for Commercial Support of Live Programs.

American Board of Cardiovascular Perfusion (ABCP) Accreditation

The American Board of Cardiovascular Perfusion is reviewing this educational activity for a maximum of 40.3 CEUs. Approved credits will be posted at www.aats.org.

The American Association for Thoracic Surgery designates the following credit hours:

Saturday, April 28, 2018 – up to 6.25 hours (CME, AAPA, ABCP)

Adult Cardiac Skills: Coronary, up to 3.75 hours
Adult Cardiac Skills: Mitral Valve, up to 3.5 hours
Adult Cardiac Skills: Atrial Fibrillation, up to 2 hours
Adult Cardiac Skills: Aortic Root, up to 2 hours
Adult Cardiac Skills: Transcatheter Valve Therapies, up to 2 hours
Congenital Skills, up to 6.5 hours
General Thoracic Skills, up to 7.5 hours
Cardiothoracic Transplant and Mechanical Circulatory Support of Heart and Lung Failure, up to 5.75 hours
Surgical Ethics Course, up to 5.5 hours
AATS/SCAI Heart Team Summit, up to 3 hours
Protecting the Brain During Heart Surgery, up to 2 hours
Survival Guide: Your First Night on Call, not for credit

Sunday, April 29, 2018 – up to 7.5 hours (CME, AAPA, ABCP)

Adult Cardiac Surgery, up to 6 hours
Congenital Heart Disease, up to 5.75 hours
General Thoracic Surgery, up to 6.25 hours
Interprofessional Cardiothoracic Team Symposium, up to 8 hours
Cardiothoracic Careers College (CCC), up to 5.5 hours
Adult Cardiac Surgery Simultaneous Session, up to 2 hours
Congenital Heart Disease Simultaneous Session, up to 2 hours
General Thoracic Surgery Simultaneous Session, up to 2 hours

Monday, April 30, 2018 – up to 7 hours (CME, ABCP)

Plenary Scientific Session, up to 2.75 hours
Presidential Address, up to 0.75 hours
Invited Guest Lecture, not for credit
Ethics Forum Luncheon, up to 1 hour
C. Walton Lillehei Resident Forum, not for credit
Adult Cardiac Surgery Simultaneous Session, up to 3 hours
Controversies in CABG 2018, up to 3 hours
Congenital Heart Disease Simultaneous Session, up to 2.75 hours
General Thoracic Surgery Simultaneous Session, up to 2.75 hours
Perioperative Care Simultaneous Session, up to 3 hours

Tuesday, May 1, 2018 – up to 6.75 hours (CME, ABCP)

Cardiac Surgery Forum, up to 1.5 hours
General Thoracic Surgery Forum, up to 1.5 hours
Adult Cardiac Emerging Technologies and Techniques / Video Session, up to 1.5 hours
Congenital Emerging Technologies and Techniques / Video Session, up to 1.2 hours
General Thoracic Emerging Technologies and Techniques / Video Session, up to 1.5 hours

Plenary Scientific Session, up to 2.25 hours
 Invited Guest Lecture, not for credit
 Aortic/Endovascular Simultaneous Session, up to 3 hours
 Congenital Heart Disease Simultaneous Session, up to 3 hours
 General Thoracic Surgery Simultaneous Session, up to 3 hours
 Enhanced Recovery after Cardiac Surgery, up to 1.5 hours
 Enhanced Recovery after Thoracic Surgery, up to 1.5 hours
 Adult Cardiac Surgery Simultaneous Session, up to 1.5 hours
 What a Cardiac Surgeon Should in 2018 Know about Transcatheter Devices, up to 1 hour
 MCS/Transplant Session, up to 1 hour
 AATS Surgical Cinema: Adult Cardiac, up to 1.5 hours
 AATS Surgical Cinema: Congenital, up to 1.5 hours
 AATS Surgical Cinema: General Thoracic, up to 1.5 hours

For further information on the Accreditation Council for Continuing Medical Education (ACCME) standards of commercial support, please visit www.accme.org.

CME Certificates and Letters of Attendance

CME (Continuing Medical Education) and CE credits and Letters of Attendance may be obtained at the CME/CE Pavilion located on Level 1 of the San Diego Convention Center. The CME/CE Pavilion computers will allow attendees to manage all of their CME/CE credits and Letter of Attendance for the Annual Meeting. Access may also be obtained post-meeting by visiting <https://ceu.experientevent.com/aat181/>.

Attendees may email their CME/CE certificate and/or Letter of Attendance to themselves or they may print them out on site at the CME/CE Pavilion.

Disclosure Policy

It is the policy of the American Association for Thoracic Surgery that any individual who is involved in planning, presenting or is an author on a program designated for AMA Physician's Recognition Award Category 1 Credit™ (and the individual's spouse/partner) must disclose to AATS all relevant financial relationships (e.g. salary, royalty, intellectual property rights, consulting fee, honoraria, ownership interest, stocks/stock options) with an ACCME-defined commercial interest(s), that is, any entity that produces, markets, re-sells, or distributes health care goods or services consumed by, or used on, patients. Relevant financial relationships are financial relationships in any amount that create a conflict of interest and that occurred in the twelve-month period preceding the time that the individual was asked to assume a role controlling content of the CME activity. A conflict of interest is created when individuals have both a relevant financial relationship with a commercial interest and the opportunity to affect the content of CME about the products or services of that commercial interest. Relevant financial relationships, or the absence thereof, are disclosed to the audience prior to an activity.

The AATS has procedures in place if a conflict of interest should arise. In addition, faculty members are asked to disclose when any discussion of unapproved use of pharmaceutical or medical device occurs. For further information on the Accreditation Council for Continuing Medical Education (ACCME) Standards of Commercial Support, please visit www.accme.org.

Committees

The following committee members have nothing to disclose with regard to relevant financial relationships. The following faculty members do not plan on discussing unlabeled/investigational uses of a commercial product.

+Ron Angona	*Viktor Hraska	+Jeff Riley
*Duke E. Cameron	Katherine J. Hoercher	+Kenneth Shann
*Thomas A. D'Amico	*David R. Jones	*Vaughn A. Starnes
Marci Damiano	David E. Lizotte, Jr.	*Luca A. Vricella
*Abe DeAnda, Jr.	*Susan Moffat-Bruce	+Rich Walczak
+Tim Dickinson	**Daniela Molena	*Y. Joseph Woo
*J. William Gaynor	*James A. Quintessenza	*Stephen C. Yang
+Bob Groom	+Jim Reagor	

The following committee members have disclosures with regard to relevant financial relationships. The following committee members do not plan on discussing unlabeled/investigational uses of a commercial product.

*David H. Adams	Research Support from Medtronic, Medtronic, NeoChord; The Icahn School of Medicine at Mount Sinai receives royalty payments for intellectual property from Edwards Lifesciences, Medtronic
*Ralph J. Damiano, Jr.	Speaker with Atricure, Edwards Lifesciences LivaNova; Research Support from Atricure
Mort Kern	Speaker with Abbot, St. Jude, Acist Medical, Heartflow, Opsens, Philips Volcano
*Marc R. Moon	Speaker with Edwards Lifesciences
*John D. Puskas	Consultant with Medtronic; Shareholder with Innovative Cardiac Technologies LLC
*Ashish S. Shah	Consultant with Transmedics
*Thoralf M. Sundt, III	Clinical Events Committee member with Medpace
*Wilson Y. Szeto	Consultant with Microinterventional Devices; Research Support from Edwards Lifesciences, Medtronic, Terumo, W L Gore
*Vinod H. Thourani	Advisor with Edwards Lifesciences, Abbott Vascular, Claret Medical, Boston Scientific, JenValve, Fore Vascular
**Betty Tong	Consultant with Medtronic
*Glenn J. Whitman	Research Support from Abbott Nutrition

Faculty

The following faculty members have nothing to disclose with regard to relevant financial relationships. The following faculty members do not plan on discussing unlabeled/investigational uses of a commercial product.

Jake H. Abernathy	Taweesak Chotivatanapong	*Isaac George
*Michael A. Acker	*Sertac Cicek	*David Glineur
*Ottavio R. Alfieri	Heidi M. Connolly	Andrew Goldstone
*Bahaaldin Alsoufi	*David T. Cooke	*Diego Gonzalez-Rivas
*Pavan Alturi	*David A. D'Alessandro	+Bob Groom
*Rafael Andrade	*Thomas A. D'Amico	*Kristine J. Guleserian
+Ron Angona	Marci Damiano	Padma Gulur
Mara B. Antonoff	*Gail E. Darling	Richard-Tien Ha
*Anelechi C. Anyanwu	*Tirone E. David	*Jonathan W. Haft
*Emile A. Bacha	*Joseph A. Dearani	James Hammel
*Vinay Badhwar	*Todd L. Demmy	*Frank L. Hanley
+Robert Baker	*Joseph Derosé	+H. Lynne Harness
Sandhya Balaram	Gabriele Di Giammarco	**Matthew Hartwig
Keki Balsara	+Tim Dickinson	Robert S. Higgins
*Clifford W. Barlow	+Chris Diodato	+Ashley Hodge
+Anton Barnett	*Jessica S. Donington	Katherine J. Hoercher
David Barron	*Gilles D. Dreyfus	*Wayne L. Hofstetter
*Joseph Bavaria	Tjark Ebels	Charles Hoopes
*David P. Bichell	Ahmed El-Eshmawi	*Viktor Hraska
Percy Boateng	*Gebrine El-Khoury	*Michel N. Ilbawi
+Christos Calaritis	John W. Entwistle	*Marshall L. Jacobs
*Christopher A. Caldarone	Kathleen Fenton	*Heinz G. Jakob
*Duke E. Cameron	*Mark K. Ferguson	Puja G. Khaitan
+Chelsea Capone	Brian Ferguson	Azeem Khan
*Paul J. Chai	Amy G. Fiedler	*Ki-Bong Kim
*Andrew C. Chang	Mario F.L. Gaudino	Richard W. Kim
*Haiquan Chen	*J. William Gaynor	+Thomas Klein

Emily Kluck
 *Benjamin D. Kozower
 Ganga Krishnamurthy
 *Irving L. Kron
 *Jennifer S. Lawton
 *Harold L. Lazar
 *Anthony E. Lerut
 Donald Likosky
 *Virginia R. Litle
 David E. Lizotte
 *Bruce W. Lytle
 David C. Magnus
 Rajendra Makkar
 *Hersh S. Maniar
 John E. Mayer
 *Shari Meyerson
 Robert Michler
 *Michael E. Mitchell
 *Susan D. Moffatt-Bruce
 **Daniela Molena
 Mindy Mordecai
 *Sudish C. Murthy
 *Song Wan
 Paul Weinberg
 *Richard I. Whyte

+Molly Oldeen
 Jay Pal
 *Harvey I. Pass
 *G. Alexander Patterson
 Giles J. Peek
 *Louis P. Perrault
 Sara J. Pereira
 Patrick Perrier
 *Gosta B. Petterson
 *Richard L. Prager
 *James A. Quintessenza
 +Jim Reagor
 *V. Mohan Reddy
 *David C. Rice
 +Jeff Riley
 Harold G. Roberts, Jr
 *Eric E. Roselli
 Mark Russo
 *Joseph F. Sabik
 *Robert M. Sade
 Inderpal S. Sarkaria
 *Hans Joachim Schaefer
 *Y. Joseph Woo
 *Doug Wood
 *Stephen C. Yang

Jan Schmitto
 Chris Sciortino
 Cyril Serrick
 Andrew Sherman
 Christian Shults
 *Sunil Singhal
 Robert L. Smith
 *Craig R. Smith
 +Al Stammers
 *Vaughn A. Starnes
 *Allan S. Stewart
 Wil Suh
 *Lars G. Svensson
 *Julie A. Swain
 *James Tatoulis
 +Joey Timpa
 *Victor T. Tsang
 *James S. Tweddell
 *Thomas K. Varghese
 *Luca A. Vricella
 +Rich Walczak
 *Thomas J. Yeh
 *Kenton J. Zehr

The following faculty members have nothing to disclose with regard to relevant financial relationships. The following faculty members plan on discussing unlabeled/investigational uses of a commercial product.

*Matthew Bacchetta *Off-label/unapproved use discussion* - Use of ECMO for more than 6 hours
 +Desiree Bonadonna *Off-label/unapproved use discussion* - All ECMO Products
 *Michael J. Mack *Off-label/unapproved use discussion* - TMVR technology
 Steven Tsui *Off-label/unapproved use discussion* - TransMedics OCS

The following faculty members have disclosures with regard to relevant financial relationships. The following faculty members do not plan on discussing unlabeled/investigational uses of a commercial product.

*Niv Ad Speaker with Medtronic; Consultant with Atribute, LivaNova; Advisor with ido Surgical; Co-Owner of LA Appendage Occlusion

 *David H. Adams Research Support from Medtronic, Medtronic, NeoChord; The Icahn School of Medicine at Mount Sinai receives royalty payments for intellectual property from Edwards Lifesciences, Medtronic

 Saif Anwaruddin Speaker with Edwards Lifesciences, Medtronic; Consultant with Medtronic, Edwards Lifesciences

 *Rakesh Arora Research Support from Pfizer Canada Inc.; Honorarium from Mallickrodt Pharmaceuticals

 Husam H. Balkhy Proctor with Intuitive Surgical

 *Christian P. Brizard Advisor with Admedus, Australia. Advisor

 *Robert J. Cerfolio Consultant with Intuitive, Ethicon, Covidien, Bovie, KCL, Myriad, Neomend/BARD, Novartis, Pinnacle, TransEnteric, Medtronic, Google, C-SATS video review, ConMed/AirSeal

 *Joanna Chikwe Speaker with Edwards Lifesciences

 *Yolonda L. Colson Research Support from Cannon USA, Stryker

*Marcelo Cypel	Consultant with United Therapeutics; Shareholder with XOR Labs Toronto, Perfusix Canada; Research Support from XVivo Perfusion
*Ralph J. Damiano, Jr.	Speaker with Atricure, Edwards Lifesciences LivaNova; Research Support from Atricure
*Steven R. DeMeester	Speaker with Bard/Davol, Novadaq; Consultant with Bard/Davol, CDx Diagnostics; Research Support from Bard/Davol, CDx Diagnostics
Paolo Denti	Consultant with 4Tech, InnovHeart, Neovasc, Abbott
*Sitaram M. Emani	Consultant with Cheisi Pharma
Ted Feldman	Consultant with Abbott, BSC, Edwards Lifesciences
*Hiran C. Fernando	Medical Monitor for Metastases Study with Galil Medical
*A. Marc Gillinov	Consultant with AtrCure, Medtronic, Abbott, CryoLife, ClearFlow; Shareholder with ClearFlow; Research Support from Abbot, Edwards; Cleveland Clinic receives royalties from AtriCure
*Michael E. Halkos	Consultant with Medtronic
*Shaf Keshavjee	Shareholder with Perfusix Canada Inc, XOR Labs Toronto Inc.; Research Support from XVIVO Perfusion, United Therapeutics
Teresa M. Kieser	Consultant with Medistim ASA, Medistim US, Ethicon Endosurgery; Research Support from Medistim ASA and US, Ethicon Endosurgery
*Leslie J. Kohman	Research Support from CareFusion
*Martin Kostolny	Proctor with Terumo, JOMDD
Lionel Lamhaut	Research Support from Maquet
*Joseph Lamelas	Speaker with Medtronic, Edwards Lifesciences; Shareholder with Miami Instruments, Inc.
*Moishe Liberman	Research Support from Ethicon, Cook, Boston Scientific
Michael J. Lim	Speaker with Abiomed, Medtronic; Consultant with Abiomed
Gabriel Loor	Research Support from TransMedics, Inc.
*James D. Luketich	Shareholder with Johnson & Johnson, Express Scripts Inc, Intuitive Surgical Inc, Proctor & Gamble
*S. Chris Malaisrie	Speaker with Abbott; Consultant with Edwards Lifesciences and CryoLife
*Blair M. Marshall	Advisor with Ethicon
*Patrick M. McCarthy	Consultant with Edwards Lifesciences, Abbott Vascular, Medtronic. Royalties as Inventor from Edwards Lifesciences
Stuart McGrane	Travel funding from Abbott
*John D. Mitchell	Speaker and Consultant with Medtronic
*Marc R. Moon	Speaker with Edwards Lifesciences
*David L. Morales	Consultant with Syncardia, Oregon Heart, Abbott Medical Inc; Advisor with Cormatrix, Inc., Berlin Heart, Inc.; Shareholder with Cormatrix, Inc.; Research Support Recipient from Cormatrix, Inc., Syncardia

*Richard G. Ohye	Advisor with Cryolife, Inc.
*Mark Onaitis	Consultant with Medtronic
*Bernard J. Park	Speaker with Intuitive Surgical; Consultant with Medtronic
Rene Petersen	Speaker with Medtronic
*Ourania Preventza	Consultant with W.L. Gore & Associates, Inc.
*John D. Puskas	Consultant with Medtronic; Shareholder with Innovative Cardiac Technologies LLC
*Siva Raja	Advisor with Smiths Medical
*Michael J. Reardon	Consultant with Medtronic, Boston Scientific
*Rishindra M. Reddy	Consultant with Intuitive Surgical; Advisor with Medtronic
Kenneth Rosenfield	Consultant/Scientific Advisory Board with with Abbot Vascular, Cardinal Health, Cook, Thrombolex, Surmodics, Volcano/Philips, Amegen; Stock Shareholder with PQ Bypass, Primacea, Capture Vascular, VOTEX, MD Insider, Micell, Shockwave, Cruzar Systems, Endospan, Eximo, Valcare, Contego; Consultant/Scientific Advisory Board with Equity or Stock Options with Capture Vascular, Contego, CRUZAR Systems, Endospan, Eximo, MD Insider, Micell, Shockwave, Silk Road Medical, Valcare, Thombolex; Research Support from Atrium-Getinge, Inari Medical, NIH, Lutonix-BARD; Board Member with VIVA Physicians, National PERT Consortium
*Marc Ruel	Advisor with Medtronic , Abbott; Research Support from Medtronic, Edwards, Cryolife
*Ashish S. Shah	Consultant with Transmedics
Alan Sihoe	Advisor with AME Publishing Co. (Hong Kong); Research Support from Medela AG (Baar, Switzerland)
Scott C. Silvestry	Speaker with Abbott; Consultant with Abbott, Medtronic
*Thoralf M. Sundt, III	Clinical Events Committee member with Medpace
Francis P. Sutter	Speaker with Intuitive Surgical, Case Observations
*Scott J. Swanson	Consultant with Ethicon, Covidien
Molly Szerlip	Speaker with Edwards Lifesciences, Medtronic
*Wilson Y. Szeto	Consultant with Microinterventional Devices; Research Support from Edwards Lifesciences, Medtronic, Terumo, W L Gore
*David P. Taggart	Speaker with Medistim, VGS, Medtronic; Consultant with Medistim, VGS, Medtronic, Stryker; Advisor with Medistim, VGS, Medtronic, Stryker; Shareholder with VGS; Research Support from Medistim, VGS, Medtronic
Gilbert Tang	Speaker with Abbott Structural Heart, Edwards Lifesciences, Medtronic
*Vinod H. Thourani	Advisor with Edwards Lifesciences, Abbott Vascular, Claret Medical, Boston Scientific, JenValve, Fore Vascular
**Betty Tong	Consultant with Medtronic
Michael Vallely	Consultant with St Jude, Medtronic
*Benny Weksler	Consultant with Intuitive Surgery

*Glenn J. Whitman	Research Support from Abbott Nutrition
*Kazuhiro Yasufuku	Consultant with Olympus America Inc, Intuitive Surgical Inc, Auris Surgical Robotics, Medtronic, Johnson and Johnson; Advisor with Conordia, Olympus America Inc.; Research Support Rfrom Olympus Corporation
The following faculty members have disclosures with regard to relevant financial relationships. The following faculty members <u>plan</u> on discussing unlabeled/investigational uses of a commercial product.	
David Amar	Research Support from Silvian Foundation.; <i>Off-label/unapproved use discussion</i> – magnesium sulfate, gabpentin off-label uses
*Joseph S. Coselli	Consultant with Vascutek Terumo, Medtronic, WL Gore; Research Support from Abbott, Vascutek Terumo, Edwards Lifesciences, Medtronic, WL Gore, Nolton Medical; Royalties from Coselli branched TAAA Graft; <i>Off-label/unapproved use discussion</i> – BioBentall with Future TAVR presentation necessitates the dicussion of experimental and off-label approaches.
Mani A. Daneshmand	Speaker with Maquet; <i>Off-label/unapproved use discussion</i> – Off Label Use of ECMO technology
Matthew R. Danter	Advisor with Medtronic; <i>Off-label/unapproved use discussion</i> – The product is the Medtronic HVAD left ventricular assist device, and the "investigational" use is implantation via non-sternotomy, less invasive approaches.
James Longoria	Shareholder and IP Rights with LC Therapeutics; <i>Off-label/unapproved use discussion</i> – RF clamp/pen for treated of atrial fibrillation
Nahush A. Mokadam	Consultant with Medtronic, Abbott; Research Support from Medtronic, Abbott, Syncardia; <i>Off-label/unapproved use discussion</i> – I will discuss off-label use of percutaneous devices and how they may be used in the setting of LVAD therapy
Victor (Gert) Pretorius	Speaker and Consultant with Medtronic, Abbott; <i>Off-label/unapproved use discussion</i> – Use of Medtronic HeartWare HVAD as Right ventricular assist device
*Mathew R. Williams	Consultant with Abbott, Boston Scientific; Research Support from Edwards, Medtronic, Livanova; <i>Off-label/unapproved use discussion</i> – Mitral clip, Caisson, Intrepid

AATS Staff

None of the AATS Staff members involved in the CME program have disclosed any relevant financial relationships. These staff members include: Melissa Binette, Michelle Cormier, Darlene Janis, Charlotte LeTourneau, Lauren Ruggiero, Ashley Quinn, Cindy VerColen.

Adult Cardiac Skills: Coronary

Ballroom 20A, SDCC

Saturday, April 28, 2018 | 8:00 AM – 12:00 PM

Course Chair: * John D. Puskas, *Mount Sinai Saint Luke's*

8:00 AM - 8:05 AM **Welcome and Introduction**
* John D. Puskas, *Mount Sinai Saint Luke's*

Conduits for CABG

8:05 AM - 8:15 AM **How to Harvest BITA Grafts: Best Practices**
Teresa M. Kieser, *Libin Cardiovascular Institute of Alberta*

8:15 AM - 8:25 AM **How to Harvest RA Grafts: Best Practices**
* John D. Puskas, *Mount Sinai Saint Luke's*

8:25 AM - 8:35 AM **How to harvest SVG Grafts: Best Practices**
*Song Wan, *The Chinese University of Hong Kong*

8:35 AM - 8:45 AM **Storage Solutions for CABG Conduits**
*Louis P. Perrault, *Montreal Heart Institute Department of Surgery*

Graft Configuration

8:45 AM - 8:55 AM **How to Deploy BITA Grafts**
*Joseph F. Sabik, III, *University Hospitals of Cleveland*

8:55 AM - 9:05 AM **How to Deploy RA Grafts**
*James Tatoulis, *Royal Melbourne Hospital*

9:05 AM - 9:15 AM **Composite Arterial Conduits**
David Glineur, *University of Ottawa Heart Institute*

9:15 AM - 9:25 AM **How to Deploy SVG Grafts**
*Ki-Bong Kim, *Seoul National University Hospital*

9:25 AM - 9:35 AM **New External Stents for SVG Grafts**
*David P. Taggart, *University of Oxford*

9:35 AM - 9:45 AM **Panel Discussion**
David Glineur, *University of Ottawa Heart Institute*
*Ki-Bong Kim, *Seoul National University Hospital*
* John D. Puskas, *Mount Sinai Saint Luke's*
*David P. Taggart, *University of Oxford*
*James Tatoulis, *Royal Melbourne Hospital*

9:45 AM - 10:00 AM **Coffee Break**

Graft Assessment by Transit Time Flow Measurement and Imaging

10:00 AM - 10:10 AM **The Physics of Transit Time Flow Measurement: What Do The Numbers Mean?**
Gabriele Di Giammarco, *University G D'Annunzio-Chieti*

10:10 AM - 10:20 AM **When Should I Revise a Graft? Cases in Which TTFM Made Aa Difference**
*David P. Taggart, *University of Oxford*

OPCAB: Best Practices

- 10:20 AM - 10:35 AM** **How to Position the Heart for OPCAB**
David Glineur, *University of Ottawa*
- 10:35 AM - 10:50 AM** **Tips and Tricks for Precise, Reproducible OPCAB**
*John D. Puskas, *Mount Sinai Saint Luke's*
- 10:50 AM - 11:05 AM** **MIDCAB and Multivessel CABG via Thoracotomy**
*Marc Ruel, *University of Ottawa Heart Institute*

Robotic CABG

- 11:05 AM - 11:20 AM** **Single Vessel LITA-LAD via Microthoracotomy**
*Michael E. Halkos, *Emory University at Midtown*
- 11:20 AM - 11:35 AM** **TECAB with Anastomotic Connectors**
Husam H. Balkhy, *University of Chicago*
- 11:35 AM - 11:50 AM** **Hybrid Coronary Revascularization**
Francis P. Sutter, *Lankenau Medical Center*
- 11:50 AM - 12:00 PM** **Panel Discussion**
Gabriele Di Giammarco, *University G D'Annunzio-Chieti*
*John D. Puskas, *Mount Sinai Saint Luke's*
*Marc Ruel, *University of Ottawa Heart Institute*
Francis P. Sutter, *Lankenau Medical Center*
- 12:00 PM - 1:00 PM** **Combined Luncheon Speaker**
*Bruce A. Reitz, *Stanford University*

Remain in Ballroom 20A, SDCC
Not for Credit

Adult Cardiac Skills: Mitral Valve

Saturday, April 28, 2018 | 8:00 AM – 12:00 PM

Course Co-Chairs: *David H. Adams, *Mount Sinai Health System*
*Marc R. Moon, *Washington University*

Ballroom 20D, SDCC

- 8:00 AM - 8:05 AM** **Welcome and Introduction**
*David H. Adams, *Mount Sinai Health System*
*Marc R. Moon, *Washington University*

Session I: Toolbox for Mitral Valve Repairs

- 8:05 AM - 8:15 AM** **Direct Access Approaches**
*Anelechi Anyanwu, *Mount Sinai Health System*
- 8:15 AM - 8:25 AM** **Mini-thoracotomy Planning and Execution**
*Y. Joseph Woo, *Stanford University*
- 8:25 AM - 8:35 AM** **Transeptal and Interatrial Groove Valve Exposure**
Percy Boateng, *Mount Sinai Health System*
- 8:35 AM - 8:50 AM** **Discussion**
- 8:50 AM – 9:00 AM** **Basic Resection Strategy**
*Gilles D. Dreyfus, *Cardiothoracic Centre of Monaco*

9:00 AM - 9:10 AM	Chordal Replacement Strategy
9:10 AM - 9:20 AM	Edge to Edge Strategy <i>*Ottavio R. Alfieri, University of Rochester</i>
9:20 AM - 9:30 AM	Annuloplasty Strategy
9:30 AM - 9:50 AM	Discussion
9:50 AM - 10:10 AM	Coffee Break

Session II: Advanced Strategies

10:10 AM - 10:20 AM	Commissurotomy and Leaflet Stripping <i>Taweesak Chotivatanapong, Chest Disease Institute</i>
10:20 AM - 10:30 AM	Patch Augmentation <i>*Vinay Badhwar, West Virginia University</i>
10:30 AM - 10:45 AM	Complex Annular Pathology <i>*Tirone E. David, Toronto General Hospital</i>
10:45 AM - 11:00 AM	Discussion
11:00 AM - 11:10 AM	Complex Endocarditis <i>Ahmed El-Eshmawi, Mount Sinai Health System</i>
11:10 AM - 11:20 AM	Anterior Leaflet Prolapse
11:20 AM - 11:30 AM	Posterior Leaflet Restriction <i>*Patrick M. McCarthy, Northwestern University</i>
11:30 AM - 12:00 PM	Discussion
12:00 PM - 1:00 PM	Combined Luncheon Speaker <i>*Bruce A. Reitz, Stanford University</i>

Ballroom 20A, SDCC
Not for Credit

AATS/SCAI Heart Team Summit
Saturday, April 28, 2018 | 9:00 AM – 12:00 PM
Course Chairs: Mort Kern, *Long Beach VA Health Care System*
**Vinod H. Thourani, MedStar Heart & Vascular Institute/Georgetown University*

Room 25ABC, SDCC

Mitral and Tricuspid Valve
Moderators: Kenneth Rosenfield, *Massachusetts General Hospital*
**Vinod H. Thourani, MedStar Heart & Vascular Institute/Georgetown University*

Panelists: Ted Feldman, *Evanston Hospital*
Mort Kern, *Long Beach VA Health Care System*
Christian Shults, *MedStar Heart & Vascular Institute*

9:00 AM - 9:12 AM	The Future of Treating Mitral Regurgitation: Surgical and Transcatheter Replacement Techniques <i>*Vinod H. Thourani, MedStar Heart & Vascular Institute/Georgetown University</i>
9:12 AM - 9:24 AM	The Future of Treating Mitral Regurgitation: Surgical and Transcatheter Repair Techniques <i>Ted Feldman, Evanston Hospital</i>

9:24 AM – 10:00 AM **Panel Discussion with Mock Heart Team**
Panelists: Ted Feldman, *Evanston Hospital*
Mort Kern, *Long Beach VA Health Care System*
Kenneth Rosenfield, *Massachusetts General Hospital*
*Vinod H. Thourani, *MedStar Heart & Vascular Institute/Georgetown University*

Case One
Christian Shults, *MedStar Heart & Vascular Institute/Georgetown University*

Case Two
Ted Feldman, *Evanston Hospital*

Coronary Artery Disease

Moderators: *Joseph Derose, *Montefiore Medical Center*
Mort Kern, *Long Beach VA Health Care System*

Panelists: Azeem Khan, *Louisiana State University*
Michael J. Lim, *Saint Louis University*
*Hersh Maniar, *Washington University*

10:00 AM - 10:12 AM **Patient Selection for Left Main Stenting: Who Should Have Surgery vs PCI**
Michael J. Lim, *Saint Louis University*

10:12 AM - 10:24 AM **Hybrid CABG: Is It the Future?**
*Joseph Derose, *Montefiore Medical Center*

10:24 AM – 11:00 AM **Panel Discussion with Mock Heart Team**
Panelists: *Joseph Derose, *Montefiore Medical Center*
Mort Kern, *Long Beach VA Health Care System*

Michael J. Lim, *Saint Louis University*
*Hersh Maniar, *Washington University*

Case One
Azeem Khan, *Louisiana State University*

Case Two
Michael J. Lim, *Saint Louis University*

Aortic Valve Disease

Moderators: *S. Chris Malaisrie, *Northwestern Memorial Hospital*
Kenneth Rosenfield, *Massachusetts General Hospital*
Wil Suh, *Long University of California Los Angeles*

Panelists: Mark Russo, *Barnabas Heart Hospital*
Molly Szerlip, *The Heart Hospital Baylor Plano*

11:00 AM - 11:12 AM **The Changing Management of AS: Which Patients Should Still Have Surgery in 2018**
*S. Chris Malaisrie, *Northwestern Memorial Hospital*

11:12 AM - 11:24 AM **Cross Training for TAVR: Is it Feasible?**
Molly Szerlip, *The Heart Hospital Baylor Plano*

11:24 AM – 11:58 AM **Panel Discussion with Mock Heart Team**
Panelists: *S. Chris Malaisrie, *Northwestern Memorial Hospital*
Kenneth Rosenfield, *Massachusetts General Hospital*
Mark Russo, *Barnabas Heart Hospital*
Wil Suh, *Long University of California Los Angeles*
Molly Szerlip, *The Heart Hospital Baylor Plano*

Case One

Mark Russo, *Barnabas Heart Hospital*

Case Two

Molly Szerlip, *The Heart Hospital Baylor Plano*

11:58 AM – 12:00 PM

Closing Remarks

Mort Kern, *Long Beach VA Health Care System*

*Vinod H. Thourani, *MedStar Heart & Vascular Institute/Georgetown University*

Adult Cardiac Skills: Atrial Fibrillation

Ballroom 20D, SDCC

Best of AATS STARS: *Surgical Treatment of Arrhythmias and Rhythm Disorders*

Saturday, April 28, 2018 | 1:00 PM – 3:00 PM

Course Chair: *Ralph J. Damiano, Jr., *Washington University*

Concomitant Atrial Fibrillation Surgery: How I Do It***Mitral Surgery/ AF Ablation***

1:00 PM – 1:10 PM

Sternotomy Approach

*Patrick M. McCarthy, *Northwestern University*

1:10 PM – 1:20 PM

Right Minithoracotomy Approach

*Ralph J. Damiano, Jr., *Washington University*

AVR / CABG/ AF Ablation

1:20 PM – 1:30 PM

CABG Off/On Pump

*John D. Puskas, *Mount Sinai Saint Luke's*

1:30 PM – 1:40 PM

Panel Discussion

1:40 PM – 1:50 PM

MAZE 4 Procedure

Harold G. Roberts, Jr., *West Virginia University Heart & Vascular Institute*

1:50 PM – 2:00 PM

Panel Discussion**Lone Atrial Fibrillation Surgery: How I Do It**

2:00 PM – 2:10 PM

Minimally Invasive Cryo-MAZE Procedure

*Niv Ad, *West Virginia University*

2:10 PM – 2:20 PM

Totally Thoracoscopic Approach

James Longoria, *Sacramento Cardiovascular Surgeons Medical Group*

2:20 PM – 2:30 PM

Hybrid Ablation

2:30 PM – 2:40 PM

Management of the Left Atrial Appendage

2:40 PM – 3:00 PM

Panel Discussion

Adult Cardiac Skills: Aortic Root
Saturday, April 28, 2018 | 1:00 PM – 3:00 PM
Course Chair: *Y. Joseph Woo, *Stanford University*

Room 25ABC, SDCC

Moderators: *Lars G. Svensson, *Cleveland Clinic*
*Y. Joseph Woo, *Stanford University*

- 1:00 PM - 1:12 PM** **Leaflet Repair Techniques in TriLeaflet and BAV**
*Y. Joseph Woo, *Stanford University*
- 1:12 PM - 1:24 PM** **Annuloplasty: Subcommissural, IntraAnnular Suture Techniques, and External and Internal Rings**
*Gebrine El-Khoury, *University Catholique de Louvain*
- 1:24 PM - 1:36 PM** **Valve Sparing Aortic Root Replacement with the Remodeling Technique is the Optimal Approach**
*Hans-Joachim Schaefer, *University Hospital*
- 1:36 PM - 1:48 PM** **Valve Sparing Aortic Root Replacement with Reimplantation into a Straight Graft is the Most Durable Approach**
*Tirone E. David, *Toronto General Hospital*
- 1:48 PM - 2:00 PM** **Aortic Root Surgery for the Marfan Patient--Special Considerations**
*Duke E. Cameron, *Massachusetts General Hospital*
- 2:00 PM - 2:12 PM** **BioBentall with Future TAVR Valve-in-Valve is the Best Approach**
*Joseph S. Coselli, *Baylor College of Medicine*
- 2:12 PM - 2:24 PM** **Partial Sternotomy or Right Anterior Thoracotomy for Aortic Root and Arch Operations**
*Eric E. Roselli, *Cleveland Clinic*
- 2:24 PM - 3:00 PM** **Panel Discussion**

Adult Cardiac Skills: Transcatheter Valve Therapies
Saturday, April 28, 2018 | 1:00 PM – 3:00 PM
Course Chair: *Wilson Y. Szeto, *University of Pennsylvania*

Ballroom 20A, SDCC

- 1:00 PM - 1:05 PM** **Welcome and Introduction**
*Wilson Y. Szeto, *University of Pennsylvania*

Aortic Valve
Moderators: *Wilson Y. Szeto, *University of Pennsylvania*
*Michael J. Reardon, *Methodist DeBakey Heart Center*

- 1:05 PM - 1:15 PM** **Transfemoral TAVR for Surgeons: Challenging Scenarios and Complication**
*Vinod H. Thourani, *MedStar Heart & Vascular Institute*
- 1:15 PM - 1:25 PM** **Alternative Access TAVR: Tips and Tricks**
*Michael J. Reardon, *Methodist DeBakey Heart Center*
- 1:25 PM - 1:35 PM** **Cerebral Embolic Protection During TAVR**
Saif Anwaruddin, *University of Pennsylvania*
- 1:35 PM - 1:45 PM** **Transcatheter Valve in Valve Implantation for Failed Aortic and Mitral Bioprosthesis: Tips and Tricks**
*Isaac George, *New York Presbyterian Hospital*
- 1:45 PM - 1:55 PM** **Panel Discussion**

Mitral Valve

Moderators: *Wilson Y. Szeto, *University of Pennsylvania*

*Mathew Williams, *New York University*

1:55 PM - 2:05 PM	Transeptal Access: A "How to Do It" for Surgeons Gilbert Tang, <i>Mount Sinai Health System</i>
2:05 PM - 2:15 PM	Transcatheter Mitral Valve Repair: Edge to Edge Leaflet Repair *Mathew Williams, <i>New York University</i>
2:15 PM - 2:25 PM	Transcatheter Mitral Valve Repair: Direct and Indirect Annuloplasty Paolo Denti, <i>San Raffaele University Hospital</i>
2:25 PM - 2:35 PM	Transapical Chordal Repair for Mitral Regurgitation Ahmed El-Eshwami, <i>Mount Sinai Health System</i>
2:35 PM - 2:45 PM	Transcatheter Mitral Valve Replacement for Mitral Regurgitation *Wilson Y. Szeto, <i>University of Pennsylvania</i>
2:45 PM - 2:55 PM	Transcatheter Mitral Valve Replacement in Patients with Sever MAC Robert L. Smith, <i>Baylor Scott & White Cardiac Surgery Specialists</i>
2:55 PM - 3:00 PM	Panel Discussion

Congenital Skills: What Are We Doing Today to Improve Tomorrow
Saturday, April 28, 2018 | 8:00 AM – 5:00 PM

Room 30ABC, SDCC

Course Chairs: +Ron Angona, *University of Oklahoma*

*James A. Quintessenza, *Cincinnati Children's Hospital*

+Jim Reagor, *Cincinnati Children's Hospital*

*Luca A. Vricella, *Johns Hopkins Hospital*

8:00 AM - 8:10 AM	Welcome and Introduction *Luca A. Vricella, <i>Johns Hopkins Hospital</i> *James A. Quintessenza, <i>Cincinnati Children's Hospital</i> +Jim Reagor, <i>Cincinnati Children's Hospital</i>
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Techniques for Creation and Repair of Cardiac Valves

8:10 AM - 8:25 AM	Tricuspidalization of the Bicuspid Aortic Valve *Viktor Hraska, <i>Children's Hospital of Wisconsin</i>
8:25 AM - 8:40 AM	Fundamental Concepts in Bicuspid Aortic Valve Repair *Hans-Joachim Schaefer, <i>University Hospital</i>
8:40 AM - 8:55 AM	The Ozaki Technique and Aortic Cusp Creation *Martin Kostolny, <i>Great Ormond Street Hospital</i>
8:55 AM - 9:10 AM	Support of the Ross Autograft *Vaughn A. Starnes, <i>Keck School of Medicine</i>
9:10 AM - 9:25 AM	ePTFE Valves and Conduits *James A. Quintessenza, <i>Cincinnati Children's Hospital</i>
9:25 AM - 9:40 AM	Melody Valve in the Mitral Position in Infants and Small Children *Paul J. Chai, <i>Morgan Stanley Children's Hospital / Columbia University</i>

9:40 AM - 9:55 AM Repair of Common AV Valve in Univentricular Hearts

*Christian P. Brizard, *Royal Children's Hospital*

9:55 AM - 10:10 AM Truncal Valve Repair

*Michel N. Ilbawi, *Advocate Children's Hospital*

10:10 AM - 10:30 AM Coffee Break

My Mishap Is Your Mishap

10:30 AM - 10:45 AM My Mishap Is Your Mishap

*Thomas J. Yeh, Jr., *The Heart Centre, Children's Hospital of Richmond, Virginia Commonwealth University Health System*

+Christos Calaritis, *The Heart Centre, Children's Hospital of Richmond, Virginia Commonwealth University Health System*

10:45 AM - 11:00 AM My Mishap Is Your Mishap

Richard W. Kim, *University of Southern California*

+Anton Barnett, *University of Southern California*

Contemporary Trends in Pediatric Perfusion

11:00 AM - 11:15 AM Database Review (US)

+Ashley Hodge, *Nationwide Children's Hospital*

11:15 AM - 11:30 AM Optimizing Pediatric Perfusion Prime Strategies: Whole Blood vs. Component Therapy Considerations

+Thomas Klein, *Vanderbilt University*

11:30 AM - 11:45 AM Prime Composition

+Jim Reagor, *Cincinnati Children's Hospital*

11:45 AM - 12:00 PM Perfusion in Hypercyanotic Patients

+Ron Angona, *University of Oklahoma*

12:00 PM - 1:00 PM Combined Luncheon Speaker

*Bruce A. Reitz, *Stanford University*

Ballroom 20A, SDCC

Not for Credit

Post-cardiotomy ECMO in 2018

1:00 PM - 1:15 PM Surgeon's Perspective (How to Minimize Morbidity)

*Giles J. Peek, *Children's Hospital at Montefiore*

1:15 PM - 1:30 PM Perfusionist's Perspective

+Joey Timpa, *Children's Hospital of Alabama*

Challenges in GUCH Operations

1:30 PM - 1:45 PM High Risk Re-entry: Strategic Approach

*Sertac Cicek, *Mayo Clinic*

1:45 PM - 2:00 PM GUCH Video One

*Gosta B. Petterson, *Cleveland Clinic*

2:00 PM - 2:15 PM GUCH Video Two

*Michael E. Mitchell, *Medical College of Wisconsin*

2:15 PM - 2:30 PM GUCH Video Three

*Kristine J. Guleserian, *Nicklaus Children's Cardiovascular Surgery*

2:30 PM - 2:45 PM Coffee Break

When There is No Valve: Best Choice of Prosthesis for GUCH and Pediatric Patients

2:45 PM - 3:00 PM **Biologic Valves**
*Joseph A. Dearani, *Mayo Clinic*

3:00 PM - 3:15 PM **Is There a Role for Mechanical Prostheses in The Right Heart?**
Tjark Ebels, *University Medical Centre Groningen Thoraxcentrum*

3:15 PM - 3:30 PM **Management of Bacterial Endocarditis in Native and Prosthetic Valves in Patients with Congenital Heart Disease**
*Bahaaldin Alsoufi, *Emory University*

Practice Variation and Standards in Perfusion

3:30 PM - 3:45 PM **Minimizing Practice Variation on Cardiopulmonary Bypass**
+Jim Reagor, *Cincinnati Children's Hospital*

3:45 PM - 4:00 PM **How to Use Data to Minimize Practice Variation**
Donald Likosky, *University of Michigan*

4:00 PM - 4:15 PM **Implementation of AmSECT's Standards and Guidelines for Cardiopulmonary Bypass**
+Molly Oldeen, *Ann & Robert H. Lurie Children's Hospital of Chicago*

General Thoracic Surgery Skills: Respecting the Past, Looking to the Future
Saturday, April 28, 2018 | 8:00 AM – 5:00 PM

Room 24ABC, SDCC

Course Chair: *Stephen C. Yang, *Johns Hopkins Hospital*

Course Co-Chair: **Daniela Molena, *Memorial Sloan Kettering Cancer Center*

8:00 AM - 8:10 AM **Welcome and Introduction**
*Stephen C. Yang, *Johns Hopkins Hospital*

Session 1: Benign Esophagus: Choose Your Own Adventure
Moderator: *Andrew C. Chang, *University of Michigan*

8:10 AM - 8:25 AM **Poetic Justice? Trading Achalasia for GERD with POEM**
*Virginia R. Litle, *Boston University Medical Center*

8:25 AM - 8:40 AM **Leaving the Wrap Behind: LINX and Stretta for GERD**
**Matthew Hartwig, *Duke University*

8:40 PM - 9:00 AM **How I Teach It: Laparoscopic PEH**
*Blair M. Marshall, *Medstar Georgetown University Hospital*

9:00 AM - 9:30 AM **Clash of the Titans I: Giant PEH Debate: Open Belsey vs. Laparoscopic**
*James D. Luketich, *University of Pittsburgh Medical Center*

9:30 AM - 10:00 AM **Discussion**

10:00 AM - 10:15 AM **Coffee Break**

Session 2: Minimally Invasive Esophagectomy: The Devil is in the Details
Moderator: *Mark Onaitis, *University of California San Diego*

10:15 AM - 10:30 AM **Reconstruction 101: The Conduit, The Hiatus, The J-tube**
Inderpal S. Sarkaria, *UPMC Shadyside*

10:30 AM - 10:45 AM	How I Do It: Lymph Node Dissection *Steven R. DeMeester, <i>Oregon Clinic</i>	
10:45 AM - 11:00 AM	Making the Most of the Mosis: Anastomotic Techniques *Gail E. Darling, <i>Toronto General Hospital</i>	
11:00 AM - 11:30 AM	How I Teach It: Laparoscopic / VATS and Robotic Esophagectomy **Daniela Molena, <i>Memorial Sloan Kettering Cancer Center</i> **Rishindra M. Reddy, <i>University of Michigan Health System</i>	
11:30 AM - 12:00 PM	Discussion	
12:00 PM - 1:00 PM	Combined Luncheon Speaker *Bruce A. Reitz, <i>Stanford University</i>	Ballroom 20A, SDCC <i>Not for Credit</i>

Session 3: Pulmonary Resection: One Port, Two Ports, Three Ports and More...

Moderator: *Kazuhiro Yasufuku, *University of Toronto*

1:15 PM - 1:30 PM	Uniport Surgery: Lobectomy, Segmentectomy *Diego Gonzalez-Rivas, <i>Coruna University Hospital</i>
1:30 PM - 1:45 PM	Needlescopic/ 2-Port VATS Lobectomy Alan Sihoe, <i>The University of Hong Kong</i>
1:45 PM - 2:00 PM	Getting Fancy with Mediastinal Staging: Indication and Tools *Todd L. Demmy, <i>Roswell Park Cancer Institute</i>
2:00 PM - 2:15 PM	It's Not All About Technique: Teaching Judgement in the OR *Shari Meyerson, <i>Northwestern University</i>
2:15 PM - 2:30 PM	How I Teach It: Robotic Lobectomy *Robert J. Cerfolio, <i>New York University</i>
2:30 PM - 3:00 PM	Discussion
3:00 PM - 3:15 PM	Coffee Break

Session 4: New Tech... New Toys

Moderator: *Scott J. Swanson, *Brigham & Women's Hospital*

3:15 PM - 3:30 PM	PA Branch Sealing with High Energy Devices: Dream or Nightmare? *Moishe Liberman, <i>Centre Hosp De l'Universite de Montreal Division of Thoracic Surgery</i>
3:30 PM - 3:45 PM	Aisle 5 Trachea & Esophagus: Update in Tissue Engineering *Rafael S. Andrade, <i>University of Minnesota</i>
3:45 PM - 4:00 PM	Where is That Small Nodule? Intraoperative Localization Techniques *Sunil Singhal, <i>University of Pennsylvania</i>
4:00 PM - 4:15 PM	Looking into the Future: Applications of Virtual Reality into Surgical Planning Rene Petersen, <i>Department of Cardiothoracic Surgery</i>
4:15 PM - 4:30 PM	The Coming Attractions of Robotic Technology *Bernard J. Park, <i>Memorial Sloan Kettering Cancer Center</i>
4:30 PM - 5:00 PM	Discussion

Cardiothoracic Transplant and Mechanical Circulatory Support of Heart and Lung Failure**Room 28ABC, SDCC****Saturday, April 28, 2018 | 8:00 AM – 3:00 PM****Course Co-Chairs:** *Ashish S. Shah, *Vanderbilt University*
+Rich Walczak, *Duke University***8:00 AM - 8:05 AM** **Welcome and Introduction**
*Ashish S. Shah, *Vanderbilt University***Heart Transplant****Moderators:** *Ashish S. Shah, *Vanderbilt University*
+Rich Walczak, *Duke University***8:05 AM - 8:20 AM** **New UNOS Organ Allocation System: Updates**
*Ashish S. Shah, *Vanderbilt University***8:20 AM - 8:35 AM** **MCS Strategies for Adults with Congenital Heart Disease**
*David L. Morales, *Cincinnati Children's Hospital***8:35 AM - 8:50 AM** **Utilization of MCS for Primary Graft Dysfunction**
*Pavan Alturi, *University of Pennsylvania***8:50 AM - 9:20 AM** **DCD Heart**
Steven Tsui, *Paperworth Hospital***9:20 AM - 9:35 AM** **Transmedics OCS Heart**
+Chris Diodato, *Massachusetts General Hospital***9:35 AM - 9:50 AM** **Transmedics OCS Heart**
David A. D'Alessandro, Jr., *Massachusetts General Hospital*9:50 AM - 10:15 AM** **Panel Discussion****10:15 AM - 10:30 AM** **Coffee Break****ECMO****Moderators:** +Desiree Bonadonna, *Duke University*
+Stuart McGrane, *Vanderbilt University***10:30 AM - 10:50 AM** **ECMO Transport Program: Design and Conquer**
*Matthew Bacchetta, *Columbia University***10:50 AM - 11:10 AM** **ECMO Transport Selection: Personnel, Devices and Patients**
Mani A. Daneshmand, *Duke University*
+Desiree Bonadonna, *Duke University***11:10 AM - 11:25 AM** **ECMO Program Management: The Impact of Regionalization and Economics**
Scott C. Silvestry, *Florida Hospital***11:25 AM - 11:50 AM** **eCPR Selections: Personnel, Devices and Patients**
Lionel Lamhaut, *Université Paris Descartes***11:50 AM - 12:00 PM** **Panel Discussion****12:00 PM - 1:00 PM** **Combined Luncheon Speaker**
*Bruce A. Reitz, *Stanford University***Ballroom 20A, SDCC**
Not for Credit

Mechanical Circulatory Support

Moderators: **David A. D'Alessandro, Jr., *Massachusetts General Hospital*
Keki Balsara, *Washington University*

- 1:00 PM - 1:12 PM** **BiVAD Video**
Victor (Gert) Pretorius, *UC San Diego Health*
- 1:12 PM - 1:24 PM** **RVAD after LVAD: Incidence, Selection and Management**
Jan Schmitto, *Hannover Medical School*
- 1:24 PM - 1:36 PM** **Sternal Sparing Approaches to LVAD Video**
Matthew R. Danter, *Vanderbilt University*
- 1:36 PM - 1:48 PM** **Advanced Rescue Techniques for LVAD Complications**
Nahush A. Mokadam, *University of Washington*
- 1:48 PM - 2:00 PM** **Implications of Momentum 3 Trial for Design, Patient Selection**
*Jonathan W. Haft, *University of Michigan*

Lung Transplant

Moderators: *Charles Hoopes, *University of Alabama at Birmingham*
Richard-Tien Ha, *Stanford University*

- 2:00 PM - 2:12 PM** **Intraoperative Support for Lung Transplant: Which Pump and Why?**
*Shaf Keshavjee, *Toronto General Hospital*
- 2:12 PM - 2:24 PM** **Intraoperative Support for Lung Transplant**
+Cyril Serrick, *University Health Network*
- 2:24 PM - 2:36 PM** **EVLP: Here to Stay or Going Away?**
Gabriel Loor, *Cleveland Clinic*
- 2:36 PM - 2:48 PM** **EVLP Video**
*Marcelo Cypel, *Toronto General Hospital*
- 2:48 PM - 3:10 PM** **Discussion**

Surgical Ethics Course

Saturday, April 28, 2018 | 8:00 AM – 3:00 PM

Course Co-Chairs: *Thomas A. D'Amico, *Duke University*
+Bob Groom, *Maine Medical Center*
*Susan D. Moffatt-Bruce, *Ohio State University*

Room 28DE, SDCC

- 8:00 AM - 8:15 AM** **Welcome and Introduction**
*Susan D. Moffatt-Bruce, *Ohio State University*
- 8:15 AM - 9:15 AM** **Keynote Address: Ethical Issues of Genomics/Precision Medicine**
David C. Magnus, PhD, *Stanford University*
- 9:15 AM - 9:30 AM** **Ethical Use of Social Media**
**Thomas K. Varghese, Jr., *University of Utah*
- 9:30 AM - 9:45 AM** **Should Live Surgical Broadcasts Still be Considered Unethical?**
*Joseph E. Bavaria, *University of Pennsylvania*
- 9:45 AM - 10:15 AM** **Panel Discussion**
Moderator: *Susan D. Moffatt-Bruce, *Ohio State University*

10:15 AM - 10:45 AM	Coffee Break	
10:45 AM - 11:00 AM	Organ Donation Without the Dead Donor Rule Robert M. Sade, <i>Medical University of South Carolina</i>	
11:00 AM - 11:15 AM	Informed Consent, Comparative Effectiveness, and Learning Health Care Leslie J. Kohman, <i>Upstate Medical University</i>	
11:15 AM - 11:45 AM	Panel Discussion Moderator: +Bob Groom, <i>Maine Medical Center</i>	
12:00 PM - 1:00 PM	Combined Luncheon Speaker *Bruce A. Reitz, <i>Stanford University</i>	Ballroom 20A, SDCC <i>Not for Credit</i>
1:00 PM - 1:15 PM	Expert Witness Testimony: Is it Ethical to Consistently Refuse to Testify for Plaintiffs John E. Mayer, <i>Boston Children's Hospital</i>	
1:15 PM - 1:30 PM	How Much Space Should There Be Between Innovation and Research? *Shaf Keshavjee, <i>Toronto General Hospital</i>	
1:30 PM - 2:00 PM	Panel Discussion Moderator: Richard I. Whyte, <i>Beth Israel Deaconess Medical Center</i>	
2:00 PM - 2:15 PM	ECMO: The Science and Ethics of Candidacy **Matthew Harwig, <i>Duke University</i>	
2:15 PM - 2:30 PM	What Do We Owe Opioid Addicts with Recurrent Endocarditis? John W. Entwistle, III, <i>Jefferson University</i>	
2:30 PM - 2:45 PM	Conscientious Objection: Should Professional Societies Declare Conscientious Objection Unethical? Puja G. Khaitan, <i>Medstar Washington Hospital Center</i>	
2:45 PM - 3:00 PM	Panel Discussion Moderator: Kathleen Fenton, <i>William Novick Global Cardiac Alliance</i>	

Protecting the Brain During Heart Surgery
Saturday, April 28, 2018 | 3:15 PM – 5:15 PM

Ballroom 20A, SDCC

Course Chairs: +Tim Dickinson, *Mayo Clinic*

*John D. Puskas, *Mount Sinai Saint Luke's*

*Ashish S. Shah, *Vanderbilt University*

+Rich Walczak, *Duke University*

3:10 PM - 3:15 PM	Welcome and Introduction * John D. Puskas, <i>Mount Sinai Saint Luke's</i>	
3:15 PM - 3:25 PM	Strategies for the Delivery of Cardioplegia: Best Practices for Myocardial Preservation +Al Stammers, <i>SpecialtyCare</i>	
3:25 PM - 3:35 PM	Adjuncts to Cardioplegia for Myocardial Protection: Role of Topical Cooling, Insulating Pads, LV Venting, and Fibrillation Sandhya Balaram, <i>Mount Sinai Medical Center</i>	

Alternative Cardioplegia Solutions for Adult Cardiac Surgery: Blood/Custodial/Del Nido Expert Opinions

- 3:35 PM - 3:45 PM** **Custodial is the Best**
- 3:45 PM - 3:55 PM** **Del Nido is the Best**
*Craig R. Smith, *Columbia University*
- 3:55 PM - 4:05 PM** **Blood Cardioplegia (Microplegia) is the Best**
*Anelechi C. Anyanwu, *Mount Sinai Medical Center*
- 4:05 PM - 4:15 PM** **St. Thomas Solution is the Best**
*Kenton J. Zehr, *Johns Hopkins Hospital*
- 4:15 PM - 4:30 PM** **Panel Discussion: How I Delivery Cardioplegia and Protect the Heart**

Best Practices for Cannulation and Clamping in CABG and Valvular Surgery

- 4:30 PM - 4:40 PM** **Central vs Peripheral Cannulation for Non-Sternotomy Procedures**
*Joseph Lamelas, *Baylor St. Luke's Medical Center*
- 4:40 PM - 4:50 PM** **Strategies and Devices to Mitigate Against Atheroembolism**
*Michael J. Mack, *The Heart Institute at Baylor*
- 4:50 PM - 5:00 PM** **Best Perfusion Practices for Cerebral Protection: BP/CPB Flow Management, Temperature, Alpha vs pH Stat Management**
+Tim Dickinson, *Mayo Clinic*
- 5:00 PM - 5:15 PM** **Panel Discussion: Avoiding Stroke in Cardiac Surgery**

Survival Guide: Your First Night on Call

Saturday, April 28, 2018 | 1:00 pm - 5:00 pm

Course Chairs: *Thomas A. D'Amico, *Duke University*

*Abe DeAnda, Jr., *University of Texas*

Rooms 23B & 23C, SDCC

Not for Credit

Designed to present early trainees and the surgical team with common clinical scenarios which they may encounter, with the emphasis being on problem-solving and communication rather than standard lectures. The course will be comprised of eight hands-on stations located in two separate rooms. Participants will be split into four groups and each group will spend 25 minutes at each station learning how to recognize, assess, and manage common post-operative complications and issues and well as develop skills for transferring this knowledge to other members of the team.

- 1:00 PM – 3:00 PM** **Groups 1-4 will rotate through Stations 1, 3, 5, 7**
- 3:00 PM – 5:00 PM** **Groups 1-4 will rotate through Stations 2, 4, 6, 8**

Stations Topics and Faculty:

Station 1: ECHO Reading/Cath

Jeffrey G. Gaca, *Duke University*

Station 2: Acute Chest Pain

Bradley G. Leshnower, *Emory University*

Station 3: Respiratory Failure

David D. Odell, *Northwestern University*

Station 4: VAD

*Leora B. Balsam, *New York University*

Station 5: Basic Perfusion Concepts+Bruce Searles, *Upstate Medical University*+Joe Sistino, *Medical University of South Carolina***Station 6: Thoracic***Malcolm M. DeCamp, Jr., *Northwestern Memorial Hospital***Station 7: Pacemaker***Glenn J. Whitman, *Johns Hopkins Hospital***Station 8: Low Cardiac Output***Reshma M. Biniwale, *University of California, Los Angeles***Enhanced Recovery after Cardiac Surgery
Saturday, April 28, 2018 | 1:00 PM – 5:00 PM****Room 29AB, SDCC**
*Not for Credit***Session 1: Background and Overview****Moderators:** **Daniel T. Engelman, *Baystate Medical Center*
Ed Boyle, *St. Charles Medical Center***1:00 PM - 1:15 PM Introduction and Overview of ERACS Goals****Daniel T. Engelman, *Baystate Medical Center***1:15 PM – 1:30 PM Fast Track Cardiac Surgery Revisited and Enhanced***Richard M. Engelman, *Baystate Medical Center***1:30 PM – 1:45 PM The History of ERAS and Why it is the Standard of Care for all Specialties**Gudrun Kunst, *King's College Hospital***1:45 PM – 2:00 PM Modeling and Validating: Economic Justifications for ERACS Interventions using Real World Data**Ed Boyle, *St. Charles Medical Center***2:00 PM – 2:15 PM Networking and Refreshment Break****Session 2: Select ERACS Iterative Expert Consensus Statements****Moderators:** *Louis P. Perrault, *Institute of Cardiology de Montreal*
Marc W. Gerdisch, *St. Francis Heart Center***2:15 PM – 2:30 PM I Applaud Your “Expert” Guideline Efforts, But I’m Not Going to Change My Practice of 20 Years***Kevin W. Lobdell, *Carolinas Healthcare System***2:30 PM – 2:45 PM Prehabilitation: “Frailty and the Value of PREHAB in the Older Adult Undergoing Cardiac Surgery”***Rakesh C. Arora, *St. Boniface General Hospital***2:45 PM – 3:00 PM Perioperative Glycemic Control and Early ERACS Data Including Preoperative Carbohydrates**Judson Williams, *WakeMed Health and Hospitals***3:00 PM – 3:15 PM Enhanced Recovery by Minimizing Opioid Use After Cardiac Surgery***Eric E. Roselli, *Cleveland Clinic***3:15 PM – 3:30 PM Networking and Refreshment Break**

Session 3: Near Future Directions in ERACS

Moderators: *Kevin W. Lobdell, *Carolinas Healthcare System*

*Eric E. Roselli, *Cleveland Clinic*

3:30 PM – 3:45 PM	Options for Sternal Closure and Prevention of Wound Infection “An Economic Imperative” Marc W. Gerdisch, <i>St. Francis Heart Center</i>
3:45 PM – 4:00 PM	Multimodal Approaches to Reduce Postoperative AKI John Kellum, <i>University of Pittsburgh Critical Care</i>
4:00 PM – 4:15 PM	Modern Chest Tube Strategies to Reduce Complications and Costs *Louis P. Perrault, <i>Institute of Cardiology de Montreal</i>
4:15 PM – 4:30 PM	Reducing Readmission after Cardiac Surgery **Daniel T. Engelman, <i>Baystate Medical Center</i>
4:30 PM – 4:45 PM	Implementing an ERACS Program V. Seenu Reddy, <i>Centennial Heart & Vascular Center</i>
4:45 PM – 5:00 PM	ERACS Symposium Wrap-Up

AATS Innovation Summit

Sunday, April 29, 2018 | 7:30 AM – 11:30 AM

Course Chairs: *W. Randolph Chitwood, Jr., *East Carolina University*

*Michael J. Mack, *Baylor Health Care System, The Heart Hospital*

Room 29AB, SDCC

Not for Credit

Program Committee

*Yolonda L. Colson, *Brigham and Women's Hospital/Harvard Medical School*

*J.Michael DiMaio, *Baylor Scott & White Health*

*Mark D. Rodefeld, *Indiana University School of Medicine*

*Todd K. Rosengart, *Baylor College of Medicine*

*Y. Joseph Woo, *Stanford University*

7:30 AM – 7:40 AM Surgeon Innovators: They Did It and So Can You!

*W. Randolph Chitwood, Jr., *East Carolina University*

Session I: Ideation – What Matters and How to Get There

Moderator: *Todd K. Rosengart, *Baylor College of Medicine*

7:40 AM – 7:53 AM Artificial Intelligence and the Future of Healthcare

*J.Michael DiMaio, *Baylor Scott & White Health*

7:53 AM – 8:06 AM Generating Great Ideas!

*Todd K. Rosengart, *Baylor College of Medicine*

8:06 AM - 8:19 AM How Do You Fund Your Idea?

Peter Boyd, *Edwards Lifesciences*

8:19 AM - 8:32 AM Entrepreneurialism: Competitive or Synergistic for Your Career?

*A.Marc Gillinov, *Cleveland Clinic Foundation*

Session II: Protecting and Building Your Idea

Moderator: *Yolonda L. Colson, *Brigham and Women's Hospital/Harvard Medical School*

8:32 AM – 8:45 AM How to Protect Your IP

Martin J. Waters, *Wilson Sonsini Goodrich & Rosati*

8:45 AM - 8:58 AM Prototyping and Testing

*James S. Gammie, *University of Maryland Medical Center*

8:58 AM – 9:11 AM Is There a Market for Your “Device”?

Andrew Cleeland, *Fogarty Institute*

9:11 AM – 9:31 AM Panel Discussion

9:31 AM – 9:45 AM Coffee Break

Keynote Address

9:45 AM – 9:50 AM Introduction

*Michael J. Mack, *Baylor Health Care System, The Heart Hospital*

9:50 AM - 10:10 AM Medical Technology: What Does Wall Street Think?

Lawrence Biegleson, *Wells Fargo*

Session III: Commercialization – Where Ideas Live or Die

Moderator: *Mark D. Rodefeld, *Indiana University School of Medicine*

10:10 AM – 10:23 AM **New Initiatives the FDA Has Taken to Facilitate Innovation in the U.S.**
John C. Laschinger, *U.S. Food and Drug Administration*

10:23 AM – 10:36 AM **The Valley of Death: What Is It and How to Cross It**
Al Gianchetti, *XyloCor Therapeutics*

Session IV: Industry Discussion

Moderator: *Y. Joseph Woo, *Stanford University*

10:36 AM – 10:49 AM **How Do Big Companies Stay as Innovators**
Larry Wood, *Transcatheter Heart Valves - Edwards Lifesciences*

10:49 AM – 11:02 AM **From an Idea – to Startup – to Commercialization: True Success Story**
Daniel S. Oh, *Intuitive Surgical, Inc.*

11:02 AM – 11:25 AM **Industry Panel Discussion**

11:25 AM – 11:30 AM **Conclusion**
*W. Randolph Chitwood, Jr., *East Carolina University*
*Michael J. Mack, *Baylor Health Care System, The Heart Hospital*

AATS/STS Adult Cardiac Surgery Symposium

Sunday, April 29, 2018 | 7:30 AM – 3:00 PM

Course Chairs: +Tim Dickinson, *Mayo Clinic*

*John D. Puskas, *Mount Sinai Saint Luke's*

Ballroom 20A, SDCC

7:30 AM - 7:32 AM **Welcome and Introduction**
*John D. Puskas, *Mount Sinai Saint Luke's*

Session A: CABG

7:32 AM - 7:44 AM **Evidence for BITA Grafting in 2018 Including Insights from the ART Trial**
*David P. Taggart, *University of Oxford*

7:44 AM - 7:56 AM **What is the Second Best Conduit?**
Mario F.L. Gaudino, *Weill Cornell Medicine*

7:56 AM - 8:08 AM **Arterial Graft Configurations and When to Use Them**
*Joseph F. Sabik, III, *University Hospitals of Cleveland*

8:08 AM - 8:20 AM **Prevention and Management of DSWI After CABG**
*Harold L. Lazar, *Boston Medical Center*

8:20 AM - 8:32 AM **CABG Without Aortic Manipulation**
Michael Vallely, *Sydney Heart & Lung Surgeons*

8:32 AM - 8:45 AM **Coronary Endarterectomy/Full Metal Jacket**
*Heinz G. Jakob, *West German Heart Center*

8:45 AM - 9:15 AM **Special Invited Lecture**
CABG: Where Have We Been, Where Are We Going?
*Bruce W. Lytle, *The Heart Institute at Baylor*

9:15 PM - 9:45 AM **Coffee Break**

Session B: Ischemic Mitral Regurgitation

9:45 AM - 10:00 AM	Moderate Ischemic Mitral Regurgitation: CABG Alone or CABG Plus MV Repair? *Robert Michler, <i>Montefiore Medical Center</i>	
10:00 AM - 10:15 AM	Severe Ischemic Mitral Regurgitation: CABG Plus MV Repair or CABG Plus MV Replacement? *Michael A. Acker, <i>University of Pennsylvania</i>	
10:15 AM - 10:30 AM	Techniques for MV Repair in Ischemic MR: Rings, Slings, Sutures, Subvalvular Techniques *Gilles D. Dreyfus, <i>Cardiothoracic Centre of Monaco</i>	
10:30 AM - 10:45 AM	Role of MitraClip in Ischemic MR *Mathew R. Williams, <i>New York University</i>	
10:45 AM - 11:25 AM	Debate: Severe Ischemic MR Should be Replaced, Not Repaired in 2018 Moderator: *John D. Puskas, <i>Mount Sinai Saint Luke's</i> Pro: *A. Marc Gillinov, <i>Cleveland Clinic</i> Con: *Irving L. Kron, <i>UVA Health System</i>	
11:30 AM - 12:30 PM	Legends Luncheon: A Conversation with Dr. George Green *George E. Green, <i>St. Luke's Roosevelt Hospital</i>	Remain in Ballroom 20A, SDCC Not for Credit

Session C: Aortic Dissection/Valve-in-Valve/Concomitant AF Ablation

Type A Dissection with Malperfusion/Mesenteric Ischemia

12:30 PM - 12:45 PM	How to Repair an Uncomplicated Type A Dissection with <5% Mortality *Lars G. Svensson, <i>Cleveland Clinic</i>	
12:45 PM - 1:00 PM	Outcomes with Conventional Repair of Complicated Type A Dissections with Malperfusion *Joseph E. Bavaria, <i>University of Pennsylvania</i>	
1:00 PM - 1:15 PM	Role of Fenestration and Extra-Anatomic Bypass *Allan S. Stewart, <i>Mount Sinai Hospital</i>	
1:15 PM - 1:30 PM	Cannulation and Perfusion Strategies for Managing the Type A Dissection with Malperfusion *Joseph S. Coselli, <i>Baylor College of Medicine</i>	
	<i>Biological Prostheses (Including TAVR) in the 50 Year Old Patient: What Are The Implications of Planned Valve-in-Valve?</i>	
1:30 PM - 1:45 PM	Expert Opinion #1: TAVR Should Be the First Procedure, with Planned Valve-in-Valve Rajendra Makkar, <i>Cedars-Sinai Medical Center</i>	
1:45 PM - 2:00 PM	Expert Opinion #2: Surgical AVR with Bioprosthesis Should Be the First Procedure, with Planned Valve-in-Valve *Clifford W. Barlow, <i>Southampton General Hospital</i>	
2:00 PM - 2:15 PM	Expert Opinion #3: Surgical AVR with the On-X Mechanical Prosthesis Should Be the first (and Last) Procedure *John D. Puskas, <i>Mount Sinai Saint Luke's</i>	
	<i>Concomitant Surgical Ablation for AF in the CABG and Valve Patient</i>	
2:15 PM - 2:30 PM	Is There a Benefit and What are the Complications of Concomitant Surgical Ablation of AF? *Niv Ad, <i>West Virginia University</i>	
2:30 PM - 3:00 PM	Debate: Which Lesions for Which Patients? - Left Atrial Lesions Only *Ralph J. Damiano, Jr., <i>Washington University</i> *A. Marc Gillinov, <i>Cleveland Clinic Foundation</i>	

Sunday, April 29, 2018 | 7:30 AM – 3:00 PM

Course Chairs: +Ron Angona, *University of Oklahoma*

*Viktor Hraska, *Children's Hospital of Wisconsin*

+Jim Reagor, *Cincinnati Children's Hospital*

*Luca A. Vricella, *Johns Hopkins Hospital*

7:30 AM - 7:40 AM

Welcome and Introduction

*Luca A. Vricella, *Johns Hopkins Hospital*

*Viktor Hraska, *Children's Hospital of Wisconsin*

+Ron Angona, *University of Oklahoma*

How Small Is Too Small: Decision Making and Techniques

7:40 AM - 7:55 AM

Aortic Arch Hypoplasia / Coarctation

*Victor T. Tsang, *Great Ormond St. Hospital for Children NHS Trust*

7:55 AM - 8:10 AM

Interrupted Aortic Arch with Small Aortic Root

*James S. Tweddell, *Cincinnati Children's Hospital Medical Center*

8:10 AM - 8:25 AM

Warm Perfusion During Aortic Arch Reconstruction in Neonates

James Hammel, *Children's Hospital & Medical Center*

8:25 AM - 8:40 AM

Borderline LV: Criteria and Novel Methods for a Biventricular Circulation

*Sitaram M. Emani, *Boston Children's Hospital*

8:40 AM - 8:55 AM

Let it Go: Is a Single Ventricle Always Better for Borderline Left Hearts

*Richard G. Ohye, *University of Michigan Frankel Cardiovascular Center*

8:55 AM - 9:10 AM

Isolated Congenital Mitral Valve Stenosis, When to Abandon the Biventricular Circulation

*Christian P. Brizard, *Royal Children's Hospital*

9:10 AM - 9:25 AM

Unbalanced Atrioventricular Septal Defect

*David P. Bichell, *Vanderbilt University*

9:25 AM - 9:40 AM

Pulmonary Atresia with Intact Ventricular Septum with Borderline Tricuspid Valve

*Emile A. Bacha, *Children's Hospital of New York*

9:40 AM - 10:10 AM

Coffee Break

Cardiopulmonary Bypass in Neonates <2 Kg

10:10 AM - 10:25 AM

Outcomes in Small Neonates

*Marshall L. Jacobs, *Johns Hopkins Hospital*

10:25 AM - 10:40 AM

Surgical Perspective

*V. Mohan Reddy, *University of California San Francisco*

10:40 AM - 10:55 AM

Perfusionist Perspective: CPB for the Sub-2000 Gram Neonate: Techniques, Strategies, and Lessons Learned

+Chelsea Capone, *University of California San Francisco*

10:55 AM - 11:10 AM

Neonatologist / Intensivist Perspective

Ganga Krishnamurthy, *Children's Hospital of New York*

11:30 AM - 12:30 PM

Legends Luncheon

*Thomas L. Spray, *Children's Hospital of Philadelphia*

Remain in Room 30ABC, SDCC

Not for Credit

Congenitally Corrected Transposition of the Great Arteries

12:30 PM - 12:45 PM	Anatomy Paul Weinberg, <i>Children's Hospital of Philadelphia</i>
12:45 PM – 1:00 PM	Natural History of CCTGA: Implications for Different Treatment Pathways Heidi M. Connolly, <i>Mayo Clinic</i>
1:00 PM - 1:15 PM	Physiological Repair and Palliation of CCTGA: Is It Ever Appropriate and For Which Patient? *Christopher A. Caldarone, <i>Hospital for Sick Children</i>
1:15 PM - 1:30 PM	Left Ventricular Training: Feasibility and Effectiveness – What Are The Limits David Barron, <i>Birmingham Children's Hospital</i>
1:30 PM – 1:45 PM	Anatomic Repair: The Double Switch (and Complications) *Viktor Hraska, <i>Children's Hospital of Wisconsin</i>
1:45 PM - 2:00 PM	Anatomical Repair of CCTGA the Senning-Rastelli and Hemi-Mustard *Frank L. Hanley, <i>Stanford University</i>
2:00 PM - 2:15 PM	Late Systemic Ventricular Function, Late Systemic AV Valve Function *Joseph A. Dearani, <i>Mayo Clinic</i>
2:15 PM - 2:30 PM	Mechanical Support and Transplantation for End-Stage Dysfunction with cCTGA *David L. Morales, <i>Cincinnati Children's Hospital</i>
2:30 PM – 3:00 PM	Panel Discussion

AATS/STS General Thoracic Surgery Symposium: *Interdisciplinary Patient-Centered Care: It Takes a Team* Room 25ABC, SDCC
Sunday, April 29, 2018 | 7:30 AM – 3:00 PM

Course Chair: *Stephen C. Yang, *Johns Hopkins Hospital*

Course Co-Chair: **Betty Tong, *Duke University*

7:30 PM - 7:40 AM **Welcome and Introduction**
*Stephen C. Yang, *Johns Hopkins Hospital*

Session 1: Lung

Moderator: *Haiquan Chen, *Fudan University Shanghai Cancer Center*

7:40 AM - 8:00 AM	AJCC Eighth Edition Staging Changes for NSCLC *Harvey I. Pass, <i>New York University</i>
8:00 AM - 8:15 AM	Still Dreaming About Screening? Obstacles in Lung Cancer Screening *Doug Wood, <i>University of Washington</i>
8:15 AM - 8:30 AM	Immunotherapy Update for NSCLC: Truths and Alternative Facts *Jessica S. Donington, <i>New York University</i>
8:30 AM - 8:45 AM	Surgery for Oligometas NSCLC: When is Resection Indicated? *John D. Mitchell, <i>University of Colorado</i>
8:45 AM - 9:00 AM	Small Cell Lung Cancer: Pushing the Surgical Role *Stephen C. Yang, <i>Johns Hopkins Hospital</i>
9:00 AM - 9:15 AM	Chemo, Bemp, Remo, Ablato: Options for Pulmonary Metastases *Hiran C. Fernando, <i>Inova Health System</i>

9:15 AM - 9:45 AM	Panel Discussion *Haiquan Chen, <i>Fudan University Shanghai Cancer Center</i>	
9:45 AM - 10:00 AM	Coffee Break	
Session 2: Esophagus		
10:00 AM - 10:15 AM	AJCC Eighth Edition Staging Changes for Esophageal Cancer *Sudish C. Murthy, <i>Cleveland Clinic</i>	
10:15 AM - 10:45 AM	Clash of the Titans II: Definitive Chemo Rads vs. Surgery for Squamous Cell Carinoma *Wayne L. Hofstetter, <i>M.D. Anderson Cancer Center</i> *Anthony E. Lerut, <i>University Hospital Leuvern</i>	
10:45 AM - 11:00 AM	Non-functioning Gastric Tubes / Gastric Outlet Obstruction	
11:00 AM - 11:15 AM	Paraconduit Hernias *Benny Weksler, <i>University of Tennessee</i>	
11:15 AM - 11:30 AM	Panel Discussion	
11:30 AM - 12:30 PM	Legends Luncheon *Mark B. Orringer, <i>University of Michigan</i>	Remain in Room 25ABC, SDCC <i>Not for Credit</i>
Session 3: ERAS and Interdisciplinary Care in General Thoracic Surgery: It Takes a Team		
Moderators: Emily Kluck, <i>Johns Hopkins Hospital</i>		
*David C. Rice, <i>Anderson Cancer Center</i>		
12:40 PM - 12:45 PM	Introduction of ERAS **Betty Tong, <i>Duke University</i>	
12:45 PM - 1:00 PM	After the Incision is Healed: Patient Advocacy and Survivorship Education Mindy Mordecai, <i>Esophageal Cancer Action Network</i>	
1:00 PM - 1:15 PM	Optimizing the Geriatric Patient: How to Screen for Frailty *Mark K. Ferguson, <i>University of Chicago</i>	
1:15 PM - 1:30 PM	Perioperative Pain Management in the Anti-Narcotic Era Padma Gulur, <i>Duke University</i>	
1:30 PM - 1:45 PM	Intraoperative Anesthetic Strategies in Thoracic Surgery David Amar, <i>Memorial Sloan-Kettering Cancer Center</i>	
1:45 PM - 2:00 PM	At the Crossroads of Dogma and Data: Compromising on Pathways for Drains, Feedings, and Tubes Emily Kluck, <i>Johns Hopkins Hospital</i>	
2:00 PM - 2:30 PM	The Patient's Voice: PROs and Survivorship *Benjamin D. Kozower, <i>Washington University</i>	
2:30 PM - 3:00 PM	Panel Discussion -----	

Sunday, April 29, 2018 | 7:30 AM – 5:00 PM

Course Chairs: Marci Damiano, *Washington University*

Katherine J. Hoercher, *Cleveland Clinic*

+Jeff Riley, *SUNY Upstate Medical University*

David E. Lizotte, Jr., *APAVCS*

*Glenn J. Whitman, *John Hopkins Hospital*

In Collaboration with the Association of Physician Assistants in Cardiovascular Surgery (APACVS)

7:30 AM - 7:40 AM Welcome and Introduction

*Glenn J. Whitman, *John Hopkins Hospital*

Current Topics in ICU ECMO

V-A ECMO

7:40 AM - 8:00 AM Harlequin Syndrome, Indications for VAV ECMO

Chris Sciortino, *University of Pittsburgh*

8:00 AM - 8:20 AM Weaning from VA ECMO: Algorithms, Myocardial Recovery Strategies

Scott C. Silvestry, *Florida Hospital*

8:20 AM - 8:40 AM Avoiding Pitfalls of VA ECMO

Jay Pal, *University of Washington*

8:40 AM - 9:00 AM Panel Discussion

9:00 AM - 9:15 AM Coffee Break

V-V ECMO

9:15 AM - 9:35 AM Indications and Contraindications for VV ECMO: Scoring Systems, Outcomes, When is Managing pCO₂ Sufficient

*Matthew Bacchetta, *Columbia University*

9:35 AM - 9:55 AM Optimizing VV ECMO: Troubleshooting Low SPO₂: Indication for RV-PA ECMO, When to Switch to VA ECMO

*Jonathan W. Haft, *University of Michigan*

9:55 AM - 10:15 AM VA and VV ECMO Monitoring: The Optimal Checklists, What are the Line Items and Why?

**David A. D'Alessandro, Jr., *Massachusetts General Hospital*

+Jeff Riley, *SUNY Upstate Medical University*

10:15 AM - 10:30 AM Panel Discussion

ECPR

10:30 AM - 10:50 AM ECPR / ED Outcomes - The Reanimateur

Lionel Lamhaut, *Université Paris Descartes*

10:50 AM - 11:10 AM ECMO for EMT's: View From the US

*Ashish S. Shah, *Vanderbilt University*

11:10 AM - 11:30 AM Panel Discussion

11:30 AM - 12:30 AM Legends Luncheons

*George E. Green

*Mark B. Orringer

*Thomas L. Spray

Taking place in Ballroom 20A, SDCC

Taking place in Room 25ABC, SDCC

Taking place in Room 30ABC, SDCC

Not for Credit

Moderators: Marci Damiano, *Washington University*
Katherine J. Hoercher, *Cleveland Clinic Foundation*

- 12:30 PM - 12:45 PM** **Prediction of Transfusions After Isolated CABG: The PERForm Registry**
+Tim Dickinson, *Mayo Clinic*
- 12:45 PM - 1:00 PM** **Directed Perfusion: Eliminating Acute Kidney Injury**
+H. Lynne Harness, *Johns Hopkins Hospital*
- 1:00 PM - 1:15 PM** **ICU Delirium: Risk Factors, Recognition and Outcomes**
*Rakesh Arora, *St. Boniface General Hospital*
- 1:15 PM - 1:30 PM** **Quality Improvement Interventions to Decrease Prolonged Mechanical Ventilation**
*Vinay Badhwar, *West Virginia University*
- 1:30 PM - 1:45 PM** **Management of Airway Complications in the ICU**
**Siva Raja, *Cleveland Clinic*
- 1:45 PM - 2:00 PM** **Arrhythmia and Pacemaker Management**
David E. Lizotte, Jr., *APAVCS*
- 2:00 PM - 2:15 PM** **Penalty of Prolonging the Hospital Stay vs. Risk of Readmission for the Complex Cardiothoracic Surgery Patient**
*Hersh S. Maniar, *Washington University*
- 2:15 PM - 2:30 PM** **Implementing a Fast Track Protocol for the TAVR Program**
Marci Damiano, *Washington University*
- 2:30 PM - 2:45 PM** **Panel Discussion**
- 2:45 PM - 3:00 PM** **Coffee Break**
- Quality and Safety**
- 3:00 PM - 3:15 PM** **Safety in Perfusion**
+Robert A. Baker, *Flinders Medical Centre and Flinders University*
- 3:15 PM - 3:30 PM** **Safety in the OR**
Jake H. Abernathy, III, *Johns Hopkins Hospital*
- 3:30 PM - 3:45 PM** **The State of Michigan Environment, Creating a Culture of Safety**
*Richard L. Prager, *University of Michigan*
- 3:45 PM - 4:00 PM** **The Role of Leadership in High Performance**
*Thoralf M. Sundt, III, *Massachusetts General Hospital*
- 4:00 PM - 4:15 PM** **What Cardiothoracic Team Can Learn From Elite Performers: A Perspective on High Performance / Preventing Harm from a Non - Health Care Professional**
Brian Ferguson, *Arena Labs*
- 4:30 PM - 5:00 PM** **Panel Discussion**

Sunday April 29th, 2018 | 7:30 AM – 3:00 PM

Course Chairs: *Joanna Chikwe, *Mount Sinai Hospital*

Amy G. Fiedler, *Massachusetts General Hospital*

*Thoralf M. Sundt, III, *Massachusetts General Hospital*

*Thomas K. Varghese, Jr., *University of Utah*

Introduction

7:30 AM – 7:40 AM **Breakfast and Welcome**

Session 1: Career Moves

7:40 AM - 7:50 AM **Beginning an Academic Career**
*A. Marc Gillinov, *Cleveland Clinic*

7:50 AM - 8:00 AM **Deciding Between Private and Academic Practice**
Sara J. Pereira, *University of Alabama*

8:00 AM - 8:10 AM **How to Plan a Job Search**
*Robert S. Higgins, *Johns Hopkins Hospital*

8:10 AM - 8:20 AM **The Recruitment Visit and Interview**
*Thomas K. Varghese, Jr., *University of Utah*

8:20 AM - 8:30 AM **Mentors, Sponsors, and Effective Networking**
Mara B. Antonoff, *UT MD Anderson Cancer Center*

8:30 AM - 8:45 AM **Moderated Panel Discussion**

8:45 AM - 9:00 AM **Coffee Break**

Session 2: Operative Skills

9:00 AM - 9:15 AM **Learning, Teaching, and Leading in the OR**
*Y. Joseph Woo, *Stanford University*

9:15 AM - 9:30 AM **Your Report Card, Your Metrics**
*Julie A. Swain, *Mount Sinai Hospital*

9:30 AM - 9:45 AM **How to Develop Independence and Proficiency**
*Shari Meyerson, *Northwestern University*

9:45 AM - 10:00 AM **Moderated Panel Discussion**

10:00 AM - 10:15 AM **Coffee Break**

Session 3: Practice Development

10:15 AM - 10:30 AM **Practice Finances: What You Need to Know**
*David T. Cooke, *University of California*

10:30 AM - 10:40 AM **How to Develop a Clinical Program**
*Ourania Preventza, *Texas Heart Institute*

10:40 AM - 10:50 AM **How to Negotiate**
*Ralph J. Damiano, Jr., *Washington University*

10:50 AM - 11:00 AM **Leadership and Managing Up**
*Robert S. Higgins, *Johns Hopkins Hospital*

11:00 AM - 11:15 AM	Time Management *Shanda H. Blackmon, <i>Mayo Clinic</i>	
11:15 AM - 11:30 AM	Building Your Clinical Practice *Thomas K. Varghese, Jr., <i>University of Utah</i>	
11:30 AM - 12:30 PM	Legends Luncheons *George E. Green *Mark B. Orringer *Thomas L. Spray	<i>Taking place in Ballroom 20A, SDCC</i> <i>Taking place in Room 25ABC, SDCC</i> <i>Taking place in Room 30ABC, SDCC</i>
Session 4: Personal Development		
12:30 PM - 12:40 PM	How to Deal with Disruptive Behavior *Virginia R. Litle, <i>Boston University</i>	
12:40 PM - 12:50 PM	How to Deal with Bias *Jessica S. Donington, <i>New York University</i>	
12:50 PM - 1:00 PM	Resilience *Thoralf M. Sundt, III, <i>Massachusetts General Hospital</i>	
1:00 PM - 1:30 PM	Question and Answer with the Dean and CEO Moderator: Amy Fielder, <i>Massachusetts General Hospital</i>	
Session 5: Next Level		
1:30 PM - 1:45 PM	Getting Off to a Good Start: Goals and Priorities for the First 5 Years *Yolanda L. Colson, <i>Brigham and Women's Hospital</i>	
1:45 PM - 1:55 PM	How to Write Great Papers and Reviews: View from JTCVS *Y. Joseph Woo, <i>Stanford University</i>	
1:55 PM - 2:10 PM	How I Got my First RO1 *Thomas K. Varghese, Jr., <i>University of Utah</i>	
2:10 PM - 2:20 PM	How I Got my First NEJM Paper Andrew Goldstone, <i>University of Pennsylvania</i>	
2:20 PM - 2:30 PM	How to Prepare for Leadership *Jennifer S. Lawton, <i>Johns Hopkins Hospital</i>	
2:30 PM	Wrap-up	
2:30 PM - 3:00 PM	1:1 Question and Answer *Shanda H. Blackmon, <i>Mayo Clinic</i> *Joanna Chikwe, <i>Mount Sinai Hospital</i> *Yolanda L. Colson, <i>Brigham and Women's Hospital</i> *David T. Cooke, <i>University of California</i> Andrew Goldstone, <i>University of Pennsylvania</i> *Jennifer S. Lawton, <i>Johns Hopkins Hospital</i> *Virginia R. Litle, <i>Boston Medical Center</i> *Ourania Preventza, <i>Texas Heart Institute</i> *Tomas K. Varghese, Jr., <i>University of Utah</i>	

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AATS ANNUAL MEETING 2018

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ABSTRACT BOOK

April 28 - May 1, 2018

San Diego Convention Center
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56th International Conference

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Since 1917, when it was founded as the first organization dedicated to thoracic surgery, the American Association for Thoracic Surgery (AATS) has evolved significantly. Today, it is an international organization consisting of over 1,400 of the world's foremost cardiothoracic surgeons representing 41 countries. Its members are selected based on their proven records of distinction within the cardiothoracic surgical field and their meritorious contributions to the existing knowledge of cardiothoracic disease and its surgical treatment. AATS continues to strengthen its commitment to science, education and research through the Annual Meeting, research grants and awards, educational symposia and courses, and the AATS official journal, The Journal of Thoracic and Cardiovascular Surgery.

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Statement of Need

Cardiovascular disease and cancer are the leading causes of mortality and morbidity around the globe. Major advances in these conditions continue to be made at a rapid pace. Improvements in diagnostic techniques as well as interventional approaches to treatment, both surgical and percutaneous, challenge the clinical practitioner to remain current. Increasingly sophisticated technology to accomplish these aims is being developed and introduced into clinical practice. Exciting advances in basic and clinical science offer opportunities for participation in scientific studies and clinical trials. All of these elements create a significant educational need for the practicing cardiothoracic surgeon. The AATS Annual Meeting fills this need through a combination of lectures, original scientific presentations and discussion forums.

Educational Objectives

At the conclusion of the AATS Annual Meeting, through comprehensive lectures and discussions, participants will be able to:

- ☐ Identify the latest techniques and current research specifically related to Adult Cardiac Surgery, Congenital Heart Disease, General Thoracic Surgery and Perioperative Care.
- ☐ Select appropriate surgical procedures and other interventions for their own patients based upon results presented.
- ☐ Incorporate the basic science developments and emerging technologies and techniques across the spectrum of cardiothoracic surgery.
- ☐ Communicate current practice management necessary for the effective and safe delivery of patient care.
- ☐ Translate expanded knowledge into practice for the improvement of patient outcomes and satisfaction.

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Target Audience

The AATS Annual Meeting is specifically designed to meet the educational needs of:

- ☐ Cardiothoracic Surgeons
- ☐ Physicians in related specialties including Cardiothoracic Anesthesia, Critical Care, Cardiology, Pulmonology, Radiology, Gastroenterology, Thoracic Oncology and Vascular Surgery
- ☐ Fellows and Residents in Cardiothoracic and General Surgical training programs
- ☐ Health Care Professionals involved in the care of cardiothoracic surgical patients including Physician Assistants, Nurse Practitioners, Nurses, Surgical Assistants and Perfusionists
- ☐ Medical students with an interest in cardiothoracic surgery

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Continuing Medical Education (CME) Accreditation

The American Association for Thoracic Surgery is accredited by the Accreditation Council for Continuing Medical Education to provide continuing medical education for physicians.

The American Association for Thoracic Surgery designates this live educational activity for a maximum of **31.5 AMA PRA Category 1 Credits™**.

Physicians should only claim credit commensurate with the extent of their participation in the activity.





American Academy of Physician Assistants (AAPA) Accreditation



This program has been reviewed and is approved for a maximum of 66.5 AAPA Category 1 CME credits by the AAPA Review Panel. PAs should claim only those credits actually spent participating in the CME activity.

This program was planned in accordance with AAPA CME Standards for Live Programs and for Commercial Support of Live Programs.

American Board of Cardiovascular Perfusion (ABCP) Accreditation

The American Board of Cardiovascular Perfusion is reviewing this educational activity for a maximum of 40.3 CEUs. Approved credits will be posted at www.aats.org.

The American Association for Thoracic Surgery designates the following credit hours:

Saturday, April 28, 2018 – up to 6.25 hours (CME, AAPA, ABCP)

Adult Cardiac Skills: Coronary, up to 3.75 hours
 Adult Cardiac Skills: Mitral Valve, up to 3.5 hours
 Adult Cardiac Skills: Atrial Fibrillation, up to 2 hours
 Adult Cardiac Skills: Aortic Root, up to 2 hours
 Adult Cardiac Skills: Transcatheter Valve Therapies, up to 2 hours
 Congenital Skills, up to 6.5 hours
 General Thoracic Skills, up to 7.5 hours
 Cardiothoracic Transplant and Mechanical Circulatory Support of Heart and Lung Failure, up to 5.75 hours
 Surgical Ethics Course, up to 5.5 hours
 AATS/SCAI Heart Team Summit, up to 4 hours
 Enhanced Recovery After Cardiac Surgery, not for credit
 Protecting the Brain During Heart Surgery, up to 2 hours
 Survival Guide: Your First Night on Call, not for credit

Sunday, April 29, 2018 – up to 7.5 hours (CME, AAPA, ABCP)

Adult Cardiac Surgery, up to 6 hours
 Congenital Heart Disease, up to 5.75 hours
 General Thoracic Surgery, up to 6.25 hours
 Interprofessional Cardiothoracic Team Symposium, up to 8 hours
 Adult Cardiac Surgery Simultaneous Session, up to 2 hours
 Congenital Heart Disease Simultaneous Session, up to 2 hours
 General Thoracic Surgery Simultaneous Session, up to 2 hours

Monday, April 30, 2018 – up to 7 hours (CME)

Plenary Scientific Session, up to 2.75 hours
 Presidential Address, up to 0.75 hours
 Invited Guest Lecture, not for credit
 Ethics Forum Luncheon, up to 1 hour
 C. Walton Lillehei Resident Forum, not for credit
 Adult Cardiac Surgery Simultaneous Session, up to 3 hours
 Controversies in CABG 2018, up to 3 hours
 Congenital Heart Disease Simultaneous Session, up to 2.75 hours
 General Thoracic Surgery Simultaneous Session, up to 2.75 hours
 Perioperative Care Simultaneous Session, up to 3 hours

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Tuesday, May 1, 2018 – up to 6.75 hours (CME)

Cardiac Surgery Forum, up to 1.5 hours

General Thoracic Surgery Forum, up to 1.5 hours

Adult Cardiac Emerging Technologies and Techniques/Video Session, up to 1.5 hours

Congenital Emerging Technologies and Techniques/Video Session, up to 1.2 hours

General Thoracic Emerging Technologies and Techniques/Video Session, up to 1.5 hours

Plenary Scientific Session, up to 2.25 hours

Invited Guest Speaker, not for credit

Aortic/Endovascular Simultaneous Session, up to 3 hours

Congenital Heart Disease Simultaneous Session, up to 3 hours

General Thoracic Surgery Simultaneous Session, up to 3 hours

Enhanced Recovery after Cardiac Surgery, up to 1.5 hours

Enhanced Recovery after Thoracic Surgery, up to 1.5 hours

Adult Cardiac Surgery Simultaneous Session, up to 1.5 hours

What a Cardiac Surgeon Should in 2018 Know about Transcatheter Devices, up to 1 hour

MCS/Transplant Session, up to 1 hour

AATS Surgical Cinema: Adult Cardiac, up to 1.5 hours

AATS Surgical Cinema: Congenital, up to 1.5 hours

AATS Surgical Cinema: General Thoracic, up to 1.5 hours

For further information on the Accreditation Council for Continuing Medical Education (ACCME) standards of commercial support, please visit **www.accme.org**.

CME Certificates and Letters of Attendance

CME (Continuing Medical Education) and CE credits and Letters of Attendance may be obtained at the CME/CE Pavilion located on Level 1 of the San Diego Convention Center. The CME/CE Pavilion computers will allow attendees to manage all of their CME/CE credits and Letter of Attendance for the Annual Meeting. Access may also be obtained post-meeting by visiting <https://ceu.experientevent.com/aat181/>.

Attendees may email their CME/CE certificate and/or Letter of Attendance to themselves or they may print them out on site at the CME/CE Pavilion.

Disclosure Policy

It is the policy of the American Association for Thoracic Surgery that any individual who is involved in planning, presenting or is an author on a program designated for AMA Physician's Recognition Award Category 1 Credit™ (and the individual's spouse/partner) must disclose to AATS all relevant financial relationships (e.g. salary, royalty, intellectual property rights, consulting fee, honoraria, ownership interest, stocks/stock options) with an ACCME-defined commercial interest(s), that is, any entity that produces, markets, re-sells, or distributes health care goods or services consumed by, or used on, patients. Relevant financial relationships are financial relationships in any amount that create a conflict of interest and that occurred in the twelve-month period preceding the time that the individual was asked to assume a role controlling content of the CME activity. A conflict of interest is created when individuals have both a relevant financial relationship with a commercial interest and the opportunity to affect the content of CME about the products or services of that commercial interest. Relevant financial relationships, or the absence thereof, are disclosed to the audience prior to an activity.

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Schrump, David S.*	F10, F9, L1	Skiba, Jacek	P12
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SUNDAY, APRIL 29, 2018

SUNDAY, APRIL 29

3:15 pm

Adult Cardiac Surgery

Ballroom 20A, SDCC

Simultaneous Scientific Session

6 minute presentation, 9 minute discussion

Moderators: *Faisal G. Bakaeen and *Joanna Chikwe

1. Twenty-Year Survival Following the Freestyle Versus Homograft Aortic Root Replacement Prospective Randomized Trial

Giovanni Melina¹, Fabio De Robertis¹, Jullien A. Gaer¹, Emiliano Angeloni², Toufan Bahrami¹, Elena Bellazzi¹, Ismail El-Hamamsy³, Cesare Quarto¹, Ulrich Rosendahl¹, *John R. Pepper¹, *Magdi H. Yacoub⁴

¹Royal Brompton and Harefield NHS Foundation Trust, London, United Kingdom;

²Ospedale Sant'Andrea, Rome, Italy; ³Montreal Heart Institute, Montreal, QC, Canada;

⁴Imperial College, London, United Kingdom

Invited Discussant: *Neal Kon

2. Impact of Cannulation Site on the Risk of Stroke and Mortality During Emergency Repair of Type A Dissection

Brad F. Rosinski, Jay J. Idrees, Andrew M. Vekstein, Michael Z. Tong, Faisal G. Bakaeen, *Edward G. Soltesz, Brian Griffin, *Eric E. Roselli, *Douglas R. Johnston, *A. Marc Gillinov, *Lars G. Svensson

Cleveland Clinic Foundation, Cleveland, OH

Invited Discussant: *Joseph E. Bavaria

3. Long-Term Follow Up of Sutureless Versus Transcatheter Aortic Valve in Elderly Patient with Aortic Stenosis at Intermediate Risk: The European Multi-Institutional Study

*Claudio Muneretto¹, Marco Solinas², Thierry Folliguet³, *Roberto Di Bartolomeo⁴, Alberto Repossini¹, Lorenzo Di Bacco¹, Carlo Savini⁴, Giovanni Concistrè², Francois Laborde⁵, Manfredo Rambaldini⁶, Steffen Pfeiffer⁷, Giuseppe Santarpino⁷, ♦Theodor Fischlein⁷

¹University of Brescia, Brescia, Italy; ²Monasterio Foundation Heart Hospital, Massa, Italy; ³Centre Hospitalo-universitaire Brabois ILCV, Vandoeuvre les Nancy, Italy;

⁴University of Bologna, Bologna, Italy; ⁵Institut Mutualiste Montsouris, Paris, Italy;

⁶Carlo Poma Hospital of Mantova, Mantova, Italy; ⁷Universitätsklinik der Paracelsus Medizinischen Privatuniversität, Nuremberg, Germany

Invited Discussant: *Guenther Laufer

* AATS Member ♦ AATS New Member * AmSECT Member

4. Hospital Variability in Post Heart Transplant Mortality Can Be Attributed to Difference in Failure to Rescue

Muath Bishawi¹, Asishana Osho², Asvin Ganapathi¹, Anthony Castleberry¹, Michael S. Mulvihill¹, Jacob Schroder¹, Mani Daneshmand¹, Chetan Patel¹, Joseph Rogers¹, *Carmelo Milano¹, ♦Matthew G. Hartwig¹

¹Duke University, Durham, NC; ²Massachusetts General Hospital, Boston, MA

Invited Discussant: Amit Pawale

5. The Long-Term Safety and Efficacy of Concomitant Cox Maze Procedures for Atrial Fibrillation in Patients Without Mitral Valve Disease

*Niv Ad¹, Sari D. Holmes¹, Anthony J. Rongione², Lisa M. Fornaresio¹, Lawrence Wei¹,

*J. Scott Rankin¹, *Vinay Badhwar¹, Paul S. Massimiano²

¹WVU Heart and Vascular Institute, Morgantown, WV; ²Adventist HealthCare, Takoma Park, MD

Invited Discussant: *Gorav Ailawadi

6. Graft Patency at 3 Months After Off and On-Pump Coronary Artery Bypass Grafting: A Multicenter Prospective Randomized Study

*Lokeswara R. Sajja¹, Kunal Sarkar², Gopichand Mannam¹, Venkata Krishna Kumar Kodali³, Chandrasekar Padmanabhan⁴, Sanjeeth Peter⁵, Anvay Vinayak Mulay⁶, Prashanthi Beri⁷

¹Star Hospitals, Hyderabad, India; ²Medica Superspeciality Hospital, Kolkata, India;

³Krishna Institute of Medical Sciences, Secunderabad, India; ⁴G. Kuppuswamy Naidu

Memorial Hospital, Coimbatore, India; ⁵DDMM Heart Institute, Gujarat, India; ⁶Fortis

Hospital, Mumbai, India; ⁷Sajja Heart Foundation, Hyderabad, India

Invited Discussant: *Bruce J. Leavitt

7. Septal Myectomy for Hypertrophic Cardiomyopathy: A Contemporary Analysis of 1,531 Myectomies in a Specialized HOCM Center

Kevin Hodges, Carlos Godoy Rivas, Jose Aguilera, Robert A. Borden, Alaa Alashi, Harry M Lever, *Lars Svensson, *A. Marc Gillinov, Gösta Pettersson, Per Wierup,

*Bruce Lytle, Robert Stewart, *Hani K. Najm, Milind Y. Desai⁴, *Nicholas Smedira
Cleveland Clinic Foundation, Cleveland, OH

Invited Discussant: *Hartzell V. Schaff

Late-Breaking Clinical Trial

LB1. Safety, Efficacy, and Hemodynamic Performance of a Stented Bovine Pericardial Aortic Valve Bioprosthesis: 2-Year Analysis

Francois Dagenais¹, Michael Moront², W. Morris Brown, III³, *Michael J. Reardon⁴, Michael W. A. Chu⁵, Cathy Zeng⁶, Robert J. M. Klautz⁷

¹Laval Hospital, Québec, QC; ²ProMedica Toledo Hospital, Toledo, OH; ³Piedmont Heart Institute, Atlanta, GA; ⁴Methodist DeBakey Heart and Vascular Center, Houston, FL;

⁵University of Western Ontario, London, ON; ⁶Medtronic, Mounds View, MN; ⁷Leiden University Medical Center, Leiden, Netherlands

Invited Discussant: *Song Wan

5:15 pm

AATS/AmSECT Welcome Reception

Exhibit Hall, SDCC

3:15 pm

**Congenital Heart Disease
Simultaneous Scientific Session**

Room 30ABC, SDCC

6 minute presentation, 9 minute discussion

Moderators: *J. William Gaynor and *Jennifer C. Romano

8. Comparison of Del Nido and Histidine-Tryptophan-Ketoglutarate Cardioplegia Solutions in Pediatric Patients Undergoing Open Heart Surgery: A Prospective Randomized Clinical Trial

*Sachin Talwar, Sujoy Chatterjee, Vishnubhatla Sreenivas, Neeti Makhija, Poonam Malhotra Kapoor, Shiv Kumar Choudhary, Balram Airan

All India Institute of Medical Sciences, New Delhi, India

Invited Discussant: *Pedro J. del Nido

9. Determinants of Acute Events Leading to Mortality After Shunt Procedure in Univentricular Palliation

Tomislav Santro¹, Ben Hobbes¹, *Yves d'Udekem², Diana Zannino³, Warwick Butt², *Igor E. Konstantinov², *Christian Brizard², Johann Brink²

¹*University of Melbourne, Melbourne, Australia*; ²*Royal Children's Hospital, Melbourne, Australia*; ³*Murdoch Children's Research Institute, Melbourne, Australia*

Invited Discussant: *Marshall L. Jacobs

10. Myocardial Recovery in Children with Heart Failure Supported with Ventricular Assist Device

Eva Maria Delmo Walter¹, Mariano Francisco del Maria Javier, III², André Rüffer³, Robert Anton Cesnjevar⁴, Alexander Horke¹, Dietmar Böthig¹, *Roland Hetzer²

¹*Hannover Medical School, Hannover, Germany*; ²*Cardio Centrum Berlin, Berlin, Germany*; ³*University Hospital Erlangen, Erlangen, Germany*; ⁴*University Hospital Erlangen, Erlangen, Germany*

Invited Discussant: *David L. Morales

11. Surgical Results of Unifocalization Revision

*Richard D. Mainwaring, William L. Patrick, Tatiana R. Rosenblatt, Michael Ma, Komal Kamra, Alisa Arunamata, *Frank L. Hanley

Stanford University, Stanford, CA

Invited Discussant: *Christian P. Brizard

SUNDAY, APRIL 29

*AATS Member ♦AATS New Member †AmSECT Member

12. Intervention for Arch Obstruction in the Interstage Period Following Norwood: Prevalence, Risk Factors, and Practice Variability

Paul Joseph Devlin¹, Brian W. McCrindle¹, Pirooz Eghtesady², Bahaaladin Alsoufi³, Eugene H. Blackstone⁴, James M. Meza⁵, *William M. DeCamp⁶, *James K. Kirklin⁷, *Jeffrey P. Jacobs⁸, *Ali Dodge-Khatami⁹, *Kristine J. Guleserian¹⁰, James E. O'Brien, Jr.¹¹, *Erle H. Austin, III¹², *Peter J. Gruber¹³, Tara Karamlou¹⁴

¹The Hospital for Sick Children, Toronto, ON, Canada; ²St. Louis Children's Hospital, St. Louis, MO; ³Children's Healthcare of Atlanta, Atlanta, GA; ⁴Cleveland Clinic, Cleveland, OH; ⁵Duke University Medical Center, Durham, NC; ⁶Arnold Palmer Hospital for Children, Orlando, FL; ⁷University of Alabama at Birmingham, Birmingham, AL; ⁸Johns Hopkins All Children's Heart Institute, St. Petersburg, FL; ⁹University of Mississippi Medical Center, Jackson, MS; ¹⁰Nicklaus Children's Hospital, Miami, FL; ¹¹Children's Mercy Hospital, Kansas City, MO; ¹²Norton Children's Hospital, Louisville, KY; ¹³Children's Hospital of Philadelphia, Philadelphia, PA; ¹⁴Phoenix Children's Hospital, Phoenix, AZ

Invited Discussant: *J. William Gaynor

13. Characteristics and Operative Outcomes for Children Undergoing Repair of Truncus Arteriosus: A Contemporary Multicenter Analysis

Christopher W. Mastropietro¹, Venu Amula², Peter Sassalos³, Jason R. Buckley⁴, Ilias Iliopoulos⁵, Christine M. Riley⁶, Aimee Jennings⁷, Keshava Murty Narayana Gowda⁸, Adnan M. Bakar⁹, Michael Wilhelm¹⁰, Aditya Badheka¹¹, Elizabeth A.S. Moser¹, John M. Costello¹²

¹Indiana University, Indianapolis, IN; ²University of Utah, Salt Lake City, UT; ³University of Michigan, Ann Arbor, MI; ⁴Medical University of South Carolina, Charleston, SC; ⁵Cincinnati Children's Hospital, Cincinnati, OH; ⁶Children's National Health System, Washington, DC; ⁷Seattle Children's Hospital, Seattle, WA; ⁸Cleveland Clinic, Cleveland, OH; ⁹Cohen Children's Medical Center, New Hyde Park, NY; ¹⁰University of Wisconsin, Madison, WI; ¹¹Stead Family Children's Hospital, Iowa City, IA; ¹²Northwestern University Feinberg School of Medicine/Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL

Invited Discussant: *Thomas L. Spray

14. Thirty-Year Experience in Pediatric Heart Transplantation for the Failing Fontan

Joshua Michael Rosenblum, Brendan P. Lovasik, Scott Gillespie, William T. Mahle, *Kirk R. Kanter

Emory University, Atlanta, GA

Invited Discussant: ♦Ryan R. Davies

Late-Breaking Clinical Trial

LB2. Targeted Increase in Pulmonary Blood Flow in a Bidirectional Glenn Circulation (Super Glenn Procedure)

Aditya Kaza, Samuel Casella, James Lock, Sitaram Emani, Chris Baird, Pedro del Nido
Boston Children's Hospital, Boston, MA

Invited Discussant: *William M. DeCamp

5:15 pm

AATS/AmSECT Welcome Reception

Exhibit Hall, SDCC

3:15 pm

**General Thoracic Surgery
Simultaneous Scientific Session**

Room 25ABC, SDCC

6 minute presentation, 9 minute discussion

Moderators: *Jessica S. Donington and *David R. Jones

15. Adjuvant Chemotherapy Improves Survival in Patients with Nodal Metastases After Neoadjuvant Therapy and Esophagectomy

Justin Drake, Kurt Tauer, David Portnoy, *Benny Weksler

University of Tennessee, Memphis, TN

Invited Discussant: ♦Daniela Molena

16. Local Failure After Stereotactic Body Radiation Therapy (SBRT) or Wedge Resection for Colorectal Pulmonary Metastases

David B. Nelson, Quynh-Nu Nguyen, Jeremy J. Erasmus, Nabihah Tayob, Kyle G. Mitchell, *Wayne L. Hofstetter, Boris Sepesi, *Garrett L. Walsh, *Ara A. Vaporciyan, *Stephen G. Swisher, Mara B. Antonoff, *Jack A. Roth, *David C. Rice, *Reza J. Mehran

MD Anderson Cancer Center, Houston, TX

Invited Discussant: *Hiran C. Fernando

17. Pushing the Limits of DCDD Lung Transplantation: What Is the Impact of the Interval Between Withdrawal of Life Sustaining Therapies to Asystole?

Robert Qaqish, Konrad Hoetzenecker, Yui Watanabe, Jonathan Yeung, Ricardo Zamel, Manyin Chen, Andrew Pierre, *Kazuhiro Yasufuku, Laura Donahoe, *Marc de Perrot, *Thomas K. Waddell, *Shaf Keshavjee, *Marcelo Cypel

University of Toronto, Toronto, ON, Canada

Invited Discussant: *Sudish C. Murthy

Late-Breaking Clinical Trial

LB3. Prospective Study of Quality of Life After Esophagectomy with a Focus on Minimally Invasive Esophagectomy

Arjun Pennathur, Ryan M. Levy, Manuel Villa Sanchez, Matthew J. Schuchert, Omar Awais, Julie Ward, William E. Gooding, Rodney J. Landreneau, Inderpal Sarkaria, Rajeev Dhupar, Neil A. Christie, *James D. Luketich

University of Pittsburgh, Pittsburgh, PA

Invited Discussant:

18. Wide Disparity in Compliance with National Comprehensive Cancer Network Guidelines in the Treatment of Malignant Pleural Mesothelioma

Fernando Espinoza-Mercado, David Berz, Jerald Borgella, Rodrigo Alban, Hrag Bairamian, Taryne Imai, Harmik J. Soukiasian

Cedars-Sinai Medical Center, Los Angeles, CA

Invited Discussant: ♦Bryan M. Burt

SUNDAY, APRIL 29

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19. Redefining the Optimal Local Therapy for Early Stage Small Cell Lung Cancer

Kathryn E. Engelhardt¹, *Malcolm M. DeCamp¹, *Chadrick E. Denlinger²,
*Shari Lynn Meyerson¹, Ankit Bharat¹, David D. Odell¹

¹Northwestern University, Chicago, IL; ²Medical University of South Carolina,
Charleston, SC

Invited Discussant: *Stephen C. Yang

20. Lack of Correlation Between Short and Long-Term Outcomes Following Lung Cancer Surgery

*Felix G. Fernandez¹, Andrzej Kosinski², ♦Betty C. Tong², *Anthony P. Furnary³,
*Mark W. Onaitis⁴, *Daniel J. Boffa⁵, *Cameron D. Wright⁶, Patricia Copwer²,
*Jeffrey P. Jacobs⁷, Robert Habib⁸, *Joe B. Putnam, Jr.⁹

¹Emory University, Atlanta, GA; ²Duke University, Durham, NC; ³Starr-Wood Cardiac
Group, Portland, OR; ⁴University of San Diego California, La Jolla, CA; ⁵Yale University,
New Haven, CT; ⁶Massachusetts General Hospital, Boston, MA; ⁷Johns Hopkins All
Childrens Hospital, St. Petersburg, FL; ⁸Society of Thoracic Surgeons, Chicago, IL; ⁹MD
Anderson Baptist Cancer Center, Jacksonville, FL

Invited Discussant: *Varun Puri

21. Operative Experience with Pulmonary Resection Following Neoadjuvant Nivolumab in Patients with Resectable Non-Small Cell Lung Cancer

Stephen R. Broderick¹, Matthew Bott², *Bernard Park², James Isbell², *Prasad Adusumilli²,
*Malcolm Brock¹, Errol Bush¹, Jamie Chaff³, Patrick Forde¹, *Robert Downey²,
*Richard Battafarano¹, *Valerie Rusch², *Stephen C. Yang¹, *David R. Jones²

¹Johns Hopkins Medical Institutions, Baltimore, MD; ²Memorial Sloan Kettering Cancer
Center, New York, NY

Invited Discussant: *Michael Lanuti

5:15 pm

AATS/AmSECT Welcome Reception

Exhibit Hall, SDCC

5:30 pm – 6:45 pm

Joint AATS/PASCaTS Forum: *Enhancing Cardiovascular Education and Skill Training in Resource-Limited Underserved Regions*

CT Theater II
Booth #1235, Exhibit Hall
Not for Credit

Moderators: *R. Morton Bolman III, *University of Vermont Medical Center*
Charles A. Yankah, *Deutsches Herzzentrum Berlin*

5:30 pm – 5:35 pm **Welcome Address**

*R. Morton Bolman III, *University of Vermont Medical Center*
Charles A. Yankah, *Deutsches Herzzentrum Berlin*

5:35 pm – 5:45 pm **Digital Health Technology: Innovations for Bridging the Gap in Cardiovascular Education in Africa**

Charles A. Yankah, *Deutsches Herzzentrum Berlin*

5:45 pm – 5:55 pm **The Frontiers of Rheumatic Mitral Valve Repair: Shaving or Replace?**

Taweesak Chotivatanapong, *Central Chest Institute of Thailand*

5:55 pm – 6:05 pm **Late Results of RVOT Reconstruction with Decellularized Allografts in Children**

Samir Sarikouch, *Medizinische Hochschule Hannover*

6:05 pm – 6:15 pm **Improving the CT Surgery Residency Programs in a Limited Resource Setting**

Francis E. Smit, *University of the Free State*

6:15 pm – 6:30 pm **Discussion**6:30 pm – 6:45 pm **Round Table: Patient and Surgical Safety at Missions in Developing Countries**

Moderator: Taweesak Chotivatanapong, *Central Chest Institute of Thailand*

*Carlos Mestres, *University Hospital Zurich*

Panelists: *Manuel J. Antunes, *University of Coimbra*
Francis E. Smit, *University of the Free State*

*J. Nilas Young, *University of California Davis*

6:15 pm – 6:45 pm

Training at the Edge: Fear, Stress and the Future of Advanced Surgical Training

CT Theater I
Booth #134, Exhibit Hall
Not for Credit

How the Cleveland Clinic Heart & Vascular Institute, Washington DC's Level 1 Trauma Center, and high-performing surgical teams are using stress sensors and virtual reality to pioneer a new paradigm in surgical learning.

Speakers: Brian Ferguson, *Arena Labs*

*Douglas K. Johnston, *Cleveland Clinic*

MONDAY, APRIL 30, 2018

6:30 am **Update on Maintenance of Certification for the American Board of Thoracic Surgery** Room 25ABC, SDCC
Not for Credit
Separate Registration Required

Speaker: *Yolanda L. Colsen, *Brigham and Women's Hospital*

This session will feature presentations and discussion focusing on Maintenance of Certification (MOC) for the ABTS. Importantly MOC Part 3 and Part 4 have changed over the past few years and will be extensively discussed. MOC Part 3 used to be a secure exam administered at a Pearson Testing Center. This is no longer the case. The current method is taking a SESATS type exam, which is tailored to the cardiothoracic surgeon's specific practice profile and is now administered at your home or office. This process will be thoroughly discussed. MOC Part 4 used to involve participation in a national database, but has now involved into a Quality Improvement Project of the surgeon's choice. All cardiothoracic surgeons are welcome in these sessions, but those approaching their 5th or 10th year of the ABTS MOC cycle will find this session particularly valuable. Adequate time will be allowed for discussion as there are often multiple areas cardiothoracic surgeons want to explore with regards to the MOC process with Board Directors.

7:20 am **Business Session, AATS Members Only** Ballroom 20A, SDCC

7:30 am **Plenary Scientific Session** Ballroom 20A, SDCC
7 minute presentation, 12 minute discussion

Moderators: *Duke E. Cameron and *Marc R. Moon

22. Clinical Outcomes 10 Years After On-Pump Versus Off-Pump Coronary Bypass Grafting by Volume Qualified Surgeons

*Joanna Chikwe, Timothy Lee, Shinobu Itagaki, Natalia Egorova, *David H. Adams
Mount Sinai Medical Center, New York, NY

Invited Discussant: Michael P. Vallely

23. Single Centre Results with Normothermic Ex Vivo Lung Perfusion (EVLP): Does the Indication for EVLP Affect Organ Utilization and Patient Outcomes After Lung Transplantation?

*Marcelo Cypel, Jonathan C. Yeung, Laura Donahoe, Manyin Chen, Ricardo Zamel, Konrad Hoetzenecker, *Kazuhiro Yasufuku, *Marc de Perrot, Andrew Pierre, *Thomas K. Waddell, *Shaf Keshavjee
Toronto General Hospital, Toronto, ON, Canada

Invited Discussant: *G. Alexander Patterson

24. Valve-Sparing Aortic Root Replacement in Children: Outcomes from 100 Consecutive Cases

Charles D. Fraser, III¹, Rui H. Liu¹, Xun Zhou¹, Nishant D. Patel¹, Cecillia Lui¹,
Alejandro Suarez Pierre¹, *Marshall L. Jacobs¹, Harry C. Dietz, III¹, Narutoshi Hibino¹,
*Duke E. Cameron², *Luca A. Vricella¹

¹The Johns Hopkins Hospital, Baltimore, MD; ²Massachusetts General Hospital, Boston, MA

Invited Discussant: *James S. Tweddell

25. Ross Procedure: A 25-Year Longitudinal Analysis

*Tirone E. David, Maral Ouzounian, Carolyn David, Cedric Manlhiot
Toronto General Hospital, Toronto, ON, Canada

Invited Discussant: *D. Craig Miller

8:50 am Awards

9:00 am – Coffee Break in the Exhibit Hall
9:40 am

MONDAY, APRIL 30

9:05 am – 9:35 am

Operating Room Support Team Turnover Increases the Risk for Sharp Count Errors During Cardiac Surgery CT Theater I
Booth #134, Exhibit Hall
6 minute presentation, 20 minute discussion *Not for Credit*

Presenter: Jordan P. Bloom, Massachusetts General Hospital

Panelists: ♦David A. D'Alessandro, Massachusetts General Hospital
*Richard L. Prager, University of Michigan
*Thoralf M. Sundt, III, Massachusetts General Hospital
Panos Vardas, Indiana University

9:40 am Invited Guest Speaker: Maximize the Data, Minimize the Fraud: A Plea to Change the Way We Publish Ballroom 20A, SDCC

*Martin J. Elliott, Great Ormond St. Hospital for Children

*AATS Member ♦AATS New Member *AmSECT Member



10:20 am Plenary Scientific Session Ballroom 20A, SDCC
Moderators: *David H. Adams and *Marc R. Moon
 7 minute presentation, 12 minute discussion

26. Thirty Years and 1,663 Consecutive Norwood Procedures: Has Survival Plateaued?

Christopher E. Mascio¹, Mallory L. Irons², Richard F. Ittenbach³, J. William Gaynor¹, Stephanie Fuller¹, Michelle Kaplinski¹, Andrea T. Kennedy¹, James M. Steven¹, Susan C. Nicolson¹, *Thomas L. Spray¹

¹Children's Hospital of Philadelphia, Philadelphia, PA; ²University of Pennsylvania, Philadelphia, PA; ³Cincinnati Children's Hospital, Cincinnati, OH

Invited Discussant: *Marshall L. Jacobs

Late-Breaking Clinical Trial

LB15. Radial Artery Versus Saphenous Vein in Coronary Artery Bypass Surgery

Mario F. Gaudino¹, Umberto Benedetto^{2}, Stephen Fremes³, Giuseppe Biondi-Zoccai⁴, Art Sedrakyan⁵, *John D. Puskas⁶, Gianni D. Angelini², Brian Buxton⁷, Giacomo Frati⁴, David L. Hare⁷, Philip Hayward⁸, Giuseppe Nasso⁹, Neil Moat¹⁰, Miodrag Peric¹¹, Kyung Jong Yoo¹², Giuseppe Speziale⁹, Leonard N. Girardi¹, David P. Taggart¹³, for the RADIAL Investigators†

¹Cornell Medicine, New York, NY; ²Bristol Heart Institute, Bristol, UK; ³Schulich Heart Centre, Sunnybrook Health Science, University of Toronto, Toronto, Canada; ⁴Sapienza University, Rome, and Department of AngioCardioNeurology, IRCCS Neuromed, Pozzilli, Italy; ⁵Healthcare Policy and Research, Cornell Medicine, New York, NY; ⁶Icahn School of Medicine at Mount Sinai, New York, NY; ⁷University of Melbourne, Melbourne, Australia; ⁸The Austin Hospital, Melbourne, Vic, Australia; ⁹Anthea Hospital, Bari, Italy; ¹⁰Royal Brompton & Harefield Trust, London, UK; ¹¹Dedinje Cardiovascular Institute and Belgrade University School of Medicine, Belgrade, Serbia; ¹²Yonsei University College of Medicine, Seoul, Korea; ¹³University of Oxford, Oxford, UK

Invited Discussant: *James Tatoulis

27. Mandatory Public Reporting of Cardiac Surgery Outcomes: The Massachusetts Experience, 2002–2014

*David M. Shahian¹, David F. Torchiana¹, *Daniel Engelman², *Thoralf M. Sundt, III¹, Richard S. D'Agostino³, Ann Lovett⁴, Matt Cioffi⁴, James Rawn⁵, Vladimir Birjiniuk⁶, Sharon-Lise T. Normand⁴

¹Massachusetts General Hospital, Boston, MA; ²Baystate Medical Center, Springfield, MA; ³Lahey Health System, Burlington, MA; ⁴Harvard Medical School, Boston, MA; ⁵Brigham and Women's Hospital, Boston, MA; ⁶Mt. Auburn Hospital, Cambridge, MA

Invited Discussant: *Anelechi C. Anyanwu

11:20 am New Member Induction Ballroom 20A, SDCC

11:40 am Presidential Address: *Gentle Handling* Ballroom 20A, SDCC
 *Duke E. Cameron, Massachusetts General Hospital, Boston, MA

12:30 pm Adjourn for Lunch in the Exhibit Hall





12:40 pm – 1:50 pm **Ethics Forum Luncheon:** Room 23BC, SDCC
The Patient Said He Would Rather Die: Should You Let Him?
Separate Registration Required
Moderator: *Robert M. Sade, *Medical University of South Carolina, Charleston, SC*
Pro: Dov Fox, *Professor of Law and Director of the Center for Health Law Policy and Bioethics at USD*
Con: *Joseph S. Coselli, *Baylor College of Medicine, Houston, TX*

12:40 pm – 1:50 pm

21st Annual C. Walton Lillehei Resident Forum

CT Theater I

6 minute presentation, 4 minute discussion

Booth #134, SDCC

Co-Chairs: *Benjamin D. Kozower and *Christian Pizarro

Not for Credit

L1. Epigenetic Induction of the Tumor Suppressor Thioredoxin-Interacting Protein (TXNIP) Sensitizes Esophageal Adenocarcinoma (EAC) to Increased DNA Damage and Apoptosis Following Treatment with Cisplatin

Paul L. Feingold, Deborah Surman, Kate Brown, Yuan Xu, Lucas McDuffie, Vivek Shukla, Emily S. Reardon, Daniel R. Crooks, Jane B. Trepel, Min-Jung Lee, Lenard M. Neckers, Jeremy L. Davis, Jonathan M. Hernandez, Choung D. Hoang, *David S. Schrupp, R. Taylor Ripley

National Cancer Institute, NIH, Bethesda, MD

Invited Discussant: *Prasad S. Adusumilli

L2. Intraoperative, Intratumoral Gene-Mediated Cytokine Immunotherapy Modifies the Tumor Microenvironment and Synergizes with Checkpoint Inhibition

Jarrod Predina, Andrew D. Newton, Astero Klampatsa, Christopher Corbett, Shayoni Nag, Steven M. Albelda, *Sunil Singhal

University of Pennsylvania, Philadelphia, PA

Invited Discussant: *Mark W. Onaitis

L3. Lung Graft-Resident Foxp3+ Cells Maintain Tolerance by Suppressing Antibody-Mediated Rejection

Jason M. Gauthier¹, Wenjun Li¹, Ryuji Higashikubo¹, Hsi-Min Hsiao¹, Satona Tanaka¹, *Alexander S. Krupnick², *Varun Puri¹, Ramsey R. Hachem¹, Andrew E. Gelman¹, *Daniel Kreisel¹

¹Washington University, Saint Louis, MO; ²University of Virginia, Charlottesville, VA

Invited Discussant: *Michael S. Mulligan

MONDAY, APRIL 30

*AATS Member ♦AATS New Member +AmSECT Member



L4. Aggressive Tissue Aortic Valve Replacement in Younger Patients: Implications from Microsimulation Analysis

Neel K. Ranganath, Michael S. Koeckert, Deane E. Smith, Kazuhiro Hisamoto,
*Mathew R. Williams, Didier F. Loulmet, *Aubrey C. Galloway, *Eugene A. Grossi
New York University, New York, NY

Invited Discussant: Percy Boateng

L5. In Vivo Functional Assessment of a Novel Bioinspired Scaffold-Based Tissue Engineered Heart Valve

Garrett Cohan¹, Antonio D'Amore¹, Yasumoto Matsumura¹, Drake Pederson¹,
Samuel Luketich¹, Vesselin Shanov², *Tirone David³, William Wagner¹,
*Vinay Badhwar⁴

¹University of Pittsburgh, Pittsburgh, PA; ²University of Cincinnati, Cincinnati, OH; ³Toronto General Hospital, Toronto, ON, Canada; ⁴West Virginia University, Morgantown, WV

Invited Discussant: David Hoganson

L6. Human Neonatal Thymus Mesenchymal Stem Cells Can Improve Survival in the Setting of Chronic Right Ventricle Pressure Overload

Josue Chery¹, Shan Huang², Shuyun Wang², Zhize Yuan², Lianghui Gong²,
Joshua Wong², Jeffrey Lee², Sean Johnson², Dingding Xiong², Ming-Sing Si²

¹Virginia Commonwealth University Medical Center, Richmond, VA; ²University of Michigan, Ann Arbor, MI

Invited Discussant: *Sunjay Kaushal

MONDAY AFTERNOON, APRIL 30, 2018

2:00 pm

**Adult Cardiac Surgery
Simultaneous Session**

Ballroom 20A, SDCC

6 minute presentation, 9 minute discussion

Moderators: *Niv Ad and *Leonard N. Girardi

28. Three-Year Outcomes of Aortic Root Surgery in Marfan Syndrome Patients: A Prospective, Multi-Center, Comparative Study

*Joseph S. Coselli¹, Irina V. Volguina¹, *Scott A. LeMaire¹, Heidi M. Connolly²,
*Thoralf M. Sundt, III³, *Hartzell V. Schaff², Dianna M. Milewicz⁴, Harry C. Dietz⁵,
*D. Craig Miller⁶ on behalf of the Aortic Valve Operative Outcomes in Marfan Patients Study Group

¹Baylor College of Medicine, One Baylor Plaza, Houston, Texas; ²Mayo Clinic, Rochester, Minnesota; ³Massachusetts General Hospital, Boston, Massachusetts; ⁴The University of Texas Health Science Center at Houston McGovern Medical School, Houston, Texas; ⁵Johns Hopkins University School of Medicine, Baltimore, Maryland; ⁶Stanford University, Stanford, California

Invited Discussant: *Eric E. Roselli



29. Surgical Aortic Valve Replacement with New Generation Bioprostheses: Sutureless Versus Rapid-Deployment

Augusto D'Onofrio¹, Stefano Salizzoni², Claudia Filippini², Chiara Tessari¹, Lorenzo Bagozzi¹, Antonio Messina³, Giovanni Troise³, Manfredo Rambaldini⁴, Magnus Dalèn⁵, Francesco Alamanni⁶, Massimo Massetti⁷, Carmelo Mignosa⁸, Claudio Russo⁹, Loris Salvador¹⁰, *Roberto Di Bartolomeo¹¹, Daniele Maselli¹², *Ruggero De Paulis¹³, *Ottavio Alfieri¹⁴, Carlo De Filippo¹⁵, Michele Portoghese¹⁶, *Uberto Bortolotti¹⁷, Mauro Rinaldi², *Gino Gerosa¹

¹University of Padova, Padova, Italy; ²University of Torino, Torino, Italy; ³Poliambulanza Hospital, Brescia, Italy; ⁴Carlo Poma Hspital, Mantova, Italy; ⁵Karolinska University Hospital, Stockholm, Sweden; ⁶University of Milan, Milano, Italy; ⁷Catholic University, Roma, Italy; ⁸Morgagni Hospital, Catania, Italy; ⁹Niguarda Hospital, Milano, Italy; ¹⁰San Bortolo Hospital, Vicenza, Italy; ¹¹University of Bologna, Bologna, Italy; ¹²S. Anna Hospital, Catanzaro, Italy; ¹³European Hospital, Roma, Italy; ¹⁴San Raffaele Hospital, Milano, Italy; ¹⁵Giovanni Paolo II Hospital, Campobasso, Italy; ¹⁶University of Sassari, Sassari, Italy; ¹⁷University of Pisa, Pisa, Italy

Invited Discussant: *Vinod H. Thourani

30. Outcomes of Dialysis Patients Undergoing Valve Replacement Operations: A Multi-Center Experience Over 20 Years

Joshua Manghelli¹, Daniel Carter¹, Ali Khiabani¹, Farah Musharbash¹, Richard Schuessler¹, *Marc R. Moon¹, Nabil Munfakh¹, Joel Corvera², *Ralph J. Damiano, Jr.¹, Spencer Melby¹

¹Washington University, St. Louis, MO; ²Indiana University, Indianapolis, IN

Invited Discussant: *Farzan Filsoufi

31. Endovascular Fenestration/Stenting First and Delayed Central Aortic Repair in Patients with Acute Type A Aortic Dissection and Critical Mesenteric Malperfusion: 20 Years' Experience

Elizabeth L. Norton¹, *Himanshu J. Patel¹, *G. Michael Deeb¹, Karen M. Kim¹, David M. Williams¹, Minhajuddin Khaja¹, Xiaoting Wu¹, Carlo Maria Rosati², Whitney E. Hornsby¹, Donald S. Likosky¹, Bo Yang¹

¹University of Michigan, Ann Arbor, MI; ²Indiana University, Indianapolis, IN

Invited Discussant: *Leonard N. Girardi

MONDAY, APRIL 30

* AATS Member ♦ AATS New Member + AmSECT Member



32. Risk Factors and Outcomes of Pacemaker Implantation After Concomitant Mitral Valve Surgery and Ablation of Atrial Fibrillation: Insights from a Surgical Ablation during Mitral Valve Surgery Trial

*Joseph J. DeRose¹, Donna Mancini², Helena L. Chang², *A. Marc Gillinov³, *Francois Dagenais⁴, *Gorav Ailawadi⁵, *Louis P. Perrault⁶, Michael K. Parides², Wendy C. Taddei-Peters⁷, *Michael J. Mack⁸, *Donald Glower⁹, Babatunde Yerokun⁹, *Pavan Atluri¹⁰, John C. Mullen¹¹, *John D. Puskas¹², Karen O'Sullivan², Nancy M. Sledz-Joyce², Hugo Tremblay¹³, Ellen Moquete², Bart S. Ferket², Alan J. Moskowitz², Alexander Iribarne¹⁴, Annetine C. Gelijns², Patrick O'Gara¹⁵, *Michael Argenziano¹⁶
¹Montefiore-Einstein Medical Center, Bronx, NY; ²Icahn School of Medicine at Mount Sinai, New York, NY; ³Cleveland Clinic, Cleveland, OH; ⁴Institut de Cardiologie et Pneumologie de Québec, Québec, QC, Canada; ⁵University of Virginia, Charlottesville, VA; ⁶Montreal Heart Institute, Montreal, QC, Canada; ⁷National Heart, Lung, and Blood Institute, Bethesda, MD; ⁸Baylor Scott & White Health, Plano, TX; ⁹Duke University, Durham, NC; ¹⁰University of Pennsylvania, Philadelphia, PA; ¹¹University of Alberta, Edmonton, AB, Canada; ¹²Mount Sinai Heart at Saint Luke's, New York, NY; ¹³Institut Universitaire de Cardiologie et de Pneumologie de Québec, Québec, QC, Canada; ¹⁴Dartmouth-Hitchcock Medical Center, Lebanon, NH; ¹⁵Brigham and Women's Hospital, Boston, MA; ¹⁶New York-Presbyterian Hospital, Columbia University, New York, NY

Invited Discussant: *Niv Ad

3:30 pm – Coffee Break in the Exhibit Hall
4:00 pm

3:35 pm – 4:00 pm

Deep Dive in Coronary Revascularization

3 minute presentations, 20 minute discussion

AATS CT Theater II

Booth #1235, Exhibit Hall

Not for Credit

Moderator: *Clifford W. Barlow, Southampton General Hospital

Panelists: *Joanna Chikwe, Mount Sinai Medical Center

◆Mario F. Gaudino, Weill Cornell Medicine, New York Presbyterian Hospital

David Glineur, University of Ottawa Heart Institute

Teresa M. Kieser, University of Calgary



4:00 pm

**Adult Cardiac Surgery
Simultaneous Session**

Ballroom 20A, SDCC

5 minute presentation, 9 minute discussion

Moderators: *David H. Adams and *Ralph J. Damiano, Jr.

Invited Speaker: *State of the Art: Mitral Repair*

*Gilles D. Dreyfus, *Cardiothoracic Centre of Monaco*

33. Predictors and Clinical Significance of Functional Mitral Valve Stenosis Following Valve Repair for Degenerative Disease

Anton Tomsic, Yasmine L. Hiemstra, Bardia Arabkhani, Thomas J. van Brakel, Michel I.M. Versteegh, Nina Ajmone Marsan, *Robert J.M. Klautz, Meindert Palmen
Leiden University, Leiden, Netherlands

Invited Discussant: *Gebrine El Khoury

34. Anticoagulation After Mitral Valve Repair

Tessa Watt, Shannon Murray, Alexander Wisniewski, Shazli Khan, Matthew A. Romano, *Steven F. Bolling
University of Michigan, Ann Arbor, MI

Invited Discussant: *Marc R. Moon

35. Impact of High Volume Marfan Syndrome Centers on Mitral Repair Rates in Patients with Marfan Syndrome

Antonio R. Polanco, Yuting P. Chiang, Jeremy J. Song, Alex M. D'Angelo, David J. Engel, Virendra I. Patel, *Hiroo Takayama
Columbia University, New York, NY

Invited Discussant: *A. Marc Gillinov

36. Preoperative Left Atrial Volume Is Associated with Postoperative Outcomes in Mitral Valve Repairs

Parvathi Balachandran, Brian D. Lahr, *Joseph A. Dearani, *Richard C. Daly, *Simon Maltais, Sorin V. Pislaru, *Hartzell V. Schaff
Mayo Clinic, Rochester, MN

Invited Discussant: *Tomasz A. Timek

37. Long-Term Results of Mitral Repair for Degenerative Mitral Regurgitation with Complete Semirigid Rings Versus Posterior Flexible Bands: Does It Make Any Difference?

Andrea Baccelli¹, Elisabetta Lapenna², Benedetto Del Forno², Alessandro Castiglioni², Giovanni La Canna², Ilaria Giambuzzi¹, *Ottavio Alfieri², Michele De Bonis²

¹*Università Vita-Salute San Raffaele, Milano, Italy;* ²*San Raffaele University Hospital, Milano, Italy*

Invited Discussant: *Clifford W. Barlow

MONDAY, APRIL 30

*AATS Member ♦AATS New Member †AmSECT Member



38AC. A Population Based Evaluation of Phase of Care Contributing to Mortality After Surgical and Transcatheter Aortic Valve Replacement

*Himanshu J. Patel¹, Patricia F. Theurer², Frances L. Shannon³, *Gaetano Paone⁴, John Heiser¹, Melissa J. Clark², *Richard L. Prager¹

¹University of Michigan, Ann Arbor, MI; ²Michigan Society of Thoracic and Cardiovascular Surgeons, Ann Arbor, MI; ³William Beaumont Hospital, Royal Oak, MI; ⁴Henry Ford Hospital, Detroit, MI

Invited Discussant: Dawn S. Hui

5:30 pm Adjourn

5:35 pm – Executive Session, AATS Members Only Ballroom 20A, SDCC
6:15 pm

2:00 pm Controversies in CABG 2018 Room 28ABC, SDCC
7 minute presentation, 8 minute discussion

Moderators: *John D. Puskas and *James Tatoulis

Conduits in CABG

38. A Meta-Analysis of the Adjusted Observational Studies Comparing the Radial Artery and the Saphenous Vein As the Second Conduit for CABG

*Mario F. Gaudino¹, Mohamed Rahouma¹, Ahmed Anwar Abouarab¹, Jeremy Leonard¹, Mohamed Kamel¹, Derrick Tam², *Leonard Girardi¹, *Stephen Fremes²

¹Weill Cornell Medicine, New York Presbyterian Hospital, New York, NY; ²Sunnybrook Health Science Center, Toronto, ON, Canada

Invited Discussant: *James Tatoulis

39. Bilateral Internal Thoracic Artery Grafting: A Propensity Analysis of the Left Internal Thoracic Artery Versus the Right Internal Thoracic Artery As a Bypass Graft to the Left Anterior Descending Artery, Including Angiographic Results

Shinji Ogawa¹, Tomohiro Tsunekawa², Koshi Sawada¹, Yoshihiro Goto¹, Soh Hosoba¹, Yutaka Koyama³, Mototsugu Tamaki³, Takayoshi Kato², Hideki Kitamura³, Shinji Tomita², Yasuhide Okawa³

¹Toyohashi Heart Center, Toyohashi, Japan; ²Gifu Heart Center, Gifu, Japan; ³Nagoya Heart Center, Nagoya, Japan

Invited Discussant: *Faisal G. Bakaeen

40. CABG with 3 Arterial Grafts Does Not Improve Outcomes Compared to 2 Arterial Grafts at 5 Year Followup

Rodolfo Rocha¹, Derrick Tam¹, Reena Karkhanis¹, Rashmi Nedadur¹, Jiming Fang², Jack Tu², *Stephen Fremes¹

¹University of Toronto, Toronto, ON, Canada; ²Institute of Clinical Evaluative Sciences, Toronto, ON, Canada

Invited Discussant: *Hossein Almassi



41. Angiographic Evaluation of Arterial Graft Function and Competitive Flow: Analysis from Two Prospective Randomized Control Series

Hidetake Kawajiri¹, *Laurent de Kerchove², Parla Astarci², Philippe Noirhomme², *Gebrine El Khoury², *Juan Grau¹, David Glineur¹

¹University of Ottawa Heart Institute, Ottawa, ON, Canada; ²Cliniques Universitaires St. Luc, Brussels, Belgium

Invited Discussant: *Song Wan

OPCAB and ONCAB: Making Sense of the Data

42. Real-World Outcomes of On-Pump Versus Off-Pump Coronary-Artery Bypass Grafting: Results from Korean National Claim Registry

♦Joon Bum Kim¹, Ae Jung Jo², Hyo Jeong Kim², Songhee Cho², Min Jung Ko², Sung Cheol Yun¹, Duk-Woo Park¹

¹University of Ulsan College of Medicine, Seoul, Republic of Korea; ²National Evidence-Based Healthcare Collaborating Agency, Seoul, Republic of Korea

Invited Discussant: Ramachandra C. Reddy

43. Off-Pump Coronary Artery Bypass Grafting Does Not Improve Long Term Survival or Freedom from Dialysis in Patients with Renal Failure

Rodolfo Rocha¹, Bobby Yanagawa¹, Jack Tu², Mohamad Hussain¹, Jiming Fang², Robert J. Cusimano¹

¹University of Toronto, Toronto, ON, Canada; ²Institute of Clinical Evaluative Sciences, Toronto, ON, Canada

Invited Discussant: ♦Mario F. Gaudino

3:30 pm – Coffee Break in the Exhibit Hall

4:00 pm

44. Off-Pump Versus On-Pump in Redo Coronary Artery Bypass Grafting: A Propensity Score Analysis of Long Term Follow Up

Magdalena Iuliana Rufa, Adrian Ursulescu, Ragi Nagib, Marc Albert, Samir Ahad, Stefan Reichert, Ulrich Franke

Robert Bosch Hospital, Stuttgart, Germany

Invited Discussant: *Michael E. Halkos

45. Twenty-Year Experience with Off-Pump Coronary Artery Bypass Surgery: Lessons Learned from Early Postoperative Angiography

*Ki-Bong Kim, Cheong Lim, Jae-Sung Choi, Jun Sung Kim, Ho Young Hwang, Se Jin Oh, Jae Woong Choi

Seoul National University Hospital, Seoul, Republic of Korea

Invited Discussant: David Glineur

MONDAY, APRIL 30

*AATS Member ♦AATS New Member +AmSECT Member



Non-Sternotomy CABG and Hybrid Revascularization

46. Very Long Term Results of Minimally Invasive Coronary Artery By-Pass: Twenty Years Experience

Alberto Repossini¹, Lorenzo Di Bacco¹, Flavia Nicoli¹, Bruno Passaretti²,
Alessandra Stara¹, *Claudio Muneretto¹

¹University of Brescia, Brescia, Italy; ²Cliniche Gavazzeni Humanitas, Bergamo, Italy

Invited Discussant: Gianluca Torregrossa

47. Short and Long-Term Outcomes of Hybrid Coronary Revascularization for Double-Vessel Disease: Is There a Difference When Compared with Traditional CABG?

Nirav C. Patel, Jonathan M. Hemli, Karthik Seetharam, Luigi Pirelli, Derek R. Brinster,
S. Jacob Scheinerman

Lenox Hill Hospital, New York, NY

Invited Discussant: *Zhe Zheng

48. Advanced Hybrid Coronary Revascularization: Mid-Term Outcomes with Robotic Beating Heart Totally Endoscopic Multi-Vessel Grafting and PCI

Hiroto Kitahara, Taishi Hirai, Mackenzie McCrorey, Brooke Patel, Sarah Nisivaco,
Sandeep Nathan, Husam Balkh

University of Chicago, Chicago, IL

Invited Discussant: *Joseph J. Derose

49. Intensive Versus Moderate Statin Therapy and Early Graft Occlusion After Coronary Bypass Surgery: The ACTIVE Randomized Clinical Trial

*Alexander Kulik¹, Amy M. Abreu¹, Viviana Boronat¹, *Marc Ruel²

¹Boca Raton Regional Hospital, Boca Raton, FL; ²University of Ottawa Heart Institute, Ottawa, ON, Canada

Invited Discussant: *David M. Shahian

5:30 pm Adjourn

5:35 pm – Executive Session, AATS Members Only

Ballroom 20A, SDCC

6:15 pm

MONDAY AFTERNOON, APRIL 30, 2018

2:00 pm

Congenital Heart Disease Simultaneous Scientific Session

Room 24ABC, SDCC

8 minute presentation, 10 minute discussion

Moderators: *Vaughn A. Starnes and *Luca A. Vricella

50. The Hidden Side of Shone Syndrome

Stephanie L. Perrier, Mangesh Jadhav, *Yves D'Udekem, Johann Brink,
*Igor E. Konstantinov, Michael M. Cheung, *Christian P. Brizard

Royal Children's Hospital, Parkville, Australia

Invited Discussant: *Christian Pizarro

51. Post-Operative Heart Block Following Congenital Heart Surgery: Analysis from the Pediatric Cardiac Critical Care Consortium.

Amy Romer¹, Sarah Tabbutt¹, Susan Etheridge², Peter Fischbach³, Nancy Ghanayem⁴,
*V. Mohan Reddy¹, Raj Sahulee⁵, Ronn Tanel¹, *James Tweddell⁶, Michael Gaies⁷,
Lauren Retzlaff⁷, Wenying Zhang⁷, Akash Patel¹

¹University of California, San Francisco, CA; ²University of Utah, Salt Lake City, UT;

³Emory University, Atlanta, GA; ⁴Texas Children's Hospital, Baylor College of Medicine, Houston, TX; ⁵New York University, New York, NY; ⁶University of Cincinnati, Cincinnati, OH; ⁷University of Michigan, Ann Arbor, MI

Invited Discussant: *Tain-Yen Hsia

52. The Third Decade of Surgical Palliation in Hypoplastic Left Heart Syndrome: Restricted Usage of the Right Ventricle to Pulmonary Artery Conduit

Thomas Kelly¹, Diana Zannino², Johann Brink³, *Yves d'Udekem³, *Igor E. Konstantinov³,
Michael Cheung³, *Christian Brizard³

¹University of Melbourne, Melbourne, Australia; ²Murdoch Children's Research Institute, Melbourne, Australia; ³Royal Children's Hospital, Melbourne, Australia

Invited Discussant: Shunnji Sano

53. Aortic Translocation, Anatomic Repair with Expanded Indications

Vincent K. Tam, Eldad Erez, Lisa Roten, Hisashi Nikaidoh, Vinod A. Sebastian,
Katy Wilson, Johnbosco Umejiego

Cook Childrens Medical Center, Fort Worth, TX

Invited Discussant: *Vaughn A. Starnes

3:15 pm – Coffee Break in the Exhibit Hall

3:55 pm

MONDAY, APRIL 30

*AATS Member ♦AATS New Member +AmSECT Member

54. Trachea Morphology Inpatients with Pulmonary Sling Before and After Slide Tracheoplasty

Shu-chien Huang, En-Ting Wu, Ching-Chia Wang, Yih-Sharng Chen, Shyh-Jye Chen
National Taiwan University Hospital, Taipei, Taiwan

Invited Discussant: *Carl L. Backer

55. Long-Term Results of Transposition of the Great Arteries with Left Ventricular Outflow Tract Obstruction: Comparison of Three Types Operation and Risk Analysis

Akihisa Furuta, Hiroshi Niinami, Goki Matsumura
Tokyo Women's Medical University, Tokyo, Japan

Invited Discussant: Hisashi Nikaidoh

56. Mid-Term Outcomes Following Repair of Double Outlet Right Ventricle

Olubunmi Oladunjoye, Breanna Piekarski, Christopher Baird, Puja Banka, Gerald Marx,
*Pedro del Nido, *Sitaram Emani
Boston Children's Hospital, Boston, MA

Invited Discussant:

57. Pulmonary Arterioplasty at Stage Two Palliation Does Not Adversely Impact Outcomes to Fontan

W. Hampton Gray, John D. Cleveland, *Winfield J. Wells, *Vaughn A. Starnes,
S. Ram Kumar
Children's Hospital of Los Angeles, Los Angeles, CA

Invited Discussant: *Jennifer C. Romano

58. The Prevalence and Impact of Congenital Diaphragmatic Hernia Among Patients Undergoing Surgery for Congenital Heart Disease

Charles D. Fraser, III¹, Kevin D. Hill², Amelia S. Wallace², Karen Chiswell², Xun Zhou¹,
Eric B. Jelin¹, David Kays³, *Jeffrey P. Jacobs³, Narutoshi Hibino¹, *Marshall L. Jacobs¹,
*Luca A. Vricella¹

¹Johns Hopkins Hospital, Baltimore, MD; ²Duke University, Durham, NC; ³Johns Hopkins All Children's Hospital, St. Petersburg, FL

Invited Discussant: *Scott M. Bradley

5:30 pm Adjourn

5:35 pm – Executive Session, AATS Members Only

Ballroom 20A, SDCC

6:15 pm

MONDAY AFTERNOON, APRIL 30, 2018

2:00 pm

General Thoracic Surgery Simultaneous Scientific Session

Room 25ABC, SDCC

8 minute presentation, 10 minute discussion

Moderators: *Thomas A. D'Amico and *Stephen C. Yang

59. First Series of Minimally Invasive, Robot-Assisted Tracheobronchoplasty with Mesh for Severe Tracheobronchomalacia

Richard Lazzaro¹, Byron Patton¹, *Paul Lee¹, Jason Karp², Efstathia Mihelis¹, Sohrab Vatsia¹, S. Jacob Scheinerman¹

¹Lenox Hill Hospital, New York, NY; ²North Shore University Hospital, Manhasset, NY

Invited Discussant: *Abbas E. Abbas

60. Single-Institution Results of Near-Infrared Intraoperative Imaging During Minimally Invasive Pulmonary Metastasectomy for Sarcomas

Jarrold D. Predina, Andrew Newton, Colleen Gaughan, Doraid Jarrar, Taine Pechet, John Kucharczuk, *Sunil Singhal

University of Pennsylvania, Philadelphia, PA

Invited Discussant:

61. Effect of Virtual-Assisted Lung Mapping (VAL-MAP) in Acquisition of Surgical Margins in Sublobar Lung Resection: A Multicenter, Prospective Study in Japan

♦Masaaki Sato¹, Masashi Kobayashi², Fumitsugu Kojima³, Fumihiro Tanaka⁴, Masahiro Yanagiya⁵, Shinji Kosaka⁶, Ryuta Fukai⁷, Yoshiaki Furuhashi⁸, Kenji Misawa⁹, Masaki Ikeda¹⁰, Hideaki Miyamoto¹¹, Ryotaro Kamohara¹², Yukihiro Yoshida¹³, Yukihiro Yoshida¹³, Hiroaki Sakai¹⁴, Yasuo Sekine¹⁵, Terumoto Koike¹⁶, Yosuke Otake¹⁷

¹University of Tokyo, Tokyo, Japan; ²Tokyo Medical and Dental University, Tokyo, Japan; ³St. Luke's International Hospital, Tokyo, Japan; ⁴University of Occupational and Environmental Health, Kitakyushu, Japan; ⁵NTT Medical Center Tokyo, Tokyo, Japan; ⁶Shimane Prefectural Central Hospital, Izumo, Japan; ⁷Shonan Kamakura General Hospital, Kamakura, Japan; ⁸Japanese Red Cross Medical Center, Tokyo, Japan; ⁹Aizawa Hospital, Matsumoto, Japan; ¹⁰Nagara Medical Center, Gifu, Japan; ¹¹Matsue Red Cross Hospital, Matsue, Japan; ¹²Nagasaki University, Nagasaki, Japan; ¹³Asahi Central Hospital, Asahi, Japan; ¹⁴Hyogo Prefectural Amagasaki General Medical Center, Amagasaki, Japan; ¹⁵Tokyo Women's Medical University Yachiyo Medical Center, Yachiyo, Japan; ¹⁶Niigata University Graduate School of Medical and Dental Sciences, Niigata, Japan; ¹⁷Kitano Hospital, Osaka, Japan

Invited Discussant: *Yolonda L. Colson

62. Prospective Feasibility Study of Sealing with Energy Vessel Sealing System for Pulmonary Vessels in Lung Surgery

Yoshihiro Miyata¹, *Morihito Okada¹, Yasuhiro Tsutani¹, Kazuya Takamochi², Shiaki Oh²,

♦Kenji Suzuki²

¹Hiroshima University, Hiroshima, Japan; ²Juntendo University, Tokyo, Japan

Invited Discussant: *Scott J. Swanson

MONDAY, APRIL 30

*AATS Member ♦AATS New Member +AmSECT Member

3:15 pm – Coffee Break in the Exhibit Hall
3:55 pm

3:25 pm – 3:50 pm

**Deep Dive: Disentangling Trade-Offs Between
Different Forms of Resource Utilization in Regionalized
Esophagectomy Care: Analysis of Healthcare Costs** AATS CT Theater I
Booth #134, Exhibit Hall
Not for Credit

5 minute presentation, 20 minute discussion

Presenter: Biniam Kidane, *University of Manitoba*

Moderator: *Robert J. Cerfolio, *New York University*

Panelists: *Gail E. Darling, *Toronto General Hospital*
*Sean C. Grondin, *Foothills Medical Centre*

3:55 pm **General Thoracic Surgery** Room 25ABC, SDCC
Simultaneous Scientific Session (*continued*)
8 minute presentation, 10 minute discussion

Moderators: *Michael Lanuti and *Robert J. Cerfolio

**63. Assessment of Competence in Video Assisted Thoracoscopic Surgery Lobectomy
— A Nationwide Study**

Rene Horsleben Petersen¹, Kirsten Gjæraa¹, Katrine Jensen¹, Lars B. Møller²,
Henrik Jessen Hansen¹, Lars Konge¹

¹Copenhagen University Hospital, Rigshospitalet, Copenhagen, Denmark; ²Aalborg
University Hospital, Aalborg, Denmark

Invited Discussant: ♦Paul H. Schipper

**64. The Role of Thoracoscopic Pneumonectomy in the Management of Non-Small
Cell Lung Cancer: A Multicenter Study of 434 Patients**

Chi-Fu Jeffrey Yang¹, *Sai Yendamuri², Nicholas Mayne¹, Athar Battoo², Hanghang Wang¹,
Ryan Meyerhoff¹, Sameer Hirji³, *Mark Berry⁴, *Robert McKenna⁵, *Todd Demmy²,
*Thomas D'Amico¹

¹Duke University, Durham, NC; ²Roswell Park Cancer Institute, Buffalo, NY; ³Brigham
and Women's Hospital, Boston, MA; ⁴Stanford University, Stanford, CA; ⁵Cedars-Sinai
Medical Center, Los Angeles, CA

Invited Discussant: *James D. Luketich

**65. Extent of Lymphadenectomy Is Associated with Oncological Efficacy of Sublobar
Resection for Lung Cancer Less Than or Equal to 2 cm**

*Brendon M. Stiles, Jialin Mao, Sebron Harrison, Benjamin Lee, Andrew Nguyen,
*Jeffrey L. Port, Art Sedrakyan, *Nasser K. Altorki

New York Presbyterian Hospital Weill Cornell Medical College, New York, NY

Invited Discussant: *Sai Yendamuri



66. Close Surgical Margins and Risks of Local Treatment Failure After Wedge Resection of Colorectal Pulmonary Metastases

David B. Nelson, Nabihah Tayob, Kyle G. Mitchell, Arlene M. Correa,
*Wayne L. Hofstetter, Boris Sepesi, *Garrett L. Walsh, *Ara A. Vaporciyan,
*Stephen G. Swisher, Mara B. Antonoff, *Jack A. Roth, *David C. Rice, *[Reza J. Mehran](#)
MD Anderson Cancer Center, Houston, TX

Invited Discussant: *Thomas K. Waddell

67. Effects of Time from Completed Clinical Staging to Surgery: Does It Make a Difference in Stage 1 Non-Small Cell Lung Cancer?

Derek Ray Serna-Gallegos, Fernando Espinoza-Mercado, Taryne Imai, David Berz,
[Harmik J. Soukiasian](#)
Cedars-Sinai Medical Center, Los Angeles, CA

Invited Discussant: *Felix G. Fernandez

5:30 pm **Adjourn**

5:35 pm – 6:15 pm **Executive Session, AATS Members Only** Ballroom 20A, SDCC

MONDAY, APRIL 30

MONDAY AFTERNOON, APRIL 30, 2018

2:00 pm **Perioperative Care** Room 28DE, SDCC
Simultaneous Scientific Session
6 minute presentation, 8 minute discussion
Moderators: Marci Damiano, Katherine J. Hoercher and
*Glenn J. Whitman

Late-Breaking Clinical Trial

68. One-Year Results from the First US-Based ERAS® Cardiac Program

[Judson Blount Williams, Jr.](#)¹, Gina McConnell², J. Erin Allender², Patricia Woltz²,
Peter K. Smith¹, ♦[Daniel T. Engelman](#)³, William T. Bradford²
¹*Duke University, Raleigh, NC*; ²*WakeMed Health and Hospitals, Raleigh, NC*; ³*Baystate Medical Center, Springfield, MA*

Invited Discussant: Subhasis Chatterjee

69. Effects of Hemoglobin A1c Levels on Short-Term Outcomes and Mortality Rates In Patients Undergoing Transcatheter or Surgical Aortic Valve Replacement

[Nnaemeka Ndubisi](#)¹, Jessica Forcillo¹, Jonh Melvan¹, John Kelly¹, John Hunting¹,
Jose Binongo¹, Vasilis Babaliaros¹, *Robert Guyton¹, Chandan Devireddy¹,
Bradley Leshnower¹, James Stewart¹, Jeffrey Miller¹, *Edward Chen¹,
*Michael Halkos¹, *Vinod Thourani²

¹*Emory University, Atlanta, GA*; ²*Medstar Washington Hospital Center, Washington DC*

Invited Discussant: *Harold L. Lazar

*AATS Member ♦AATS New Member +AmSECT Member



70. The Utility of Platelet Reactivity Assay in Patients on P2Y12 Receptor Antagonists Undergoing Coronary Artery Bypass Grafting

Jota Nakano, Erin St. Angelo, Bola Lawuyi, Nichole Melody, Menghan Liu, Duc Thinh Pham, *Patrick M. McCarthy, Andrei Churyla, *S. Chris Malaisrie
Northwestern University, Chicago, IL

Invited Discussant: *J. Michael DiMaio

71. Hyperlactemia During Cardiopulmonary Bypass Is Predictive of Postoperative Renal Failure, Ventilatory Failure and Mortality, Even in the Absence of Postoperative Shock

Xun Zhou, Alejandro Suarez-Pierre, Charles D. Fraser, III, Cecillia Lui, Jeffrey M. Dodd-O, Laeben C. Lester, Viachaslau Barodka, Marc Sussman, *Glenn J. Whitman
Johns Hopkins Hospital, Baltimore, MD

Invited Discussant: Rita Karianna Milewski

72. Impact of Public Reporting on Risk Aversion in Cardiac Surgery

Robert B. Hawkins¹, J. Hunter Mehaffey¹, Clifford Fonner², *Alan Speir³, Mohammed Quader⁴, *Irving L. Kron¹, *Jeffrey B. Rich⁵, *Gorav Ailawadi¹
¹University of Virginia, Charlottesville, VA; ²Virginia Cardiac Services Quality Initiative, Falls Church, VA; ³Inova Heart and Vascular Institute, Falls Church, VA; ⁴Virginia Commonwealth University, Richmond, VA; ⁵Cleveland Clinic, Cleveland, OH

Invited Discussant:

3:15 pm – Coffee Break in the Exhibit Hall

3:55 pm

73. Adult Cardiovascular Surgical Intensive Care Unit Organization and Outcome: Does the 24-hour presence of an intensivist Lead to Better Clinical Outcomes?

Pascal Huard, Jed Lipes, Ying Tung Sia, Marc-Antoine Tardif, Mathieu Simon, Steve Blackburn, Stephane Langevin, *Francois Dagenais, Dimitri Kalavrouziotis, *Siamak Mohammadi

Quebec Heart & Lung University Institute, Quebec City, QC, Canada

Invited Discussant: *David A. Fullerton

74. Is Routine Extubation Overnight Safe in Cardiac Surgery Patients?

Elizabeth D. Krebs¹, Robert B. Hawkins¹, J. Hunter Mehaffey¹, Clifford E. Fonner², *Alan M. Speir³, Mohammed A. Quader⁴, *Jeffrey B. Rich⁵, Leora T. Yarboro¹, Nicholas R. Teman¹, *Gorav Ailawadi¹
¹University of Virginia, Charlottesville, VA; ²Virginia Cardiac Services Quality Initiative, Virginia Beach, VA; ³INOVA Heart and Vascular Institute, Falls Church, VA; ⁴Virginia Commonwealth University, Richmond, VA; ⁵Cleveland Clinic, Cleveland, OH

Invited Discussant: *Kevin W. Lobdell



75. Advances in Management of Post Cardiotomy Open Chest: Use of Negative Pressure Dressing in 588 Adults

*Gosta B. Pettersson, *Faisal G. Bakaeen, Osama Haddad, Mudathir Ibrahim, Salvior Mok, *Douglas R. Johnston, *Edward G. Soltesz, *Nicholas G. Smedira, *Kenneth R. McCurry, Stephanie L. Mick, *Jose L. Navia, Per Wierup, Michael Z. Tong, Penny Houghtaling, *Eric E. Roselli, *A Marc Gillinov, *Eugene H. Blackstone, *Lars G. Svensson

Cleveland Clinic, Cleveland, OH

Invited Discussant:

76. Prevalence and Burden of Opioid-Induced Respiratory Depression and Postoperative Nausea/Vomiting Associated with Acute Postoperative Pain Treatment After Cardiothoracic/Vascular Surgery

Gary M. Oderda¹, Anthony J. Senagore², Kellie Morland³, Sheikh Usman Iqbal⁴, Marla Kugel³, Sizhu Liu³, Nestor Villamizar⁵, Ashraf S. Habib⁶

¹University of Utah, Salt Lake City, UT; ²University of Texas, Galveston, TX; ³Xcenda LLC, Palm Harbor, FL; ⁴Trevena, Inc., Chesterbrook, PA; ⁵University of Miami, Miami, FL; ⁶Duke University, Durham, NC

⁶Duke University, Durham, NC

Invited Discussant: ♦Daniel T. Engelman

Late-Breaking Clinical Trial

LB4. Postoperative Atrial Fibrillation Is Reduced by Transcutaneous Electrical Stimulation of the Auricular Vagal Nerve

Martin Andreas, Philipp Arzl, Andreas Mitterbauer, Alfred Kocher, Guenther Laufer, Michael Wolzt

Medical University of Vienna, Vienna, Austria

Invited Discussant: Kaushik Mandal

Late-Breaking Clinical Trial

LB5. Fresh Frozen Plasma Is More Expensive and Carries Greater Risk Than Human Antithrombin Concentrate in Treating Heparin Resistance for Cardiac Surgery

Abigail Whateley Driscoll, Michelle Taylor

Apri Health, Rochester, MN

Invited Discussant: *Robert S. Kramer

5:30 pm Adjourn

5:35 pm – Executive Session, AATS Members Only
6:15 pm

Ballroom 20A, SDCC

MONDAY, APRIL 30

*AATS Member ♦AATS New Member + AmSECT Member



TUESDAY MORNING, MAY 1, 2018

7:00 am **Cardiac Surgery Forum** Room 28DE, SDCC
5 minute presentation, 5 minute discussion

Moderators: *Todd K. Rosengart and *Tomasz A. Timek

F1. Patient Specific iPSC Disease Model Identified Dysfunction of Vascular Smooth Muscle Cells As a Cause of Loeys-Dietz Syndrome

Kui Hu^{1,2}, Yun Wan², Jinmiao Chen¹, Jun Li¹, *Chunsheng Wang¹

¹Zhongshan Hospital of Fudan University, Shanghai, China; ²People's Hospital of Guizhou Province, Guiyang, China

Invited Discussant: *Y. Joseph Woo

F2. Fibrosis and Disruption of Trilayered Structure Are Evident in Mitral Valve Leaflets Explanted from Swine That Underwent Undersizing Mitral Annuloplasty for Repair of Ischemic Mitral Regurgitation

Alicja Sielicka, Muralidhar Padala

Emory University, Atlanta, GA

Invited Discussant: Spencer Melby

F3. Injectable Supraphysiologic PEG Hydrogels Reduce Infarct Strain and Improve Remote Myocardial Function Following Ischemic Injury

Ravi K. Ghanta¹, Yunge Zhao², Aarthi Pugazenthi¹, Lauren N. Russell², Kyle J. Lampe²

¹Baylor College of Medicine, Houston, TX; ²University of Virginia, Charlottesville, VA

Invited Discussant: *Takashi Nitta

F4. Left Ventricular Dysfunction After Two Hours of Polarizing or Depolarizing Cardioplegic Arrest in a Porcine Model of Cardiopulmonary Bypass

Terje Aass¹, Lodve Stangeland², Christian Arvei Moen¹, Atle Solholm¹, Geir Olav Dahle², David J. Chambers³, Malte Urban¹, Knut Nesheim¹, *Rune Haaverstad¹, Knut Matre², Ketil Grong²

¹Haukeland University Hospital, Bergen, Norway; ²University of Bergen, Bergen, Norway; ³St Thomas' Hospital, London, United Kingdom

Invited Discussant: *Jennifer S. Lawton

F5. Cardiac Bioengineering with Human Induced Pluripotent Stem Cells Using Genome Editing and a Visual Evaluation System

Junya Aoyama¹, Kohei Homma², Sumiko Usui¹, Yasuo Miyagi¹, Nari Tanabe³, Takahiro Natori³, Makoto Kaneda¹, *Takashi Nitta¹

¹Nippon Medical School, Tokyo, Japan; ²Keio University, Tokyo, Japan; ³Tokyo University of Science, Suwa, Nagano, Japan

Invited Discussant: *Robert E. Michler

F6. Effects of Central Pulmonary Artery Banding in Doxorubicin-Induced Toxic Left Ventricular Cardiomyopathy: An Experimental Ovine Model

Can Yerebakan¹, Johannes Boltze², Uygur Yörüker³, Hatem Elmontaser³, Heiner Latus³, Markus Khalil³, Stefan Ostermayer⁴, Gunter Kerst⁴, Blanka Steinbrenner³, Christa Tandl⁵, Matthias Schneider⁶, Dietmar Schranz³, Hakan Akinturk³

¹Children's National Heart Institute, Washington, DC; ²Fraunhofer Research Institution for Marine Biotechnology, Lubeck, Germany; ³Pediatric Heart Center Giessen, Giessen, Germany; ⁴University of Aachen, Aachen, Germany; ⁵J.W. Goethe University Frankfurt, Frankfurt, Germany; ⁶Veterinary Medicine Clinic for Small Animals, Giessen, Germany

Invited Discussant: Ram Kumar Subramanyan

F7. Aberrant Biomechanical Properties and Stress Mapping Dissection Probability Models in Ascending Aortas of Patients Sustaining Acute Type A Aortic Dissection During Surveillance

Leonid Emerel¹, James Thunes¹, Spandan Maiti¹, Trevor Kickliter¹, Marie Billaud², Julie A. Phillippi², David A. Vorp¹, *Thomas G. Gleason¹

¹University of Pittsburgh, Pittsburgh, PA; ²McGowan Institute for Regenerative Medicine, Pittsburgh, PA

Invited Discussant: *Scott A. LeMaire

F8. ASD Closure Device with Biodegradable Materials

Hirotsugu Kurobe¹, Tadahisa Sugiura², Hideki Miyachi², Mark W. Maxfield¹, Tetsuya Kitagawa¹, *Tohsihar Shinoka²

¹Tokushima University, Tokushima-Shi, Japan; ²Nationwide Children's Hospital, Columbus, OH

Invited Discussant: Richard W. Kim

8:30 am Adjourn

7:00 am General Thoracic Surgery Forum

Room 23BC, SDCC

5 minute presentation, 5 minute discussion

Moderators: *Prasad Adusumilli and *Sai Yendamuri

F9. RNA-Based Induction of p53 Activity in Malignant Pleural Mesothelioma

Anand Singh¹, Nisan Bhattacharyya¹, Abhishek Srivastava², R. Taylor Ripley¹, *David S. Schrupp¹, Chuong D. Hoang¹

¹National Institutes of Health, Bethesda, MD; ²University of Pittsburgh, Pittsburgh, PA

Invited Discussant: *Marc de Perrot

TUESDAY, MAY 1

*AATS Member ♦AATS New Member +AmSECT Member

F10. 'Minority MOMP' May Induce Esophageal Carcinogenesis After Exposure to Bile Acids

Yuan Xu, Deborah R. Surman, Kate Brown, Jonathan M. Hernandez, Choung D. Hoang, Jeremy L. Davis, *David S. Schrupp, R. Taylor Ripley
National Cancer Institute, NIH, Bethesda, MD

Invited Discussant: *Virginia R. Litle

F11. Oncogenic Features of KDM4A Histone Demethylase in Mesothelioma

Lapidot Moshe, *Raphael Bueno
Brigham and Women's Hospital, Boston, MA

Invited Discussant: *Isabelle Schmitt-Opitz

F12. The Protective Effect of Prone Positioning on Porcine Lungs During Ex Vivo Lung Perfusion

Hiromichi Niikawa, Toshihiro Okamoto, Kamal S. Ayyat, Yoshifumi Itoda, *Kenneth R. McCurry
Cleveland Clinic, Cleveland, OH

Invited Discussant: Dan Kriesel

F13. Novel 3D-Printed Circumferential Tracheal Graft Enhances Graft Integration and Minimizes Granulation Tissue

Sadiq Rehmani, Wissam Raad, Landon Guntman, Farhan Jivraj, *Raja Flores, Robert Lebovics, Faiz Bhora
Icahn School of Medicine at Mount Sinai, New York, NY

Invited Discussant: *Christine L. Lau

F14. Strategies for Removal and Replacement of Pulmonary Epithelium in Extracorporeal Lungs on Cross-Circulation Support

John D. O'Neill, Brandon A. Guenthart, Ahmed Hozain, Gordana Vunjak-Novakovic, *Matthew Bacchetta
Columbia University, New York, NY

Invited Discussant: *Marcelo Cypel

F15. Tumor Associated Macrophage Is Associated with Angiogenesis in Human Esophageal Squamous Cell Carcinoma

Haibo Ma¹, Jianjun Qin¹, Xintao Chen², Yin Li¹
¹Zhengzhou University, Zhengzhou, China; ²The People's Hospital of Jiaozuo City, Jiaozuo, China

Invited Discussant: *Sunil Singhal

F16. Immunogenomic Determinants of Response to PD-1 Blockade in Non-Small Cell Lung Cancer (NSCLC)

Cynthia Y. Truong¹, Hyun-Sung Lee¹, Hee-Jin Jang¹, Masatsugu Hamaji², David A. Wheeler¹, Shawn S. Groth¹, *David J. Sugarbaker¹, ♦Bryan M. Burt¹
¹Baylor College of Medicine, Houston, TX; ²Kyoto University Hospital, Kyoto, Japan

Invited Discussant: Matthew J. Bott

8:30 am Adjourn

TUESDAY MORNING, MAY 1, 2018

7:00 am

Adult Cardiac Emerging Technologies and Techniques/Case Video Forum

Room 28ABC, SDCC

5 minute presentation, 5 minute discussion

Moderators: Husam H. Balkhy and *Wilson Y. Szeto

T1. Minimalist Transcatheter Aortic Valve Replacement: Trends in 925 Patients with Severe Aortic Stenosis

*Vinod H. Thourani¹, John J. Kelly², Norihiko Kamioka², Jose N. Binongo², Tianyu Gao², Hope A. Caughron², Jessica Forcillo², Chandan Devireddy², Stamatios Lerakis², Kretan Mavromatis², Bradley G. Leshnower², *Robert A. Guyton², Patricia Keegan², Amy Simone², James P. Stewart², Vasilis Babaliaros²

¹Medstar Heart and Vascular Institute, Washington, DC; ²Emory University, Atlanta, GA

T2. Early and Midterm Results of Frozen Elephant Trunk Operation with Evita Open Stent-Graftin Patients with Marfan Syndrome: Results of a Multicentre Study

Kazimierz Jan Jan Widenka¹, *Heinz Jakob², *Davide Pacini³, Wolfgang Hemmer⁴, Martin Grabenwoeger⁵, Thanos Sioris⁶, Anton Moritz⁷, Konstantinos Tsagakis²

¹University of Rzeszów Poland, Rzeszów, Poland; ²University Hospital Essen, Essen, Germany; ³Sant'Orsola-Malpighi Hospital, Bologna, Italy; ⁴Sana Cardiac Surgery Stuttgart GmbH, Stuttgart, Germany; ⁵Hospital Hietzing, Vienna, Austria; ⁶Tampere University, Tampere, Finland; ⁷Johann Wolfgang Goethe University Hospital, Frankfurt am Main, Germany

T3. "Frozen Apex" Restoration of the Left Ventricle for Dilated Cardiomyopathy in Non-Transplant Candidates — Toward Less Invasive and More Effective Surgery

*Masashi Komeda, Hirotomo Uchiyama, Takashi Kusunose, Shoji Fujiwara, Toshimi Ujiie

Iseikai Hospital, Osaka, Japan

T4. Percutaneous Mitral Valve Repair As Salvage Therapy in Patients with Refractory Cardiogenic Shock

Vincent Chan, Marino Labinaz, Benjamin Hibbert, *Thierry Mesana

University of Ottawa Heart Institute, Ottawa, ON, Canada

Invited Speaker: Innovation in 2018

*James L. Cox, Northwestern University Memorial Hospital

T5. A Novel Beating-Heart Totally Endoscopic Tricuspid Valvuloplasty Technique with Patch Augmentation in Reoperative Cardiac Surgery

Huanlei Huang, Zerui Chen, Huiming Guo, Qingshi Zeng, Xiaohua Zhang, Cong Lu, Yingjie Ke, Ren Zhu

Guangdong General Hospital, Guangzhou, China

TUESDAY, MAY 1

*AATS Member ♦AATS New Member +AmSECT Member



T6. Impact of Hybrid Thoracoabdominal Aortic Repair on Visceral and Spinal Cord Perfusion: The New and Improved SPIDER-Graft

Sabine Wipper¹, Harleen K. Sandhu², Daniel Manzoni¹, Christoph Behem¹, Constantin Trepte¹, Charles C. Miller, III², *Anthony L. Estrera², *Hazim J. Safi², Tilo Kölbel¹, E. Sebastian Debus¹

¹University Heart Center Hamburg-Eppendorf, Hamburg, Germany; ²McGovern Medical School at UTHealth, Houston, TX

T7. Case Video: Suprasternal Transcatheter Aortic Valve Replacement: A Novel Simplified Approach

Kyle W. Eudailey¹, Susheel Kodali², *Isaac George²

¹Princeton Baptist Medical Center, Birmingham, AL; ²New York Presbyterian Hospital, Columbia University, New York, NY

8:30 am Adjourn

**7:00 am Congenital Emerging Technologies and Room 24ABC, SDCC
Techniques/Case Video Forum**

5 minute presentation, 5 minute discussion

Moderators: *Paul J. Chai and *Aditya K. Kaza

T8. Combined Ventricular Assist Device and Hybrid Stage 1 Procedure As Bridge to Transplantation in Hypoplastic Left Heart Syndrome with Severe Tricuspid Regurgitation or Right Ventricular Dysfunction

*Mark Bleiweis, Joseph Philip, Ahmed Mohsen, Alan Brock, Susan Cooke, James Curt Fudge, Himesh Vyas, Lisa Schnabel, Karl M. Reyes

University of Florida, Gainesville, FL

T9. A Novel, Patient-Specific, 3D Printed, Bioresorbable External Airway Splint for the Treatment of Life-Threatening Tracheobronchomalacia

Andrea S. Les¹, Colleen L. Flanagan¹, Ayishwariya Premanathan², Scott J. Hollister³, *Richard G. Ohye¹, Glenn E. Green¹

¹University of Michigan, Ann Arbor, MI; ²Materialise USA LLC, Plymouth, MI; ³Georgia Institute of Technology, Atlanta, GA

T10. Trans-Aortic and Pulmonic Modified Konno Procedure and Concomitant Myectomy for Hypertrophic Obstructive Cardiomyopathy

Yasuhiro Kotani, *Shunji Sano, Yosuke Kuroko, Naohiro Horio, Sachiko Kawada, Yasuyuki Kobayashi, Sadahiko Arai, Shingo Kasahara

Okayama University, Okayama, Japan

T11. Systemic Atrioventricular Valve Replacement with a Melody Valve in an Infant with a Single-Ventricle Physiology

Shuhua Luo, Jennifer Russell, *Glen Van Arsdell, Osmay Honjo

Hospital for Sick Children, Toronto, ON, Canada





T12. Internal Pulmonary Artery Banding: Better Flow Control and Less Complication

Eung Re Kim, Woong-Han Kim, Lim Jae Hong, Jooncheol Min, Jae Gun Kwak
Seoul National University Children's Hospital, Seoul, Republic of Korea

T13. Superior 5-Year Durability of Custom-Constructed Extracellular Matrix Right Ventricle-to-Pulmonary Artery Valved-Conduits in Children Under 2 Years of Age

Patrick I. McConnell¹, Zachary Daniels², Daniel Gomez¹

¹Nationwide Children's Hospital, Columbus, OH; ²Ohio University, Dublin, OH

T14. Robotic Totally Endoscopic Repair of Isolated Left Partial Anomalous Pulmonary Venous Drainage

Brian Mitzman, Mackenzie Mccrorey, Brooke Patel, *Amit Patel, *Gerhard Ziemer, Husam Balkhy

University of Chicago, Chicago, IL

T15. Comparison of Percutaneous and Surgical Pulmonary Valve Replacement in Large Right Ventricular Outflow Tracts

Xiangbin Pan, Wenbin Ouyang, Keming Yang, Shoujun Li

Fuwai Hospital, Beijing, China

8:30 am Adjourn

7:00 am General Thoracic Emerging Technologies and Techniques/Case Video Forum

Room 25ABC, SDCC

5 minute presentation, 5 minute discussion

Moderators: *Diego Gonzalez Rivas and ♦Daniel P. Raymond

T16. Autotransplantation for Locally Advanced Central Lung Cancer

Kirsten A. Freeman, *Mauricio Pipkin, *Tiago Machuca

University of Florida, Gainesville, FL

T17. Resection of Mediastinal Paraganglioma Utilizing Cardiopulmonary Bypass

Tamer Attia, Michael Tong, ♦Daniel Raymond

Cleveland Clinic, Cleveland, OH

T18. In Vitro Resistance and Gas Transfer Properties of the Pulmonary Assist Device, an Ambulatory ECMO Oxygenator Designed for Destination Therapy

Caitlin T. Demarest¹, David J. Skoog², *Matthew D. Bacchetta¹, Keith E. Cook²

¹Columbia University, New York, NY; ²Carnegie Mellon University, Pittsburgh, PA

TUESDAY, MAY 1

*AATS Member ♦AATS New Member +AmSECT Member



T19. Robotic-Assisted Left Upper Lobe Sleeve Lobectomy

Peter J. Kneuert¹, *Jeffrey L. Port², *Brendon M. Stiles², Andrew B. Nguyen²,
Sebron W. Harrison², *Nasser K. Altorki², Benjamin E. Lee²

¹Ohio State University, Columbus, OH; ²New York Presbyterian Hospital, Weill Cornell
Medicine, New York, NY

T20. Per-Oral Endoscopic Myotomy for the Treatment of Epiphrenic Esophageal Diverticulum

Igor Brichkov, Ory Wiesel

Maimonides Medical Center, Brooklyn, NY

Late-Breaking Clinical Trial

T21. Lung Transplantation Using NAT (Nucleic Acid Testing) Positive Hepatitis C (HCV) Donors to HCV Negative Recipients

*Marcelo Cypel, Jordan Feld, Lianne G. Singer, Deepali Kumar, Rafaela Vanin Pinto Ribeiro,
Marcos Galasso, Jonathan C. Yeung, Laura Donahoe, Andrew Pierre, Nikki Marks,
*Kazuhiro Yasufuku, *Marc de Perrot, *Thomas K. Waddell, *Shaf Keshavjee, Atul Humar
Toronto General Hospital, Toronto, ON, Canada

T22. Left Upper Lobe Auto-Transplantation As a Salvage Surgery After Definitive Chemoradiotherapy for Lung Cancer

*Hiroshi Date, Masatsugu Hamaji, Akihiro Aoyama
Kyoto University, Kyoto, Japan

T23. Gastric Perfusion Assessment During Esophagectomy Can Identify Patients at Low Risk for Anastomotic Leak

♦Rishindra M. Reddy, Aladdein Mattar, Lili Zhao, *Andrew C. Chang, *Mark B. Orringer,
*Jules Lin, Kiran Lagisetty, William Lynch, Philip Carrott
University of Michigan, Ann Arbor, MI

T24. Sternal Reconstruction for Dehiscence After Cardiac Surgery: A Single Centre Experience Using a Titanium Bar Osteosynthesis System, In Situ Bone Grafting and Omentoplasty

Ian Cummings¹, Metesh Acharya², Hesham Ahmed³, Periklis Perikleous⁴, Nizar Asadi⁴,
Henrietta Wilson⁵, Vladimir Anikin⁴

¹The Royal Brompton Hospital, London, United Kingdom; ²St. George's University
Hospital, London, United Kingdom; ³Menoufia University Hospital, Menoufia, Egypt;
⁴Harefield Hospital, London, United Kingdom; ⁵St Bart's Hospital, London, United
Kingdom

8:30 am Adjourn

TUESDAY MORNING, MAY 1, 2018

8:40 am

Plenary Scientific Session

Ballroom 20A, SDCC

6 minute presentation, 11 minute discussion

Moderators: *Duke E. Cameron and *Marc R. Moon

77. Mortality and Morbidity of Lobar Versus Sub-Lobar Resection in CALGB 140503 (ALLIANCE)

*Nasser K. Altorki¹, *Dennis Wigle², Xiaofei Wang³, Lin Gu³, Jean Deslauriers⁴, Ahmed Ashrafi⁵, Rodney Landrenau¹, *Daniel Miller⁶, *Daniel Miller⁶, *Moishe Liberman⁷, *David Jones⁸, *Robert Keenan⁹, Massimo Conti⁴, Gavin Wright¹⁰, Linda Veit¹¹, Thomas Stinchcombe³, Everett Vokes¹², *Leslie Kohman¹¹

¹New York-Presbyterian Weill Cornell Medical Center, New York, NY; ²Mayo Clinic, Rochester, NY; ³Duke University, Durham, NC; ⁴Institut Universitaire de Cardiologie et de Pneumologie de Québec, Quebec, QC, Canada; ⁵University of British Columbia, Vancouver, BC, Canada; ⁶WellStar Health System, Marietta, GA; ⁷University of Montreal, Centre Hospitalier de l'Université de Montreal, Montreal, QC, Canada; ⁸Memorial Sloan Kettering Cancer Center, New York, NY; ⁹Moffitt Cancer Center, Tampa, FL; ¹⁰St Vincent's Hospital Melbourne, Melbourne, Australia; ¹¹State University of New York Upstate Medical University, Syracuse, NY; ¹²University of Chicago Comprehensive Cancer Center, Chicago, IL

Invited Discussant: *Scott J. Swanson

Late-Breaking Clinical Trial

LB6. Three-Year Outcomes of Aortic Valve Replacement with a Bioprosthetic Valve with a Novel Tissue

*Douglas R. Johnston¹, *John D. Puskas², *Joseph E. Bavaria³, *Eugene H. Blackstone¹, *Bartley Griffith⁴, James S. Gammie⁴, David A. Heimansohn⁵, Jerzy Sadowski⁶, Krzysztof Bartus⁶, Jacek Rozanski⁷, *Todd Rosengart⁸, *Leonard N. Girardi⁹, Charles T. Klodell¹⁰, Mubashir A. Mumtaz¹¹, *Hiroo Takayama⁹, *Michael Halkos¹², *Vaughn Starnes¹³, Percy Boateng¹⁴, *Tomasz A. Timek¹⁵, William Ryan¹⁶, Shuab Omer¹⁷, *Craig R. Smith⁹, *Lars G. Svensson¹

¹Cleveland Clinic, Cleveland, OH; ²Mount Sinai Saint Luke's, New York, NY; ³Hospital of the University of Pennsylvania, Philadelphia, PA; ⁴University of Maryland, Baltimore, MD; ⁵St. Vincent Heart Center, Indianapolis, IN; ⁶Jagiellonian University, John Paul II Hospital, Krakow, Poland; ⁷National Institute of Cardiology, Warsaw, Poland; ⁸Baylor College of Medicine, Houston, TX; ⁹Columbia University – New York Presbyterian Hospital, New York, NY; ¹⁰University of Florida, Gainesville, FL; ¹¹Pinnacle Health, Harrisburg, PA; ¹²Emory University, Atlanta, GA; ¹³University of Southern California, Los Angeles, CA; ¹⁴Mount Sinai Medical Center, Philadelphia, PA; ¹⁵Spectrum Health Medical Group, Grand Rapids, MI; ¹⁶Heart Hospital Baylor, Plano, TX; ¹⁷Michael E DeBakey VA Medical Center, Houston, TX

Invited Discussant: *Tirone E. David

TUESDAY, MAY 1

*AATS Member ♦AATS New Member +AmSECT Member

78. POEM (Per Oral Endoscopic Myotomy): Another Tool in the Tool Box

♦Siva Raja, Hafiz Umair Siddiqui, *Sudish Murthy, Usman Ahmad, Andrew Tang, Hari Keshava, Scott Gabbard, Prashanthi Thota, Monica Ray, Neha Wadwa, Madhu Sanaka

Cleveland Clinic, Cleveland, OH

Invited Discussant: *Steven R. DeMeester

79. Anomalous Aortic Origin of a Coronary Artery (AAOCA): Are We Closer to Risk Stratification?

Anusha Jegatheeswaran¹, Paul J. Devlin¹, Brian W. McCrindle¹, *William G. Williams¹, *Christopher A. Caldarone¹, *William M. DeCamp², *J. William Gaynor³, *Marshall L. Jacobs⁴, *James K. Kirklin⁵, Richard O. Lorber⁶, Carlos M. Mery⁷, Silvana Molossi⁷, James D. St. Louis⁸, Julie A. Brothers³

¹Hospital for Sick Children, Toronto, ON, Canada; ²Arnold Palmer Hospital for Children, Orlando, FL; ³Children's Hospital of Philadelphia, Philadelphia, PA; ⁴Johns Hopkins University, Baltimore, MD; ⁵University of Alabama, Birmingham, AL; ⁶Cleveland Clinic Foundation, Cleveland, OH; ⁷Texas Children's Hospital, Toronto, ON; ⁸Children's Mercy Hospital and Clinics, Kansas City, MO

Invited Discussant: *Charles D. Fraser

9:55 am **Awards**

10:00 am – **Coffee Break in the Exhibit Hall**

10:40 am

10:10 am – 10:40 am

ICU Staffing Models: Are Open or Closed Units the Future?

AATS CT Theater I
Booth #134, Exhibit Hall
Not for Credit

Moderator: *Glenn J. Whitman, *Johns Hopkins Hospital*

Panelists: *Rakesh C. Arora, *St. Boniface General Hospital*
Nicholas C. Cavarocchi, *Jefferson University*
*Robert S. Kramer, *Maine Medical Center*

10:40 am **Plenary Scientific Session**

Ballroom 20A, SDCC

6 minute presentation, 11 minute discussion

Moderators: *Duke E. Cameron and *Marc R. Moon

**AATS C. Walton Lillehei Resident Forum Award
Lillehei Winner Presentation**

Introduced by: *Christian Pizarro,
Research Scholarship Committee Co-Chair



80. Spinal Cord Deficit After 1109 Extent II Open Thoracoabdominal Aortic Aneurysm Repairs

*Joseph S. Coselli, Matt D. Price, Qianzi Zhang, *Ourania Preventza, Kim I. de la Cruz, Hiruni S. Amarasekara, Susan Y. Green, *Scott A. LeMaire
Baylor College of Medicine, Houston, TX

Invited Discussant: *Lars G. Svensson

81. Do the Surgical Results in the National Lung Screening Trial Reflect Modern Thoracic Surgical Practice?

Mohamed K. Kamel, Mohamed Rahouma, Benjamin Lee, Sebron Harrison, Andrew Nguyen, *Jeffrey Port, *Nasser K. Altorki, *Brendon M. Stiles
Weill Cornell Medical Center, New York, NY

Invited Discussant: *Gail E. Darling

82. Disparity Between Recent Graduates and Experienced Surgeons' Assessment of Time to Operative Independence

Dawn S. Hui¹, *Richard Lee¹, *Marc R. Moon², Melanie A. Edwards¹, Mina L. Boutros¹, Jessica G.Y. Luc³, *Richard L. Prager⁴, *Keith S. Naunheim¹

¹*Saint Louis University, Saint Louis, MO*; ²*Washington University, Saint Louis, MO*;

³*University of Alberta, Edmonton, AB*; ⁴*University of Michigan, Ann Arbor, MI*

Invited Discussant: *Ralph J. Damiano, Jr.

11:45 am

Invited Guest Speaker: *The Thinking Eye*

Edward R. Tufte, *Yale University*

12:30 pm

Adjourn for Lunch in the Exhibit Hall

12:40 pm –

Preparing Yourself for an

Room 29BCD, SDCC

1:50 pm

Academic Career Luncheon

Available to residents, fellows, and medical students.

Separate Registration Required

12:40 pm – 1:10 pm

AATS/AmSECT Symposium: Acute Kidney Injury After Cardiac Surgery: Impact on Long-Term Outcomes and Cost

AATS CT Theater II
Booth #1235, Exhibit Hall
Not for Credit

Moderators: *George Justison, *University of Colorado*

*Hersh Maniar, *Washington University*

TUESDAY, MAY 1



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TUESDAY AFTERNOON, MAY 1, 2018

12:40 pm Moderated Poster Competitions

Adult Cardiac Moderated Poster Competition

Aisle 1200, Exhibit Hall, SDCC

3 minute presentation, 2 minute discussion

Not for Credit

Moderators: *W. Randolph Chitwood, Jr. and *T. Sloane Guy

P1. Septal Myectomy with Versus without Mitral Subvalvular Apparatus Intervention in patients with Hypertrophic Obstructive Cardiomyopathy: Prospective Randomised Study

Alexander Afanasyev¹, Alexander Bogachev-Prokophiev¹, Alexey Pivkin¹, Michail Ovcharov¹, Ravi Sharifulin¹, Sergey Zheleznev¹, Dmitry Kozmin², Alexander Karaskov¹

¹Meshalkin National Medical Research Center, Novosibirsk, Russian Federation;

²Federal Center for Cardiovascular Surgery, Astrakhan, Russian Federation

P3. Ten Years UK Experience in Survival for Surgical TAVI Approaches

Francesca D'Auria, Aung Myat, Uday Trivedi, David Hildick-Smith

Brighton and Sussex University Hospital, Royal Sussex County Hospital, Brighton, United Kingdom

P4. Subannular Repair in Mitral Valve Surgery for Type IIIb Functional Mitral Regurgitation

Eva Karolina Harmel, Jonas Pausch, Christoph Sinning, Jens Kubitz,

*Hermann Reichenspurner, Evaldas Girdauskas

University Heart Center, Hamburg, Germany

P5. Cost-Effectiveness of Coronary-Artery Bypass Grafting (CABG) Alone Versus CABG Plus Mitral-Valve Repair for Moderate Ischemic Mitral Regurgitation: Results from a Randomized Clinical Trial

Bart Ferket¹, *Vinod H. Thourani², *Pierre Voisine³, Samuel F. Hohmann⁴, Helena L. Chang¹, *Peter K. Smith⁵, *Robert E. Michler⁶, *Gorav Ailawadi⁷, *Louis P. Perrault⁸, Marissa A. Miller⁹, Karen O'Sullivan¹, Stephanie L. Mick¹⁰, Emilia Bagiella¹, *Michael A. Acker¹¹, Ellen Moquete¹, Judy W. Hung¹², Jessica R. Overbey¹, Kinjal Shah¹, Margaret Iraola¹³, *James Gammie¹⁴, Annetine C. Gelijns¹, Patrick T. O'Gara¹⁵, Alan J. Moskowitz¹

¹Icahn School of Medicine at Mount Sinai, New York, NY; ²Medstar Heart and Vascular Institute, Washington, DC; ³Institut Universitaire de Cardiologie et de Pneumologie de Québec, Québec, QC, Canada ⁴Vizient, Chicago, IL; ⁵Duke University, Durham, NC;

⁶Montefiore Medical Center, Bronx, NY; ⁷University of Virginia, Charlottesville, VA

⁸Montreal Heart Institute, Montreal, QC, Canada ⁹National Heart, Lung, and Blood Institute, Bethesda, MD; ¹⁰Cleveland Clinic, Cleveland, OH; ¹¹University of Pennsylvania, Philadelphia, PA; ¹²Massachusetts General Hospital, Boston, MA; ¹³Suburban Hospital, Bethesda, MD; ¹⁴University of Maryland, Baltimore, MD; ¹⁵Brigham and Women's Hospital, Boston, MA



P6. Importance of Age in Selection of a Prosthesis for Patients with Aortic Valve Regurgitation: A Propensity Score Matched Analysis of 427 Patients

Ishan K. Shah, *Hartzell V. Schaff, *Richard C. Daly, *Kevin L. Greason, *John M. Stulak, *Alberto Pochettino, Rick A. Nishimura, Brian D. Lahr, *Joseph A. Dearani
Mayo Clinic, Rochester, MN

P7. Long Term Results After Porcine Xenograft for Aortic-, Mitral- and Doublevalve Replacement

Sven Lehmann, Khalil Jawad, Maja Dieterlen, Stefan Feder, Jens Garbade, *Michael Borger
Heart Center Leipzig, Leipzig, Germany

P8. Late left Ventricle Remodeling After Repair of degenerative Mitral Regurgitation: Is It Worse in Women? Insights from >1000 Surgical Repair Patients

Vincent Chan, *Marc Ruel, *Thierry Mesana
University of Ottawa Heart Institute, Ottawa, ON, Canada

P9. Mitral Valve Reoperation for Bioprosthetic Structural Valve Deterioration the Surgical Benchmark

Hoda Javadikasgari, *Eric E. Roselli, Bassman Tappuni, Suyog A. Mokashi, Stephanie Mick, *Jose L. Navia, Ashley M. Lowry, Per Wierup, Milind Y. Desai, *Eugene H. Blackstone, *Lars G. Svensson, *A. Marc Gillinov
Cleveland Clinic, Cleveland, OH

P10. Influence of Surgical Volume on Outcomes in Low Risk Patients Having Isolated Surgical Aortic Valve Replacement

*Todd Dewey, Morley Herbert, Syma Prince, Bruce Bowers
Medical City Dallas Hospital, Dallas, TX

P11. Surgical AVR for Bicuspid Aortic Valve Disease: Is It the Last Stronghold for the Surgeon?

Joshua Chung, *Alfredo Trento, Wen Cheng, Danny Ramzy, Fardad Esmailian, Michele A. DeRobertis, James Mirocha, Lawrence S.C. Czer
Cedar Sinai Medical Center, Los Angeles, CA

P12. Long Term Survival After Concomitant Surgical Ablation for Atrial Fibrillation in Patients Undergoing Mitral Valve Procedures — Analysis from Polish Nationwide Cardiac Surgery Registry (KROK)

Piotr Suwalski¹, Jakub Staromlynski¹, Marek Jasinski², *Marian Zembala³, Kazimierz Widenka⁴, Mirosław Brykczynski⁵, Jacek Skiba⁶, Michał Oskar Zembala³, Krzysztof Bartus⁷, Tomasz Hirnle⁸, Janusz Sierdziński², Zdzisław Tobota⁹, *Bohdan Maruszewski⁹

¹Central Clinical Hospital of the Ministry of the Interior and Administration, Warsaw, Poland; ²Medical University of Warsaw, Warsaw, Poland; ³Silesian Center for Heart Diseases, Zabrze, Poland; ⁴Szpital Wojewódzki N2, Rzeszów, Poland; ⁵Pomeranian Medical University, Szczecin, Poland; ⁶4th Military Clinical Hospital, Wrocław, Poland; ⁷Jagiellonian University, John Paul II Hospital, Kraków, Poland; ⁸Medical University of Białystok, Białystok, Poland; ⁹The Children's Memorial Health Institute, Warsaw, Poland

TUESDAY, MAY 1

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P13. Impact of “High-Risk” Donor Heart on the Outcome of Orthotopic Heart Transplant: A Propensity Matched Score Analysis of the United Network for Organ Sharing Database

Yasuhiro Shudo, Jeffrey E. Cohen, Vijaya Bharathi Lingala, *Y. Joseph Woo
Stanford University, Stanford, CA

P14. Repair-Oriented Classification of Bicuspid Aortic Valve Anatomy: A Clinical Study in Aortic Valve Repair Surgery

*Laurent de Kerchove¹, Stefano Mastrobuoni¹, Lennart Froede², *Munir Boodhwani³,
*Gebrine el Khoury¹, Hans-Joachim Schäfers²

¹*Cliniques Universitaires Saint-Luc, Brussels, Belgium*; ²*Universitätsklinikum des Saarlandes, Homburg, Germany*; ³*University of Ottawa Heart Institute, Ottawa, ON, Canada*

Late-Breaking Clinical Trial

LB7. Dissected Aorta Repair Through Stent Implantation (DARTS): First-in-Man Results of a Feasibility, Safety and Performance Trial

Sabin Joseph Bozso¹, Jeevan Nagendran¹, Roderick G.G. MacArthur¹, Michael W.A. Chu², Bob Kiaii², Ismail El-Hamamsy³, Raymond Cartier³, Ali Shariari⁴, Michael C. Moon¹

¹*University of Alberta, Edmonton, AB, Canada*; ²*Western University, London, ON, Canada*; ³*Montreal Heart Institute, Montreal, QC, Canada*; ⁴*Ascyrus Medical, Boca Raton, FL*

Late-Breaking Clinical Trial

LB8. Long-Term Outcomes of Aortic Root Operations in the United States Among Medicare Beneficiaries: An Analysis of the Society of Thoracic Surgeons Adult Cardiac Surgery Database

Babatunde A. Yerokun¹, Prashanth Vallabhajosyula², Maria V. Grau-Sepulveda³, Ehsan Benrashid¹, Ying Xian³, David N. Ranney¹, Muath Bishawi¹, *Jeffrey P. Jacobs⁴, *Vinay Badhwar⁵, *Vinod Thourani⁶, Joseph E. Bavaria², G. Chad Hughes¹

¹*Duke University, Durham, NC*; ²*University of Pennsylvania, Philadelphia, PA*; ³*Duke Clinical Research Institute, Durham, NC*; ⁴*Johns Hopkins All Children’s Heart Institute, Saint Petersburg, FL*; ⁵*West Virginia University Heart & Vascular Institute, Morgantown, WV*; ⁶*Medstar Heart Institute/Washington Hospital Center, Washington, DC*

Congenital Heart Disease

Aisle 1200, Exhibit Hall, SDCC

Moderated Poster Competition

Not for Credit

3 minute presentation, 2 minute discussion

Moderators: *Sitaram M. Emani and *James J. Gangemi

P15. Can We Still Improve Survival Outcomes of Neonatal Biventricular Repairs?

Osami Honjo, Christoph Haller, Shuhua Luo, Kasey Moss, Steve Fan, Cedric Manlihot, Wenli Xie, Alli Moinshaghagh, Steven Schwartz, *Christopher Caldarone,
*Glen Van Aresdell

The Hospital for Sick Children, Toronto, ON, Canada



P16. Aortic Valve Function After Repair of Ventricular Septal Defect and Aortic Regurgitation

Can Yerebakan¹, David Zurakowski², Lucas Mota¹, Mahmut Ozturk¹, Lok Sinha¹, Karthik Ramakrishnan¹, Lowell Frank¹, *Richard A. Jonas¹, Pranava Sinha¹

¹Children's National Heart Institute, Washington, DC; ²Boston Children's Hospital, Boston, MA

P17. Do Patients with an Anomalous Origin of the Left Coronary Artery (ALCAPA) Benefit from an Early Mitral Valve Repair? A Retrospective Observational Study

Viktoria H. Weixler, David Zurakowski, Christopher W. Baird, Breanna L. Piekarski, *Pedro J. del Nido, *Sitaram M. Emani

Boston Children's Hospital, Boston, MA

P18. An International Survey Comparing Different Physician Models for Health Care Delivery in Pediatric Cardiac Intensive Care

Priya Bhaskar, Mallikarjuna Rettiganti, Punkaj Gupta

Arkansas Children's Hospital, Little Rock, AR

P19. Revival and Modification of the Mustard Operation for Neglected Patients with TGA in the Developing World

Hatem Hosny¹, Yasser Sedky², Walid Simry¹, Ahmed Afifi¹, Heba Aguib¹, *Magdi Yacoub¹

¹Aswan Heart Centre, Aswan, Egypt; ²Cairo University, Cairo, Egypt

P20. Single-Centre 20-Year Experience of Truncus Arteriosus Repair

Yaroslav Ivanov, Yaroslav Mykychak, Oleg Fedevych, Oleksandra Motrechko, Andrii Kurkevych, Illya Yemets

Ukrainian Children's Cardiac Center, Kyiv, Ukraine

P21. Ideal Pulmonary Valve Annulus Dimension After Annulus Preservation in Tofis Far Smaller than Normal Annulus Size for Each Patient

Donghee Kim, Eun Seok Choi, Chun Soo Park, *Tae-Jin Yun

Asan Medical Center, Seoul, Republic of Korea

P22. Thirty Year Serial Follow-Up of Two Surgical Strategies During Repair of Tetralogy of Fallot

Bartholomew V. Simon¹, Subhashini Subramanian², Michael F. Swartz¹, Nader Atallah-Yunes³, *George M. Alfieris¹

¹University of Rochester, Rochester, NY; ²Hackensack University, Hackensack, NJ;

³Upstate Medical University, Syracuse, NY

P23. Impact of Left Atrioventricular Valve Size After Biventricular Repair for Complete Atrioventricular Septal Defect

Motonori Ishidou, Kenta Imai, Kazuyoshi Kanno, Masaya Murata, Keiichi Hirose, Akio Ikai, Kisaburo Sakamoto

Mt. Fuji Shizuoka Children's Hospital, Shizuoka, Japan

P24. Therapeutic Heparinization Increases Risk of Bleeding in Pediatric Patients Following Cardiac Surgery

Carina N. Vorisek, Jenna C. Rogers, Breanna L. Piekarski, Olubunmi Oladunjoye, *Sitaram M. Emani

Boston Children's Hospital, Boston, MA

TUESDAY, MAY 1

*AATS Member ♦AATS New Member †AmSECT Member



P25. Functional Tricuspid Valve Regurgitation in Adult with Congenital Heart Disease: Which Is the Best Surgical Option for Repair?

Mauro Lo Rito, Maria Grandinetti, Giulia Muzio, Alessandro Varrica, *Alessandro Frigiola, Angelo Micheletti, Massimo Chessa, *Alessandro Giamberti
IRCCS Policlinico San Donato, San Donato Milanese, Italy

Late-Breaking Clinical Trial

LB9. Outcome Related to Immediate Extubation After Stage 1 Norwood Palliation for Hypoplastic Left Heart Syndrome

Joby Varghese, James M. Hammel, Ali Ibrahimiyeh, Rebecca Siecke, Shelby Kutty
Children's Hospital and Medical Center, Omaha, NE

General Thoracic

Aisle 1200, Exhibit Hall, SDCC

Moderated Poster Competition

Not for Credit

3 minute presentation, 2 minute discussion

Moderators: *Frank A. Baciewicz and *Bernard J. Park

P26. Outcomes and Risk Factors for Morbidity and 30 Day Mortality for Decortication for Empyema and Complex Pleural Effusion

Shamus R. Carr¹, Christopher W. Towe², James M. Donahue³, Sunghee Kim⁴, Whitney M. Burrows¹, Yaron Perry², Luis Argote-Green², *Philip A. Linden²

¹University of Maryland, Baltimore, MD; ²University Hospitals Cleveland Medical Center and Case Western Reserve, Cleveland, OH; ³University of Alabama, Birmingham, AL;

⁴Duke Clinical Research Institute, Durham, NC

P27. Chest CT Imaging Improves Potential Lung Donor Assessment

Jason Michael Gauthier¹, Andrew Bierhals¹, Keki R. Balsara¹, Ramsey R. Hachem¹, Chad A. Witt¹, Elbert P. Trulock¹, Derek E. Byers¹, Roger D. Yusem¹, Patrick R. Aguilar¹, Gary Marklin², *Bryan F. Meyers¹, *G. Alexander Patterson¹, *Benjamin D. Kozower¹, *Daniel Kreisel¹, *Varun Puri¹

¹Washington University, Saint Louis, MO; ²Mid-America Transplant, Saint Louis, MO

P28. Occult Nodal Metastasis and Nodal Upstaging in Patients Undergoing Anatomic Resection for Small (≤ 2 cm) Clinical Node Negative Non-Small Cell Lung Cancer: A Prospective Cohort Study

Eric Michael Robinson, Ilkka K. Ilonen, Andrew J. Plodkowski, *Manjit S. Bains, *Bernard J. Park, Matthew Bott, *Robert J. Downey, James M. Isbell, *Prasad S. Adusumilli, *Valerie W. Rusch, *David R. Jones, *James Huang
Memorial Sloan Kettering Cancer Center, New York, NY

P29. Clinical Validation of a Competency Assessment Scale for Anatomic Lung Resection

Simon R. Turner¹, Hollis Lai¹, Basil S. Nasir², Kazuhiro Yasufuku³, Colin Schieman⁴, *James Huang⁵, Eric L.R. Bédard¹

¹University of Alberta, Edmonton, AB, Canada; ²Université de Montréal, Montreal, QC, Canada; ³Toronto General Hospital, Toronto, ON, Canada; ⁴University of Calgary, Calgary, AB, Canada; ⁵Memorial Sloan Kettering Cancer Center, New York, NY



P30. Opioid Over-Prescription After Open and Laparoscopic Hiatal Hernia Repair

Alyssa A. Mazurek¹, Alexander Brescia², Ryan Howard², Alexander Schwartz², Kenneth Sloss², *Andrew Chang², Philip Carrott², *Jules Lin², William Lynch², *Mark Orringer², ♦Rishindra Reddy², Pooja Lagisetty², Jennifer Waljee², Michael Englesbe², Chad Brummett², Kiran Lagisetty²

¹University of Michigan, Ann Arbor, MI; ²Michigan Medicine, Ann Arbor, MI

P31. Prevalence and Risk Factors of Reflux After Esophagectomy for Esophageal Cancer

Samina Park, Yongwoo Chung, Kwanyong Hyun, Hyun Joo Lee, In Kyu Park, *Young Tae Kim, Chang Hyun Kang

Seoul National University Hospital, Seoul, Republic of Korea

P32. Relative Incremental Cost of Complications of Esophagectomy

Abraham Geller, Ashok Muniappan, *Henning Gaissert, *Douglas Mathisen, Christopher Morse, *Cameron Wright, *Michael Lanuti

Massachusetts General Hospital, Boston, MA

P33. The Cost Burden of Esophageal Anastomotic Leak — A Steep Price to Pay

John Agzarian, Sue L. Visscher, Ariel W. Knight, *Mark S. Allen, *Stephen D. Cassivi, *Francis C. Nichols, *K. Robert Shen, *Dennis A. Wigle, *Shanda H. Blackmon

Mayo Clinic, Rochester, MN

P34. Personalized Prediction of Improved Survival with Surgery for Advanced Stage Non-Small Cell Lung Cancer Using a Surgical Selection Score

Elizabeth A. David, Stina Andersen, Laurel A. Beckett, Joy Melnikow, James M. Clark, Lisa M. Brown, *David T. Cooke, Karen Kelly, Robert J. Canter

University of California Davis, Sacramento, CA

P35. CPET and the Prediction of Major Adverse Events in High-Risk Patients Undergoing Lung Resection

Elaine Shien Teh¹, Melanie McCabe², Shubhra Sinha¹, Natasha Joshi¹, Kajan Kamalanathan¹, Mat Molyneux¹, Neil Rasburn¹, Timothy Batchelor¹, Gianluca Casali¹, Eveline Internullo¹, Rakesh Krishnadas¹, Douglas West¹

¹University Hospitals Bristol NHS Foundation Trust, Bristol, United Kingdom; ²University of Cambridge, Cambridge, United Kingdom

P36. Influence of Geographic and Socioeconomic Factors on the Survival and the Utilization of Trimodality Therapy in Elderly Patients with Locally Advanced Esophageal Cancer: An Analysis of the National Cancer Database

Aitua Salami¹, *Abbas E. Abbas², Roman Petrov², Charles T. Bakhos¹

¹Einstein Healthcare Network, Philadelphia, PA; ²Temple University, Philadelphia, PA

P37. Challenging 30-Day Mortality As a Site-Specific Quality Metric in Non-Small Cell Lung Cancer

Carrie B. Moore, Morgan L. Cox, Michael S. Mulvihill, Jacob Klapper, *Thomas A. D'Amico, ♦Matthew G. Hartwig

Duke University, Durham, NC

TUESDAY, MAY 1



*AATS Member ♦AATS New Member +AmSECT Member



12:45 pm **Update of Surgical Ablation and Coronary Bypass Grafting** CT Theater I
Booth #134, Exhibit Hall
5 minute presentation, 7 minute discussion *Not for Credit*

Moderators: *Niv Ad and *Douglas R. Johnston

LB10. Stroke and Mortality After Ablation of Atrial Fibrillation During Coronary Artery Bypass Grafting

*S. Chris Malaisrie¹, *Patrick M. McCarthy¹, Jane Kruse¹, Roland A. Matsouaka², Andrei Churyla¹, Maria V. Grau-Sepulveda¹, Daniel J. Friedman¹, *James L. Cox¹, J. Matthew Brennan¹

¹Northwestern University, Chicago, IL; ²Duke University, Durham, NC

LB11. Two-Year Impact of Surgical Ablation for Atrial Fibrillation During Coronary Artery Bypass Grafting

*J. Scott Rankin¹, Daniel J. Lerner², Mary Jo Braid-Forbes³, Michelle M. McRea³, *Vinay Badhwar¹

¹West Virginia University, Morgantown, WV; ²Health Sciences West, Scarsdale, NY;

³Braid-Forbes Health Research, Silver Spring, MD

LB12. The HISTORIC AF Trial: Mid-Term Results of Hybrid Thoracoscopic Ablation

*Claudio Muneretto¹, Gianluca Polvani², Lorenzo Di Bacco¹, Ralf Krakor³, Jonida Bejko¹, Gianluigi Bisleri⁴, Antonio Curnis¹, Claudio Tondo²

¹University of Brescia, Brescia, Italy; ²University of Milan, Centro Cardiologico Monzino, Milano, Italy; ³Staedtisches Klinikum, Dortmund, Germany; ⁴Queen's University, Kingston, ON, Canada

LB13. REQUEST REGISTRY: An Interim Analyses

*David P. Taggart¹, Gabriele Di Giammarco², *John D. Puskas³, Georg Wendt⁴, Gregory D. Trachiotis⁵, Teresa M. Kieser⁶, Stuart J. Head⁷, *A. Pieter Kappetein⁷

¹Oxford University, Oxford, United Kingdom; ²University G D'Annunzio-Chieti, Chieti Scalo, Italy; ³Mount Sinai St. Luke's, New York, NY; ⁴INCCI, Luxemburg, Germany; ⁵Veterans Affairs Medical Center, Arlington, VA; ⁶University of Calgary, Calgary, Canada; ⁷Erasmus MC, Rotterdam, Netherlands

LB14. Is Gender an Independent Predictor for Survival in Patients with BITA Grafts?

*Daniel O. Navia, Mariano Vrancic, Fernando Piccinini, Mariano Camporrotondo, Juan Espinosa, Alberto Dorsa, Adriana Rossi, Mariano Benzadon, Instituto Cardiovascular de Buenos Aires, Buenos Aires, Argentina

TUESDAY AFTERNOON, MAY 1, 2018

2:00 pm

Aortic/Endovascular Sugery Simultaneous Scientific Session

Room 28ABC, SDCC

6 minute presentation, 8 minute discussion

Moderators: *Himanshu J. Patel and *Eric E. Roselli

83. The Differential Impact of Intimal Tear Location on Aortic Dilation and Re-Intervention in Acute Type I Aortic Dissection After Total Arch Replacement

Woon Heo¹, Suk-Won Song¹, Kwang-Hun Lee¹, Tae-Hoon Kim¹, Min-Young Baek¹, Kyung-Jong Yoo¹, *Bum-Koo Cho², Hye Sun Lee¹

¹Yonsei University, Seoul, Republic of Korea; ²The Korea Heart Foundation, Seoul, Republic of Korea

Invited Discussant: *Anthony L. Estrera

84. Fate of Distal Aorta After Frozen Elephant Trunk for Type A Aortic Dissection in Marfan Syndrome

Yu Chen¹, Wei-Guo Ma¹, Xu-Dong Pan¹, Ai-Hua Zhi², Wei Zhang¹, Mohammad Zafar³, Jun Zheng¹, Yong-Min Liu¹, Jun-Ming Zhu¹, *John A. Elefteriades³, *Li-Zhong Sun¹

¹Capital Medical University, Beijing, China; ²Chinese Academy of Medical Sciences, Beijing, China; ³Yale New Haven Hospital, New Haven, CT

Invited Discussant: *Steven L. Lansman

85. TEVAR Has Improved Outcomes Compared to Open Surgical Repair for Descending Thoracic Aneurysms: A Propensity Analysis Among Medicare Patients in the Recent Era

Chase Robert Brown, Zehang Chen, Peter W. Groeneveld, Fabliha Khurshan, Fenton McCarthy, *Joseph Bavaria, *Nimesh Desai

University of Pennsylvania, Philadelphia, PA

Invited Discussant: *Ourania Preventza

86. Short- and Long-Term Outcomes of Aortic Root Repair Versus Replacement in Patients Undergoing Acute Type A Aortic Dissection Repair-20-Year Experience

Reilly Hobbs, Elizabeth L. Norton, *Himanshu J. Patel, *G. Michael Deeb, Karen M. Kim, Xiaoting Wu, Whitney E. Hornsby, Donald S. Likosky, Bo Yang

University of Michigan, Ann Arbor, MI

Invited Discussant: *Eric E. Roselli

87. Outcomes of Two Different Geometric Orientations for Aortic Neoroot Creation in Repair of Sievers Type I Bicuspid Aortic Valve with Root Reimplantation

Mary A. Siki, Andreas Haberteuer, *Joseph E. Bavaria, Caroline Komlo, Maxwell Hunt, Melanie Freas, Rita Karianna Milewski, *Nimesh D. Desai, *Wilson Y. Szeto,

♦Prashanth Vallabhajosyula

University of Pennsylvania, Philadelphia, PA

Invited Discussant: ♦Michael P. Fischbein

TUESDAY, MAY 1

*AATS Member ♦AATS New Member +AmSECT Member

88. Long Term Survival, Risk of Re-Intervention, and Surveillance Imaging After Acute Type A Aortic Dissection Repair in the United States

Alexander Iribarne, Anthony DiScipio, Jock McCullough, Gouri Chakraborti, Andrea Austin, Philip Goodney
Dartmouth-Hitchcock Medical Center, Lebanon, NH

Invited Discussant: *John R. Doty

89. Does Incidental Splenectomy Impact Survival After Thoracoabdominal Aortic Aneurysm Repair?

Subhasis Chatterjee, *Scott Anthony LeMaire, Hiruni S. Amarasekara, Susan Yvonne Green, Matt Darwin Price, *Ourania Preventza, Chris John Pirko, Qianzi Zhang, Kim Insua de la Cruz, Samuel Rob Todd, *Joseph Stapleton Coselli
Baylor College of Medicine, Houston, TX

Invited Discussant: *Edward P. Chen

3:40 pm – Coffee Break in the Exhibit Hall
4:05 pm

90. Fifteen-Year Experience with Valve-Sparing Reimplantation Technique for the Treatment of Aortic Aneurysm and Aortic Regurgitation

Stefano Mastrobuoni, *Laurent de Kerchove, Emiliano Navarra, Philippe Noirhomme, *Gebrine El Khoury
St. Luc's Hospital, Brussels, Belgium

Invited Discussant: *Abe DeAnda, Jr.

91. Complete Thoracic Aorta Remodeling After Endovascular Aortic Repair Is a New Therapeutic Target for Chronic DeBakey IIIB Aneurysm

Tae-Hoon Kim¹, Suk-Won Song¹, Woon Heo¹, Won-Ki Woo¹, Min-Young Baek¹, Kwang-Hun Lee¹, Kyung-Jong Yoo¹, *Bum-Koo Cho²
¹*Yonsei University, Seoul, Republic of Korea;* ²*The Korea Heart Foundation, Seoul, Republic of Korea*

Invited Discussant: *G. Chad Hughes

92. Loeys-Dietz Syndrome: Intermediate-Term Outcomes of Medically and Surgically Managed Patients

Muhammad Aftab², Frank Cikach, Jr.¹, Jay J. Idrees¹, Yuanjia Zhu¹, Christina M. Rigelsky¹, Vidyasagar Kalahasti¹, *Eric E. Roselli¹, *Lars G. Svensson¹
¹*Cleveland Clinic, Cleveland, OH;* ²*University of Colorado, Aurora, CO*

Invited Discussant: *Duke E. Cameron

93. Decision-Making Algorithm for Ascending Aortic Aneurysm — Real World Effectiveness

Ayman A. Saeyeldin, Mohammad A. Zafar, Camilo A. Velasquez, Adam J. Brownstein, Syed Usman B. Mahmood, Young Erben, Bulat A. Ziganshin, *John A. Elefteriades
Yale New Haven Hospital, New Haven, CT

Invited Discussant: *Edward P. Chen



94. Surgical Aortic Arch Intervention Is Associated with Increased Mortality: Outcomes from a Longitudinal Analysis

Daniel P. Logsdon, Michael E. Bowdish, *Robbin G. Cohen, Fernando Fleischman, Mark J. Cunningham, Ramsey Elsayed, Joshua Perese, Tiffany Sierro, Tyler Fugere, *Vaughn A. Starnes

University of Southern California, Los Angeles, CA

Invited Discussant: *Thoralf M. Sundt, III

95. In the Endovascular Era Is Elective Open Aortic Arch Surgery in Elderly Patients Greater Than or Equal to 75 Years of Age Still Justified?

*Ourania Preventza, Matt D. Price, Hiruni S. Amarasekara, Vicente Orozco-Sevilla, Subhasis Chatterjee, Qianzi Zhang, Kim I. de la Cruz, *Joseph S. Coselli

Baylor College of Medicine, Houston, TX

Invited Discussant: *S. Chris Malaisrie

5:34 pm Adjourn

**2:00 pm Congenital Heart Disease
Simultaneous Scientific Session**

Room 24ABC, SDCC

8 minute presentation, 10 minute discussion

Moderators: *Charles B. Huddleston and *Christian Pizarro

96. Need for Repair of Partial and Transitional Atrioventricular Septal Defects During Infancy Is Associated with Increased Risk of Reoperation

Carlos M. Mery¹, Rodrigo Zea-Vera¹, Martin A. Chacon-Portillo¹, M. Scott Binder², Wei Zhang¹, William B. Kyle¹, Iki Adachi¹, *Jeffrey S. Heinle¹, *Charles D. Fraser, Jr.¹

¹*Texas Children's Hospital, Houston, TX;* ²*Eastern Virginia Medical School, Norfolk, VA*

Invited Discussant: *David P. Bichell

97. Comparison of Two Cardiopulmonary Bypass Protocols: The Conventional Strategy and a New Strategy Based on Miniature Circuit

Yiqun Ding, Baoying Meng, Fang Chen, Cheng Zhang

Shenzhen Children's Hospital, Shenzhen, China

Invited Discussant: *Mark E. Galantowicz

98. Complete Unroofing of the Intramural Coronary Artery for Anomalous Aortic Origin of the Coronary Artery — The Role of Aortic Commissural Resuspension

Can Yerebakan, Mahmut Ozturk, Lok Sinha, *Richard A. Jonas, Pranava Sinha

Children's National Heart Institute, Washington, DC

Invited Discussant: *J. William Gaynor

99. The Impact of Residual Lesions on Outcomes After Congenital Cardiac Surgery

*Meena Nathan, Brielle Tishler, Hua Liu, Caitlin Walsh, Kimberlee Gauvreau, Colan Steven, Mayer John, Jr., *Pedro del Nido

Boston Children's Hospital, Boston, MA

Invited Discussant: *Emile A. Bacha

TUESDAY, MAY 1

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100. The Fate of the Branch Pulmonary Arteries Related to Hybrid Approach for Hypoplastic Left Heart Syndrome

Uygar Yörüker, Klaus Valeske, Matthias Müller, Christian Jux, Hakan Akintürk
Justus Liebig University, Gießen, Germany

Invited Discussant:

3:30 pm – Coffee Break in the Exhibit Hall

4:00 pm

101. Systemic Atrioventricular Valve Replacement in Patients with Functional Single Ventricle

Tomohiro Nakata, Takaya Hoashi, Masatoshi Shimada, *Hajime Ichikawa
National Cerebral and Cardiovascular Center, Osaka, Japan

Invited Discussant: *Jonathan M. Chen

102. Single-Center Results of Pulmonary Vein Stenosis Repair in the Current Era

Yaroslav Mykychak, Kostiantyn Krykunov, Yaroslav Ivanov, Andrii Pavlenko, Anna Pavlova, Andrii Maksymenko, Roman Sekelyk, Andrii Kurkevych, Illya Yemets
Ukrainian Children's Cardiac Center, Kyiv, Ukraine

Invited Discussant: *Christopher A. Caldarone

103. Outcomes of Complete Ventricular Septation for Multiple Muscular Ventricular Septal Defects in Infants Under 4 kg

Damien J. LaPar, Mariana Chavez, *Sitaram M. Emani, Christopher W. Baird
Boston Children's Hospital, Boston, MA

Invited Discussant: *Christopher J. Knott-Craig

104. High Waitlist Mortality in Transplantation for Pulmonary Venous Disease: An Analysis of the United Network for Organ Sharing (UNOS) Pediatric Thoracic Transplantation Database

Rachel D. Vanderlaan¹, Kyle Runeckles², Cedric Manlhiot², Anne I. Dipchand²,
*Christopher A. Caldarone²

¹University of Toronto, Toronto, ON, Canada; ²Hospital for Sick Children, Toronto, ON, Canada

Invited Discussant: *Charles B. Huddleston

105. Long-Term Outcomes of Mechanical Aortic Valve Replacement in Children

Takashi Kakuta, Takaya Hoashi, Masatoshi Shimada, Hideto Ozawa, Tomohiro Nakata,
*Hajime Ichikawa

National Cerebral and Cardiovascular Research Center, Suita, Japan

Invited Discussant: *Luca A. Vricella

106. Femoral Vein Homograft As Right Ventricle to Pulmonary Artery Conduit for Stage 1 Norwood Operation: An Update

T.K. Kumar, Mario Briceno-Medina, Hitesh Sandhu, Umar Boston,
*Christopher Knott-Craig

Le Bonheur Children's Hospital, Memphis, TN

Invited Discussant: *Sitaram M. Emani

5:38 pm

Adjourn





2:00 pm

**General Thoracic Surgery
Simultaneous Scientific Session**

Room 25ABC, SDCC

8 minute presentation, 10 minute discussion

Moderators: *Shaf Keshavjee and ♦Matthew G. Hartwig

107. A National Analysis of Mechanical Ventilation and Extracorporeal Membrane Oxygenation As a Bridge to Lung Transplantation: Closing the Gap

J.W. Awori Hayanga¹, Sari D. Holmes¹, Yue Ren¹, Heather K. Hayanga¹,
Norihiisa Shigemura², Ghulam Abbas¹, *Vinay Badhwar¹

¹West Virginia University, Morgantown, WV; ²Temple University, Philadelphia, PA

Invited Discussant: *Jonathan D'Cunha

108. Inter-Observer Variability in Radiological Judgement Impairs Grading of Primary Graft Dysfunction After Lung Transplantation

Stefan Schwarz, Moritz Muckenhuber, Alberto Benazzo, Lucian Beer, Florian Gittler,
Helmut Prosch, *Walter Klepetko, Konrad Hoetzenecker

Medical University of Vienna, Vienna, Austria

Invited Discussant: *Frank D'Ovidio

109. Interfacility Transport of Patients Requiring Extracorporeal Membrane Oxygenation Support: Single Center Model and Experience

Yuliya Tipograj, Peter Liou, *Matthew Bacchetta, Cara Agerstrand
Columbia University, New York Presbyterian Hospital, New York, NY

Invited Discussant: Christopher Sciortino

110. Twenty-Four Years Experience of Open Surgical Repair for Pectus Excavatum

Hiroshi Iida, Ryuta Fukai

Hayama Heart Center, Kanagawa, Japan

Invited Discussant: *Daniel L. Miller

111. Carinal Surgery: A Single Institution Experience Spanning Two Decades

Christina L. Costantino, Abraham Geller, *Cameron D. Wright, Harald C. Ott,
Ashok Muniappan, *Douglas J. Mathisen, *Michael Lanuti

Massachusetts General Hospital, Boston, MA

Invited Discussant:

3:30 pm – Coffee Break in the Exhibit Hall

4:00 pm

TUESDAY, MAY 1



* AATS Member ♦ AATS New Member + AmSECT Member



3:35 pm – 4:00 pm

Deep Dive: The Addition of a Mobile App Technology to a Post-Discharge Home Care Program Following Thoracic Surgery Reduces the Rate of Emergency Room Visits AATS CT Theater I
Booth #134, Exhibit Hall
Not for Credit
5 minute presentation, 20 minute discussion

Presenter: Yaron Shargall, *McMaster University*

Panelists: *Shanda H. Blackmon, *Mayo Clinic*
*Brendan M. Stiles, *New York Presbyterian Weill Cornell Medical College*
*Stephen C. Yang, *Johns Hopkins Medical Institutions*

4:00 pm **General Thoracic Surgery** Room 25ABC, SDCC
Simultaneous Scientific Session (*continued*)
8 minute presentation, 10 minute discussion

Moderators: *Gail E. Darling and *Virginia R. Litle

112. Resection of Tumors with Carinal Involvement After Induction Treatment

Domenico Galetta, Lorenzo Spaggiari
European Institute of Oncology, Milan, Italy

Invited Discussant:

113. Neoadjuvant Versus Adjuvant Chemotherapy in Completely Resected cT2-4N0-1M0 Non-Small Cell Lung Cancer

Wanpu Yan, Whitney S. Brandt, Kay See Tan, *Manjit S. Bains, *Bernard J. Park,
*Prasad S. Adusumilli, *James Huang, Matthew J. Bott, *Valerie W. Rusch,
♦Daniela Molena, James M. Isbell, Smita Sihag, Jamie E. Chافت, Mark G. Kris,
*David R. Jones

Memorial Sloan-Kettering Cancer Center, New York, NY

Invited Discussant: *Jessica S. Donington

114. Prognostic Value of Neoadjuvant Treatment Response in Locally Advanced Esophageal Adenocarcinoma

Shawn S. Groth¹, ♦Bryan M. Burt¹, Farhood Farjah², Brandon G. Smaglo¹,
Yvonne H. Sada¹, *David J. Sugarbaker¹, Nader N. Massarweh¹

¹*Baylor College of Medicine, Houston, TX*; ²*University of Washington, Seattle, WA*

Invited Discussant: ♦Siva Raja



115. Development and External Validation of a Prediction Model of Pathological Lymph Node Metastasis in Lung Adenocarcinoma with Clinical Stage IA and Dominant Solid Part (JCOG0201A): Ancillary Analysis of Japan Clinical Oncology Groups Trial, JCOG0201

Keiju Aokage¹, ♦Kenji Suzuki², Masashi Wakabayashi³, Hisashi Saji⁴, Aritoshi Hattori², Hiroshige Yoshioka⁵, Yoshitaka Zenke⁶, Yasuhiro Tsutani⁷, Hiroyuki Ito⁸, Tadashi Aoki⁹, Kazuo Nakagawa¹⁰, Jiro Okami¹¹, Kazuya Takamochi², *Morihiro Okada⁷, Tomonori Mizutani³, Haruhiko Fukuda³, Shun-ichi Watanabe¹⁰

¹National Cancer Center Hospital East, Kashiwa, Japan; ²Juntendo University School of Medicine, Tokyo, Japan; ³JCOG Data Center/Operations Office, National Cancer Center, Tokyo, Japan; ⁴St. Marianna University, Kanagawa, Japan; ⁵Kansai Medical University Hospital, Osaka, Japan; ⁶Tokyo Metropolitan Cancer and Infectious Diseases Center Komagome Hospital, Tokyo, Japan; ⁷Hiroshima University Hospital, Hiroshima, Japan; ⁸Kanagawa Cancer Center, Kanagawa, Japan; ⁹Niigata Cancer Center Hospital, Niigata, Japan; ¹⁰National Cancer Center, Tokyo, Japan; ¹¹Osaka Cancer Institute, Osaka, Japan

Invited Discussant: *Prasad S. Adusumilli

116. Induction Chemoradiotherapy for Esophageal Cancer: Comparing CROSS Regimen with Cisplatin/5-FU

Abraham Geller, Ashok Muniappan, *Henning A. Gaissert, *Douglas J. Mathisen, Christopher Morse, *Cameron D. Wright, *Michael Lanuti
Massachusetts General Hospital, Boston, MA

Invited Discussant: *Arjun Pennathur

117. Patterns and Risk of Recurrence in Esophageal Cancer Patients with a Pathological Complete Response After Neoadjuvant Chemoradiotherapy Followed by Surgery

Arianna Barbetta, Tamar Nobel, Meier Hsu, Key See Tan, *Manjit S. Bains, *Prasad S. Adusumilli, Matthew J. Bott, *James Huang, James M. Isbell, *Bernard J. Park, Valerie W. Rush, Smita Sihag, *David R. Jones, ♦Daniela Molena
Memorial Sloan Kettering Cancer Center, New York, NY

Invited Discussant:

5:38 pm

Adjourn

TUESDAY, MAY 1



*AATS Member ♦AATS New Member +AmSECT Member





2:00 pm –
3:30 pm

**What a Cardiac Surgeon In 2018
Should Know About Transcatheter Devices**

Ballroom 20A, SDCC

6 minute presentation, 9 minute discussion

Co-Chairs: *Lars G. Svensson, *Cleveland Clinic*
*Vinod H. Thourani, *MedStar Heart and Vascular Institute*

Panelists: *Isaac George, *New York Presbyterian Hospital*
Stephanie Mick, *Cleveland Clinic*
Jason H. Rogers, *University of California, Davis*

118. Causes of Death in Intermediate Risk Patients from the Randomized Surgical Replacement and Transcatheter Aortic Valve Implantation Trial

Hafid Amrane¹, *G. Michael Deeb², Jeffrey J. Popma³, Mubashir Mumtaz⁴,
Nicolas M. van Mieghem⁵, *Thomas G. Gleason⁶, *Michael J. Reardon⁷

¹*Medisch Centrum Leeuwarden, Leeuwarden, Netherlands*; ²*University of Michigan, Ann Arbor, MI*; ³*Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA*; ⁴*Pinnacle Health Harrisburg Hospital, Harrisburg, PA*; ⁵*Erasmus Medical Centre Rotterdam, Rotterdam, Netherlands*; ⁶*University of Pittsburgh, Pittsburgh, PA*; ⁷*Houston Methodist DeBakey Heart & Vascular Center, Houston, TX*

Invited Discussant: *Y. Joseph Woo

119. Inter-Site Variability of Mortality and Stroke for Sites Performing Both Surgical and Transcatheter Aortic Valve Replacement for Aortic Valve Stenosis in Intermediate Risk Patients

*Kevin L. Greason¹, *Eugene Blackstone², Jeevanantham Rajeswaran²,
*Lars G. Svensson², Jeffrey W. Moses³, John Webb⁴, Murat E. Tuzcu²,
*Craig R. Smith³, *Michael Mack⁵, *Vinod H. Thourani⁶, Susheel Kodali³,
*D. Craig Miller⁷

¹*Mayo Clinic, Rochester, MN*; ²*Cleveland Clinic, Cleveland, OH*; ³*Columbia University, New York, NY*; ⁴*University of British Columbia, Vancouver, BC*; ⁵*The Heart Hospital Baylor Plano, Denton, TX*; ⁶*Emory University, Atlanta, GA*; ⁷*Stanford University, Stanford, CA*

Invited Discussant: *Michael J. Reardon

Case Examples of the Heart Team at Work

2:30 pm Heart Team Approach to Treatment of 2 Patients with Degenerative Mitral Regurgitation

Jason H. Rogers, *University of California, Davis*

2:40 pm Heart Team Approach to Treatment of 2 Patients with Functional Mitral Regurgitation

*Vinod H. Thourani, *MedStar Heart and Vascular Institute*

2:50 pm Heart Team Approach to treatment of 2 Patients with Functional Tricuspid Regurgitation

*Isaac George, *New York Presbyterian Hospital*





3:00 pm **Which Patients will Undergo Surgical AVR in the Era of TAVR?**
Stephanie Mick, *Cleveland Clinic*

3:10 pm **Discussion**

3:30 pm **Adjourn**

2:00 pm – 3:30 pm **Enhanced Recovery After Cardiac Surgery** Room 28DE, SDCC

Session 1: ERAS® Cardiac Surgery Past and Present

Moderators: ♦ Daniel T. Engelman, *Baystate Medical Center*

2:00 pm **ERAS® Cardiac Surgery Overview and Mission Past: Fast Track Surgery Present: Introduction, Overview**

♦ Daniel T. Engelman, *Baystate Medical Center*

* Richard M. Engelman, *Baystate Medical Center*

2:15 pm **Consensus Guidelines Grading Process and Structure**

* Rakesh C. Arora, *St. Boniface General Hospital*

2:25 pm **2018 ERAS® Cardiac Surgery Consensus Guidelines**

Marc W. Gerdisch, *St. Francis Heart Center*

* Ali Khoynzhad, *Long Beach Memorial Heart and Vascular Institute*

* Louis P. Perrault, *Institute of Cardologie de Montreal*

* Eric E. Roselli, *Cleveland Clinic*

2:50 pm **Guidelines, Consensus, and Opinions: Secrets of High-Performance Organizations**

* Kevin W. Lobdell, *Carolinas Healthcare System*

Session 2: ERAS® Cardiac Surgery Results, Future Consensus Work and Open Discussion

Moderators: ♦ Daniel T. Engelman, *Baystate Medical Center*

3:00 pm **Clinical Results: Real-World Incorporation of ERAS Cardiac**

V. Seenu Reddy, *Centennial Heart & Vascular Center*

Judson Williams, *Duke University*

3:15 pm **Preview and Voting for 2019 Collaborative Efforts and Open Forum of Best Practices in Enhanced Recovery**

Faculty and Audience Discussion

3:30 pm **Adjourn**

TUESDAY, MAY 1



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2:00 pm –	Enhanced Recovery After Thoracic Surgery	Room 23BC, SDCC
3:30 pm	Course Chairs: *Shanda H. Blackmon, <i>Mayo Clinic</i> *Gaetano Rocco, <i>NCI, Pascale Foundation</i>	
2:00 pm	Introduction *Shanda H. Blackmon, <i>Mayo Clinic</i> *Gaetano Rocco, <i>NCI, Pascale Foundation</i>	
2:05 pm	Evidence Supporting ERAS in GTS Literature *Alessandro Brunelli, <i>St. James's University Hospital</i>	
2:12 pm	Re-Defining Neuraxial Anesthesia for an ERAS Program *Reza J. Mehran, <i>MD Anderson Cancer Center</i>	
2:22 pm	How to Start an ERAS Program & Unexpected Benefits Linda W. Martin, <i>University of Virginia Health System</i>	
2:32 pm	ERAS After Esophagectomy Jonathan Spicer, <i>McGill University</i>	
2:39 pm	ERAS Means Minimally Invasive *Hiran C. Fernando, <i>Inova Health System</i>	
2:46 pm	ERAS Includes Open Surgery *Haiquan Chen, <i>Fudan University Shanghai Cancer Center</i>	
2:53 pm	Debate: New York Versus Rochester Efficiency Models *Robert J. Cerfolio, <i>New York University</i> Michael Brown, <i>Mayo Clinic</i>	
3:13 pm	Questions to the Panel and Discussion	
3:30 pm	Adjourn	





4:05 pm

Adult Cardiac Surgery

Ballroom 20A, SDCC

5:40 pm

Simultaneous Scientific Session

5 minute presentation, 9 minute discussion

Moderators: Nirav C. Patel and *John D. Puskas

120. Tissue Versus Mechanical Aortic Valve Replacement in Young Patients:

A Multi-Center Experience

Alexander Iribarne¹, Gerald L. Sardella², Michael P. Robich³, Daniel J. Gelb¹,
Yvon R. Baribeau⁴, *Bruce J. Leavitt⁵, Robert A. Clough⁶, Paul W. Weldner⁷,
Anthony W. DiScipio¹

¹Dartmouth-Hitchcock Medical Center, Lebanon, NH; ²Concord Hospital, Concord, NH; ³Maine Medical Center, Portland, ME; ⁴Catholic Medical Center, Manchester, NH;

⁵University of Vermont, Burlington, VT; ⁶Eastern Maine Medical Center, Bangor, ME;

⁷Central Maine Medical Center, Lewiston, ME

Invited Discussant: *Joanna Chikwe

121. Equivalent Long-Term Survival After Isolated Bioprosthetic Versus Mechanical Aortic Valve Replacement: A Propensity Matched Analysis

Tamer Attia, *Faisal G. Bakaeen, *Edward G. Soltesz, *Eric E. Roselli,
*Nicholas G. Smedira, *A. Marc Gillinov, *Lars G. Svensson, Andrew Toth,
Jeevanantham Rajeswaran, *Eugene H. Blackstone, *Douglas R. Johnston
Cleveland Clinic, Cleveland, OH

Invited Discussant: *Ko Bando

122. Trans-Catheter Tricuspid Valve Therapy — First World Series of Native Annulus Implantation

*Jose L. Navia, Haytham Elgharably, Samir Kapadia, Amar Krishnaswamy
Cleveland Clinic, Cleveland Clinic, OH

Invited Discussant: *Hersh Maniar

123. Predicting 30-Day Readmission After CABG: An Accurate Bedside Assessment Tool

Joshua Michael Rosenblum, Rena C. Moon, Jose N. Binongo, Chadwick William Stouffer,
Bradley Graham Leshnowar, Jeffrey S. Miller, *Edward P. Chen, Omar M. Lattouf,
*Robert A. Guyton, *Michael E. Halkos, William Brent Keeling

Emory University, Atlanta, GA

Invited Discussant: *Richard L. Prager

124. Multi-Vessel Versus Single-Vessel Robotic Totally Endoscopic Coronary Artery Bypass: Impact of a Beating Heart Approach with Anastomotic Connectors

Husam H. Balkhy, Sarah Nisivaco, Hiroto Kitahara, Brooke Patel, Mackenzie McCrorey
University of Chicago, Chicago, IL

Invited Discussant: Nirav C. Patel

5:15 pm

Adjourn

TUESDAY, MAY 1



*AATS Member ♦AATS New Member +AmSECT Member



TUESDAY AFTERNOON, MAY 1, 2018

4:05 pm MCS/Transplant Session Room 23BC, SDCC

5:40 pm 5 minute presentation, 7 minute discussion

Moderators: *Nader Moazami and Scott C. Silvestry

125. Optimal Timing for Heart Transplantation in Patients Bridged with Left Ventricular Assist Devices: Is Timing of the Essence?

Chase Robert Brown, Fabliha Khurshan, J. Eduardo Rame, Zehang Chen,

*Michael Acker, Fenton McCarthy, Peter Groeneveld, *Nimesh Desai

University of Pennsylvania, Philadelphia, PA

Invited Discussant: *Manuel J. Antunes

126. Outcomes of Bridge to Cardiac Re-Transplantation in the Contemporary Mechanical Circulatory Support Era: An Analysis of the UNOS Database

Koji Takeda, Joseph Sanchez, Masahiko Ando, Marisa Cevasco, *Hiroo Takayama,

*Yoshifumi Naka

Columbia University, New York, NY

Invited Discussant: Fardad Esmailian

127. To Repair or Not to Repair: Continuous Flow Left Ventricular Assist Device with Uncorrected MR Has Little Adverse Impact on Survival, RV Function and Pulmonary Artery Pressure

Muhammad F. Masood, Irene Fischer, Gregory A. Ewald, *Ralph J. Damiano, Jr.,

*Marc R. Moon, Keki R. Balsara, Akinobu Itoh

Washington University, Saint Louis, MO

Invited Discussant: *Walter P. Dembitsky

Invited Speaker:

Reducing the Burden of Adverse Events with MCS: Is Better Technology the Answer?

*Ashish S. Shah, *Vanderbilt University*

128. Extended Duration Counterpulsation with a Minimally Invasive Circulatory Assist Device: Initial Clinical Experience

*Valluvan Jeevanandam, Tae Song, David Onsager, Takeoshi Ota, Colleen Jurisek,

Thomas Lammy, Nir Uriel

University of Chicago, Chicago, IL

Invited Discussant: *Ahmet Kilic

129. Management of Severe Mitral Regurgitation During Left Ventricular Assist Device Implantation — Repair or Not Repair?

Amit Pawale, Shinobu Itagaki, Aditya Parikh, Sean Pinney, *David H. Adams,

*Anelechi C. Anyanwu

Mount Sinai Medical Center, New York, NY

Invited Discussant:



130. Minimally Invasive Left Ventricular Assist Device Implantation May Be Associated with Improved Survival in High-Risk Patients

Chetan Pasrija¹, Mariem Sawan¹, Erik Sorensen¹, Hannah Voorhees¹, Van-Khue Ton¹, Erica Feller¹, David J. Kaczorowski¹, *Bartley P. Griffith¹, *Si M. Pham², Zachary N. Kon¹

¹University of Maryland, Baltimore, MD; ²Mayo Clinic, Jacksonville, FL

Invited Discussant: ♦Edwin McGee

5:36 pm Adjourn

TUESDAY EVENING, MAY 1, 2018

5:40 pm – AATS Surgical Cinema: Adult Cardiac Ballroom 20A, SDCC
7:10 pm

Moderators: *Clifford W. Barlow, *Southampton General Hospital*
*David H. Adams, *Mount Sinai Medical Center*
*Thoralf M. Sundt, III, *Massachusetts General Hospital*

5:40 pm **Complex Coronary Revascularization**
*John D. Puskas, *Mount Sinai St. Luke's*

5:55 pm **Minimally-Invasive AVR: State of the Art**
*Douglas R. Johnston, *Cleveland Clinic*

6:10 pm **Minimally-Invasive MVR: State of the Art**
*Y. Joseph Woo, *Stanford University*

6:25 pm **Total Endovascular Aortic Arch Replacement**
*Marc R. Moon, *Washington University*

6:40 pm **Valve-Sparing Aortic Root Replacement**
*Gebrine El Khoury, *Université catholique de Louvain*

6:55 pm **How to Do a State of the Art Open Cox Maze IV Operation**
*Ralph J. Damiano, Jr., *Washington University*

5:40 pm – AATS Surgical Cinema: Congenital Room 24ABC, SDCC
7:30 pm

Moderators: *Viktor Hraska, *Children's Hospital of Wisconsin*
*James A. Quintessenza, *Cincinnati Children's Hospital*

5:40 pm **Surgery for Rare Form of AAOCA**
*Martin Kostolny, *Great Ormond Street Hospital*

5:50 pm **Pulmonary Artery Unifocalization**
*Frank L. Hanley, *Stanford University*

TUESDAY, MAY 1

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- 6:00 pm Complex Pulmonary Artery Reconstruction**
*David P. Bichell, *Vanderbilt University*
- 6:10 pm Nikaidoh Procedure**
*Viktor Hraska, *Children's Hospital of Wisconsin*
- 6:20 pm Half-Turned Truncal Switch for TGA with LVOTO**
Masaaki Yamagishi, *Children's Medical Center, Kyoto*
- 6:30 pm Centrifugal VAD Placement in the Failing Fontan**
Christopher E. Mascio, *Children's Hospital of Philadelphia*
- 6:40 pm – Repair of Taussig-Bing Heart with Inverted Coronaries**
*Emile A. Bacha, *Columbia University*
- 6:50 pm – Arterial Switch Operation with Single Interarterial Coronary**
*James A. Quintessenza, *Cincinnati Children's Hospital*
- 7:00 pm – Norwood Procedure**
*Christian Pizarro, *Dupont Children's Hospital*
- 7:10 pm – Norwood Procedure – Done by a Resident**
*James S. Tweddell, *Cincinnati Children's Hospital*
- 7:20 pm – Discussion**



5:40 pm – AATS Surgical Cinema: General Thoracic Room 24ABC, SDCC
7:10 pm

Moderators: *David R. Jones, *Memorial Sloan-Kettering Cancer Center*
*David J. Sugarbaker, *Baylor College of Medicine*

- 5:40 pm Laparoscopic Repair of a Giant Paraesophageal Hernia**
*James D. Luketich, *University of Pittsburgh*
- 5:55 pm Uniportal Double Sleeve Resection: How I Do It**
*Diego Gonzalez-Rivas, *Coruna University Hospital*
- 6:10 pm How I Do an Extrapleural Pneumonectomy for Malignant**
*David J. Sugarbaker, *Baylor College of Medicine*
- 6:25 pm How I Do a Pulmonary Thromboendarterectomy for Chronic Thromboembolic Disease**
*Marc de Perrot, *Toronto General Hospital*
- 6:40 pm How I Do a Robotic Segmentectomy**
*Bernard J. Park, *Memorial Sloan-Kettering Cancer Center*
- 6:55 pm Discussion**



SUNDAY, APRIL 29, 2018

SUNDAY, APRIL 29

3:15 pm

**Adult Cardiac Surgery
Simultaneous Scientific Session**

Ballroom 20A, SDCC

6 minute presentation, 9 minute discussion

Moderators: *Faisal G. Bakaeen and *Joanna Chikwe

1. Twenty-Year Survival Following the Freestyle Versus Homograft Aortic Root Replacement Prospective Randomized Trial

Giovanni Melina¹, Fabio De Robertis¹, Jullien A. Gaer¹, Emiliano Angeloni², Toufan Bahrami¹, Elena Bellazzi¹, Ismail El-Hamamsy³, Cesare Quarto¹, Ulrich Rosendahl¹, *John R. Pepper¹, *Magdi H. Yacoub⁴

¹Royal Brompton and Harefield NHS Foundation Trust, London, United Kingdom;

²Ospedale Sant'Andrea, Rome, Italy; ³Montreal Heart Institute, Montreal, QC, Canada;

⁴Imperial College, London, United Kingdom

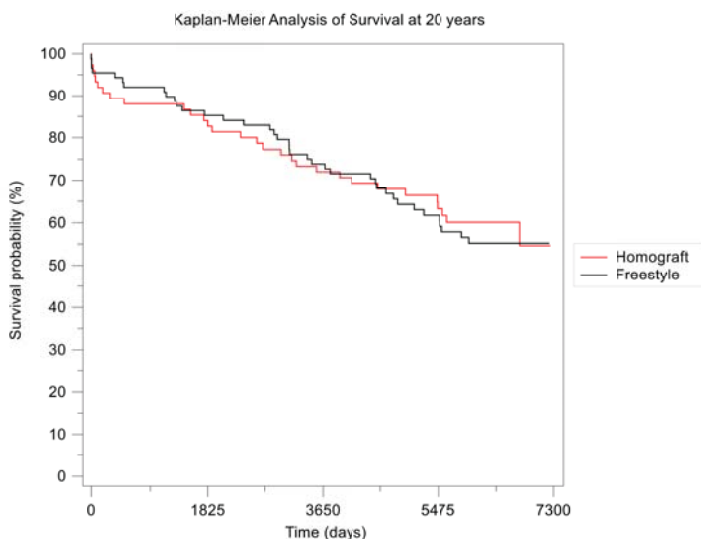
Invited Discussant: *Neal Kon

Objective: To investigate the very long-term survival of patients undergoing xenograft versus homograft full root aortic valve replacement (AVR).

Methods: A total of 166 patients (mean age 65 ± 8 years) requiring aortic valve surgery were randomized to undergo Freestyle bioprosthesis (N = 90) or Homograft (N = 76) full root AVR between 1997 and 2005 in a single Institution. Six patients randomly assigned to Homograft crossed over to Freestyle because of unavailability of suitably sized homografts. All surgeons were required to adhere to the standard surgical technique for homograft root implantation previously described. Follow-up data included routine clinical and echocardiographic assessments.

Results: There were no significant differences between the two groups in terms of baseline characteristics. Coronary artery bypass grafting was associated with root AVR in 76/166 (46%, $p = \text{NS}$ between groups) patients and overall hospital mortality was 4.8% (8/166, $p = \text{NS}$ between groups). Median follow-up was 15.9 years (maximum 20 years; 2138 patient-years). The Kaplan-Meier survival analysis in the Figure below shows that there was no significant difference between the two arms at 5, 10 and 15 years. Twenty-year survival was $54.9 \pm 4.5\%$ for the Freestyle group versus $54.6 \pm 7.4\%$ for the Homograft group ($p = 0.8$) (Figure). At last follow-up, peak aortic valve gradient was 15 ± 6.2 mmHg in the Freestyle and 21.3 ± 14 mmHg in the Homograft group ($p = 0.008$). The rate of aortic regurgitation showed a trend toward a higher incidence among patients in the Homograft group ($p = 0.063$). Actuarial freedom from aortic valve dysfunction, including need for reoperation, was $93.3 \pm 6.4\%$ for the Freestyle and $43.2 \pm 1.2\%$ for the Homograft group ($p = 0.003$).

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Conclusion: This is the first ever study to investigate the very long-term survival of xenograft versus homograft full root AVR in a prospective randomized trial. Twenty-year overall survival from this study was similar after Freestyle or Homograft full root aortic valve replacement. The two prostheses behave differently suggesting a possible advantage of the porcine xenograft over homograft.

2. Impact of Cannulation Site on the Risk of Stroke and Mortality During Emergency Repair of Type A Dissection

Brad F. Rosinski, Jay J. Idrees, Andrew M. Vekstein, Michael Z. Tong, Faisal G. Bakaeen, *Edward G. Soltesz, Brian Griffin, *Eric E. Roselli, *Douglas R. Johnston, *A. Marc Gillinov, *Lars G. Svensson

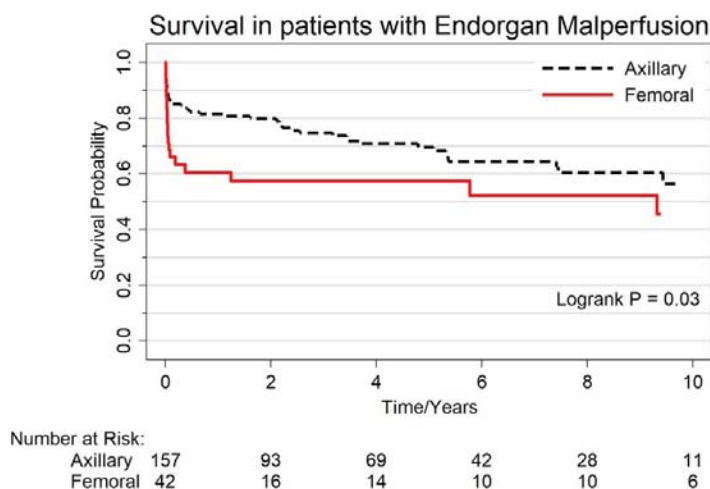
Cleveland Clinic Foundation, Cleveland, OH

Invited Discussant: *Joseph E. Bavaria

Objective: To determine whether cannulation site significantly impacts the risk of in-hospital outcomes and survival after emergency repair of acute type A dissection.

Methods: From January 2000 through December 2016, 782 patients underwent emergency surgical repair for acute type A dissection (DeBakey type I: 86% (n = 675) type II: 13% (n = 99), indeterminate: 1% (n = 8). Cannulation site was axillary or subclavian artery in 79% (n = 614) of which a side graft was used in 94% (n = 579), femoral artery in 13% (n = 103), or ascending aorta (central) in 8.3% (n = 65). Four propensity matched comparisons were performed: 1) Axillary vs. Central or Femoral (175 pairs); 2) Central vs. Axillary (60 pairs); 3) Femoral vs. Axillary (30 pairs) in patients with malperfusion, and 4) Femoral vs. Axillary in patients without malperfusion (54 pairs). Multivariable logistic regression was performed to determine predictors of operative mortality and stroke.

Results: Operative mortality was 8.8% (n = 69) and the risk of stroke was 6.9% (n = 54). Old age, presence of tamponade and the use of antegrade brain perfusion predicted the use of femoral cannulation (all, $p < 0.05$). In the overall comparison (Axillary vs. Femoral or Central), propensity matching did not show significant differences in the risk of stroke (5.6% vs. 9.7%, $p = 0.06$) or mortality (5% vs. 8%, $p = 0.15$). However, in the second comparison, the risk of stroke was significantly higher after central cannulation compared to axillary cannulation with side graft (17% vs. 5.6%, $p = 0.009$), but the mortality was similar (8% vs. 5%, $p = 0.27$). In the subset of patients presenting with end-organ malperfusion, a matched comparison of Femoral vs. Axillary artery cannulation showed a significantly higher risk of mortality (20% vs. 7.7%, $p = 0.04$), but the risk of stroke was similar (10% vs. 4.6%, $p = 0.25$). In contrast, no significant difference in mortality (3.7 vs. 4%, $p = 0.89$) or stroke (5.6% vs. 5.8%, $p = 0.94$) was noted in these groups when malperfusion was not present. After multivariable regression, significant predictors of mortality were presence end-organ malperfusion, shortness of breath, claudication, and coronary involvement (all, $p < 0.03$). Multivariable regression also predicted central cannulation as a predictor of stroke ($p = 0.03$). In patients with malperfusion, the long-term survival at 1, 3, 5, and 10 years was significantly worse in patients with femoral vs. axillary cannulation ($p = 0.03$) (Figure): Axillary: 81%, 75%, 70%, 57%, and 65%. Femoral: 61%, 58%, 58%, and 46%, respectively.



Conclusions: Axillary artery cannulation should be preferred when feasible over central cannulation when the anticipated risk of stroke is high. Femoral cannulation should be avoided in patients presenting with end-organ malperfusion. However, when end-organ malperfusion is not present, both axillary and femoral artery cannulation are safe options.



3. Long-Term Follow Up of Sutureless Versus Transcatheter Aortic Valve in Elderly Patient with Aortic Stenosis at Intermediate Risk: The European Multi-Institutional Study

*Claudio Muneretto¹, Marco Solinas², Thierry Folliguet³, *Roberto Di Bartolomeo⁴, Alberto Repossini¹, Lorenzo Di Bacco¹, Carlo Savini⁴, Giovanni Concistrè², Francois Laborde⁵, Manfredo Rambaldini⁶, Steffen Pfeiffer⁷, Giuseppe Santarpino⁷, ♦Theodor Fischlein⁷

¹University of Brescia, Brescia, Italy; ²Monasterio Foundation Heart Hospital, Massa, Italy; ³Centre Hospitalo-universitaire Brabois ILCV, Vandoeuvre les Nancy, Italy; ⁴University of Bologna, Bologna, Italy; ⁵Institut Mutualiste Montsouris, Paris, Italy; ⁶Carlo Poma Hospital of Mantova, Mantova, Italy; ⁷Universitätsklinik der Paracelsus Medizinischen Privatuniversität, Nuremberg, Germany

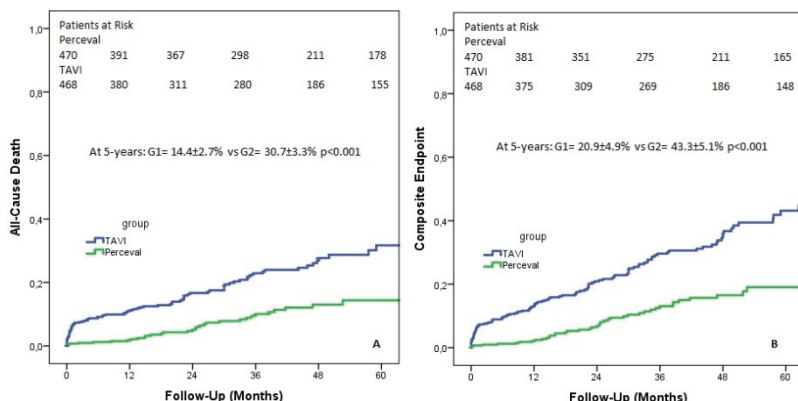
Invited Discussant: *Guenther Laufer

Objective: Recent randomized trials depicted comparable outcome of transcatheter aortic valve (TAVR) versus standard surgical valve replacement (sAVR) in patients with severe aortic stenosis and intermediate risk profile. In the last decade Sutureless valves (SV) became a viable alternative to standard bioprostheses showing a significant reduction of cross-clamping time with potential benefit for patients outcome. This multi-institutional European study compares the long-term outcome of elderly patients with severe aortic stenosis and intermediate risk profile who underwent isolated sutureless versus TAVR aortic valve implant.

Methods: From 2008 to 2015, 967 consecutive elderly patients (>75 years old) with intermediate risk (STS score from 4% to 8%) and isolated aortic stenosis entered the study (SV = 481; TAVR = 486). A full matching Propensity Score was performed eliminating patients out of common support area (standard difference <10%) and two matched groups of 470 (G1) and 468 (G2) patients respectively were obtained. Primary study endpoints included all-cause death at 30 days and at five years. Secondary study endpoints included early and late incidence of composite adverse events (MACCEs: all-cause death, stroke, PM implant, acute MI, paravalvular leak > 2+, device failure requiring re-operation).

Results: After matching there were no difference in major variables between groups (G1 vs. G2: mean age 83.3 ± 4.8 vs. 83.1 ± 5.6 years $p = 0.918$; mean STS score 6.1 ± 2.2 vs. 6.3 ± 2.4 $p = 0.325$). The 30-days mortality was significantly lower in SV group (G1 = 1.7% vs. G2 = 6.2%; $p = 0.006$) as well as incidence of permanent PM implantation (G1 = 5.5% vs. G2 = 11.7%, $p = 0.004$) and peripheral vascular complications (G1 = 0% vs. G2 = 8.2%, $p < 0.001$). Stroke/TIA incidence at 30 days was 1.0% in G1 and 3.6% in G2 ($p = 0.087$) and cumulative at five years was 1.7% (G1) and 4.8% (G2) respectively ($p = 0.020$). Early significant perivalvular leak (> grade II) was observed in 0.85% in G1 and 7.4% in G2 ($p < 0.001$). At mean follow-up of 60 months, overall survival and the survival freedom from MACCEs were significantly better in patients undergoing SV (G1 = $14.4 \pm 2.7\%$ vs. G2 = $30.7 \pm 3.3\%$ $p < 0.001$) (G1 = $20.9 \pm 4.9\%$ vs. G2 = $43.3 \pm 5.1\%$ $p < 0.001$); cardiac death occurred in 1.5% (G1) and 6.5% (G2) ($p = 0.006$); while valve death occurred in 0% in G1 versus 2.6% in G2 ($p = 0.015$). Multivariable Cox Regression Analysis identified TAVR as independent predictor for mortality and MACCEs at five years (TAVR vs. SV: HR = 2.1, CI = 1.12–4.17, $p = 0.002$) (TAVR vs. SV: HR 2.9, CI 1.6–4.3, $p < 0.001$).





Conclusion: The use of sutureless rapid deployment valves when compared with TAVR significantly improved the outcomes of elderly patients with isolated aortic stenosis and intermediate risk profile. The use of TAVR in this subset population should be evaluated in further controlled randomized trial having sutureless valve as comparative cohort.

4. Hospital Variability in Post Heart Transplant Mortality Can Be Attributed to Difference in Failure to Rescue

Muath Bishawi¹, Asishana Osho², Asvin Ganapathi¹, Anthony Castleberry¹, Michael S. Mulvihill¹, Jacob Schroder¹, Mani Daneshmand¹, Chetan Patel¹, Joseph Rogers¹, *Carmelo Milano¹, ♦Matthew G. Hartwig¹

¹Duke University, Durham, NC; ²Massachusetts General Hospital, Boston, MA

Invited Discussant: Amit Pawale

Objective: Despite improvements in patient management, heart transplantation continues to be associated with high rates of complications and considerable variability in per-hospital outcomes. While some complications may not be preventable, the ability to rapidly diagnose and “rescue” (Failure to Rescue, FTR) a patient from a complication relates to the quality of care of the health care system and can help identify important areas for outcome improvements across centers.

Methods: The UNOS database was used to identify primary heart transplants between 01/2000 and 03/2016. Centers with less than 10 transplants during the study period or less than 2 transplants per year were excluded. Operative mortality was defined as either within the index hospitalization (in hospital) or within 30 days of transplant (30-day mortality). Rates of post-transplant complications including need for dialysis, permanent pacemaker, stroke, and acute rejection were calculated. Hospitals were stratified into equal sized terciles based on operative mortality. Failure to rescue rates were calculated by dividing the number of patients with a complication that died over the overall number of patients with that complication.

Results: A total of 29,528 heart transplants were identified and performed within 140 transplant centers during the study period. Overall in-hospital mortality was 5.73%, and the 30-day mortality was 4.86% across all centers. Hospitals were stratified based

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on hospital mortality into 3 equal size groups: low mortality (n = 46 centers, average mortality 4.05%) medium (n = 47 centers, average mortality 7.02%), and high mortality (n = 47 centers, average mortality 11.69%). The composite complication rate decreased slightly with decreasing hospital mortality group 26.93%, 25.96%, and 22.09% ($P < 0.01$). The overall FTR rate significantly decreased with decreasing hospital mortality group: 23.28%, 15.68%, and 11.14% ($p < 0.01$). Post-transplant dialysis FTR was 44.14% for high mortality hospitals, 33.66% for medium and 26.73% for low mortality hospitals ($p < 0.01$). FTR from post-transplant stroke also decreased with decreasing mortality group: 40%, 35.33% and 22.84% ($p < 0.01$), respectively. Post-transplant rejection FTR also decreased with decreasing mortality group: 5.86%, 4.06% and 2.58% ($p < 0.01$). There was no difference for FTR from post-transplant pacemaker.

Conclusion: While there are small differences in complication rates across hospitals following heart transplantation, there are large and significant differences in failure to rescue after a number of complications that help explain variability in hospital mortality outcomes.

5. The Long-Term Safety and Efficacy of Concomitant Cox Maze Procedures for Atrial Fibrillation in Patients Without Mitral Valve Disease

*Niv Ad¹, Sari D. Holmes¹, Anthony J. Rongione², Lisa M. Fornaresio¹, Lawrence Wei¹,
*J. Scott Rankin¹, *Vinay Badhwar¹, Paul S. Massimiano²

¹WVU Heart and Vascular Institute, Morgantown, WV; ²Adventist HealthCare, Takoma Park, MD

Invited Discussant: *Gorav Ailawadi

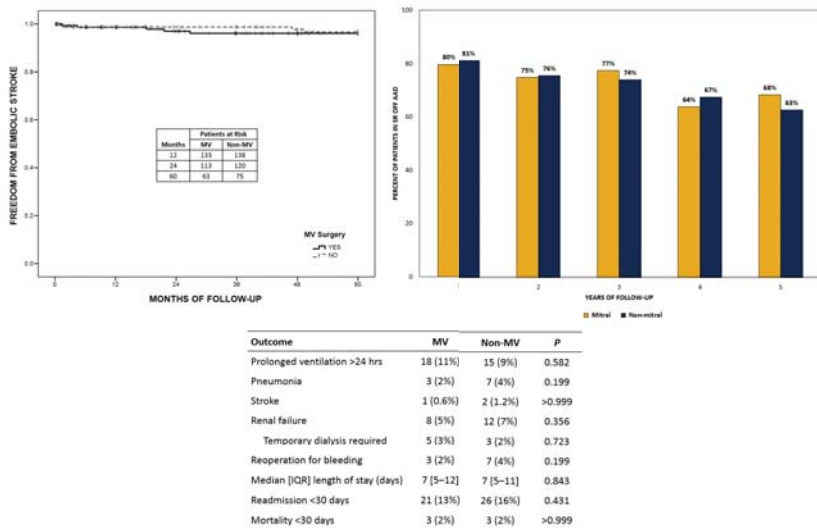
Objective: Recently published guidelines from different organizations have shown that surgical treatment for atrial fibrillation (AF) is associated with improved operative and long-term outcomes. However, review of several national registries reveals that the percent of non-mitral valve patients with AF who are treated with surgical ablation at the time of surgery is 20–25%, as surgeons are reluctant to perform the procedures for patients whose surgery would not otherwise require left atriotomy. The purpose of this study was to compare outcomes of concomitant Cox maze (CM) with and without mitral valve (MV) procedures.

Methods: Patients who underwent concomitant CM procedures were prospectively followed since September 2005. Of the final cohort of 711 patients, 238 patients did not have MV surgery. Data on rhythm, medication status, follow-up interventions, and clinical events were captured prospectively according to HRS guidelines. Mixed model logistic regression was used to identify factors associated with failure. Propensity score matching was conducted to balance preoperative characteristics between patients with and without concomitant MV procedures, with 164 pairs remaining after matching.

Results: In general MV patients were younger (65 vs. 67 years, $P = 0.047$), had higher EuroSCORE II (5.0% vs. 3.8%, $P = 0.002$), larger LA size (5.3 vs. 4.8 cm, $P < 0.001$), and shorter median AF duration (19 vs. 25 months, $P = 0.064$). Early outcomes were similar for the matched groups (Table). Cumulative 5-year freedom from stroke was high for all patients and did not differ between the matched MV and non-MV groups (96.1% vs. 96.6%, $P = 0.667$; Figure). At each time point, return to SR off antiarrhythmic



medications was similar for the matched groups, including 5 years after surgery (68% vs. 63%, $P = 0.492$; Figure). Factors associated with failure throughout 5 years of follow-up were longer AF duration (OR = 1.08, $P = 0.001$; OR = 1.08, $P = 0.017$) and fewer cases of surgeon experience (OR = 0.98, $P = 0.016$; OR = 0.96, $P = 0.004$) for both groups.



SUNDAY, APRIL 29

Conclusions: The Cox maze procedure is very safe and effective with comparable outcomes when performed concomitant to MV or non-MV surgery. Shorter AF duration and surgeon experience were significantly associated with better success in both groups. Surgeons should base the decision to perform surgical ablation procedures on AF pathophysiology and the benefit to patients, not on the type of concomitant procedure.

6. Graft Patency at 3 Months After Off and On-Pump Coronary Artery Bypass Grafting: A Multicenter Prospective Randomized Study

*Lokeswara R. Sajja¹, Kunal Sarkar², Gopichand Mannam¹, Venkata Krishna Kumar Kodali³, Chandrasekar Padmanabhan⁴, Sanjeeth Peter⁵, Anvay Vinayak Mulay⁶, Prashanthi Beri⁷

¹Star Hospitals, Hyderabad, India; ²Medica Superspeciality Hospital, Kolkata, India;

³Krishna Institute of Medical Sciences, Secunderabad, India; ⁴G. Kuppuswamy Naidu Memorial Hospital, Coimbatore, India; ⁵DDMM Heart Institute, Gujarat, India; ⁶Fortis Hospital, Mumbai, India; ⁷Sajja Heart Foundation, Hyderabad, India

Invited Discussant: *Bruce J. Leavitt

Objective: Coronary artery bypass grafting (CABG) is performed either with the aid of cardiopulmonary bypass (on-pump) or without cardiopulmonary bypass (off-pump). Recent trials in this domain had a lack of angiographic data to support the superiority of one technique over the other. The primary objective of the study was to assess whether the quality of revascularisation in terms of graft patency in off-pump CABG is essentially inferior to that of on-pump CABG through direct angiographic evidence.

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Methods: Three hundred and twenty patients with multivessel coronary artery disease were enrolled in a multicentre prospective randomized trial to on-pump (n = 162) or off-pump (n = 158) CABG between March 2016 to March 2017. A sample size of 162 per each group of patients is arrived by assuming alpha of 5%, power of 90%, patency rate of 85% on on-pump with 10% clinical margin, dropout rate of 20% and sampling ratio of 1:1. The patients were followed for 3 months to assess the graft patency by using either multidetector computerized tomography (MDCT) or conventional coronary angiography (CCA). CTRI/2017/10/010030.

Results: Follow-up graft angiograms were done in 239 (75%) patients (MDCT in 190 patients and CCA in 49 patients). There is no statistically significant difference in overall graft patency at 3 months between on-pump [376 grafts/429 grafts (87.6%)] and off-pump [366 grafts/420 grafts (87.1%)] groups (p = 0.83). In the 3 coronary artery territories the patency rates of grafts were similar (left anterior descending coronary artery territory; p = 0.55, left circumflex coronary artery territory; p = 0.77, and right coronary artery territory; p = 0.64) between off-pump and on-pump groups. There is no significant difference in the patency rates of different bypass conduits (left internal thoracic artery (ITA); p = 0.66, right ITA; p = 0.97, radial artery graft p = 0.81; saphenous vein graft; p = 0.86) between off-pump and on-pump groups. There is no significant difference in mortality at 3 months [off-pump 1 (0.63%) patient vs. on-pump 3 (1.85%) patients (p = 0.32)] between the groups. There is no significant difference in the mean number of grafts per patient between on-pump group (3.64 ± 0.70) and off-pump group (3.45 ± 0.75) (p = 0.107).

Table: Graft Patency Between Off-Pump and On-Pump CABG

Number of Grafts	Off-Pump CABG Number (%)	On-Pump CABG Number (%)	P Value
Patent (742)	366 (87.14)	376 (87.65)	0.82
Occluded (107)	54 (12.86)	53 (12.35)	0.82
LAD territory (332)	147/165 (89.09)	152/167 (91.02)	0.55
LCx territory (301)	130/148 (87.84)	136/153 (88.89)	0.77
RCA territory (216)	89/107 (83.18)	88/108 (80.73)	0.64
LITA graft 236/256 (92.10)	118/129 (91.47)	118/127 (92.91)	0.66
RA graft 76/91(83.50)	38/45 (84.44)	38/46 (82.61)	0.81
RITA graft 41/50 (82.0)	23/28 (82.14)	18/22 (81.82)	0.97
SV graft 389/452 (86.06)	187/218 (85.78)	202/234 (86.32)	0.86

Conclusions: There is no significant difference in overall graft patency rates between off-pump and on-pump CABG groups. Further there is no difference in the graft patency among the 3 coronary artery territories and the different types of conduits between off-pump and on-pump CABG patients at 3 months. There is no difference in mortality and number of grafts per patient between the groups.

7. Septal Myectomy for Hypertrophic Cardiomyopathy: A Contemporary Analysis of 1,531 Myectomies in a Specialized HOCM Center

Kevin Hodges, Carlos Godoy Rivas, Jose Aguilera, Robert A. Borden, Alaa Alashi, Harry M Lever, *Lars Svensson, *A. Marc Gillinov, Gösta Pettersson, Per Wierup, *Bruce Lytle, Robert Stewart, *Hani K. Najm, Milind Y. Desai⁴, *Nicholas Smedira
Cleveland Clinic Foundation, Cleveland, OH

Invited Discussant: *Hartzell V. Schaff

Objective: Outcomes after septal myectomy are closely linked to hospital volume. This study evaluates operative approach and contemporary surgical outcomes for septal myectomies performed by a single surgeon (NS) at a high-volume, specialized hypertrophic cardiomyopathy (HOCM) center.

Methods: This is a retrospective review of 1,531 patients, undergoing extensive septal myectomy (Figure) for HOCM by a single surgeon from 2005 through 2015. Demographic profiles, echocardiogram-derived ventricular morphology and hemodynamics, operative data, and in-hospital outcomes were analyzed.

Results: 579 patients underwent an isolated septal myectomy (SM), 471 a myectomy with concomitant procedure (e.g., CABG, valve replacement, maze procedure, etc.) (SM-CP), and 481 a myectomy with mitral valve or subvalvular apparatus intervention (SM-MV). SM-MV interventions included anterior leaflet plication (44.9%), resection of chordae tendineae (35.3%), papillary muscle reorientation (25.3%), papillary muscle resection (18.7%), mitral valve debridement (6.2%) and posterior leaflet plication (4.8%). Mean preoperative resting gradients were similar for all groups (66.0 ± 45.9 mmHg for SM, 60.6 ± 46.6 mmHg for SM-CP, and 62.8 ± 44.5 mmHg for SM-MV, $p = 0.13$). SM-MV patients had thinner septums than patients undergoing SM or SM-CP (18.8 ± 3.0 mm for SM-MV vs. 21.6 ± 3.7 mm for SM and 20.7 ± 3.6 mm for SM-CP, $p = 0.001$). For SM, the mean cross-clamp time was 27.6 ± 10.2 minutes, mean cardiopulmonary bypass time was 37.9 ± 14.8 minutes, and median length of stay was 6 days (interquartile range 5.0–7.3 days). Less septal myocardium was removed for SM-MV patients compared to patients undergoing SM or SM-CP (6.9 ± 3.1 gm for SM-MV vs. 9.1 ± 4.0 gm for SM and 8.2 ± 3.7 gm for SM-CP, $p = 0.001$). The in-hospital permanent pacemaker rate for complete heart block was 4.2%. Rates varied depending on the presence of preoperative right bundle branch block (RBB): 1.5%, 10% and 100% for no RBB, incomplete RBB and complete RBB, respectively. Overall, there were 2 post-operative ventricular septal defects (0.2%) and none for SM. Operative mortality was 0.3%. Post-operatively, all groups achieved excellent hemodynamic results with similar resting LVOT gradients (15.0 ± 8.1 mmHg for SM, 15.7 ± 10.9 mmHg for SM-CP, 14.5 ± 7.8 mmHg for SM-MV, $p = 0.12$) and peak LVOT gradients after administration of amyl nitrate (24.7 ± 16.7 mmHg for SM, 24.7 ± 14.8 mmHg for SM-CP, 25.0 ± 15.8 mmHg for SM-MV, $p = 0.97$).

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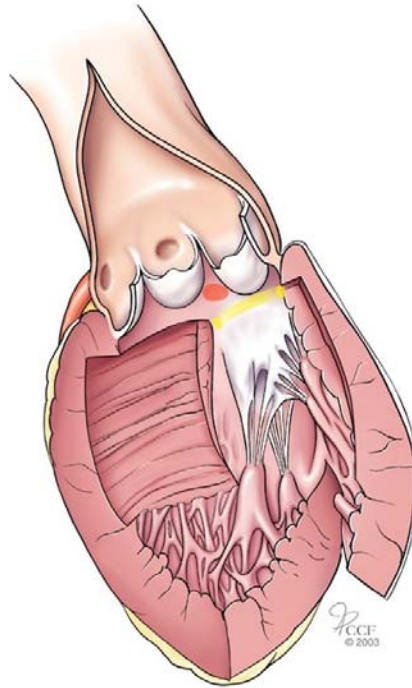


Figure. Extensive septal myectomy. The myectomy extends from trigone to trigone in all cases and into the depths of the ventricle as guided by the intraoperative transesophageal echocardiogram.

Conclusions: After myectomy, pacemaker requirement is uncommon, complications are infrequent and patients have a reliable reduction in both resting and, more importantly, provokable LVOT gradients. A mitral valve intervention is a useful adjunct in patients with moderate hypertrophy. Septal myectomy can be performed safely with excellent outcomes when the procedure is performed by a highly experienced surgeon in a high-volume, specialized center.

Late-Breaking Clinical Trial

LB1. Safety, Efficacy, and Hemodynamic Performance of a Stented Bovine Pericardial Aortic Valve Bioprosthesis: 2-Year Analysis

Francois Dagenais¹, Michael Moront², W. Morris Brown, III³, *Michael J. Reardon⁴, Michael W. A. Chu⁵, Cathy Zeng⁶, Robert J. M. Klautz⁷

¹Laval Hospital, Québec, QC; ²ProMedica Toledo Hospital, Toledo, OH; ³Piedmont Heart Institute, Atlanta, GA; ⁴Methodist DeBakey Heart and Vascular Center, Houston, FL; ⁵University of Western Ontario, London, ON; ⁶Medtronic, Mounds View, MN; ⁷Leiden University Medical Center, Leiden, Netherlands

Invited Discussant: *Song Wan

5:15 pm

AATS/AmSECT Welcome Reception

Exhibit Hall, SDCC

8. Comparison of Del Nido and Histidine-Tryptophan-Ketoglutarate Cardioplegia Solutions in Pediatric Patients Undergoing Open Heart Surgery: A Prospective Randomized Clinical Trial

*Sachin Talwar, Sujoy Chatterjee, Vishnubhatla Sreenivas, Neeti Makhija,
Poonam Malhotra Kapoor, Shiv Kumar Choudhary, Balram Airan

All India Institute of Medical Sciences, New Delhi, India

Invited Discussant: *Pedro J. del Nido

Objective: We conducted a first of its kind prospective randomized trial comparing del Nido (DN) cardioplegia with Histidine-tryptophan- ketoglutarate cardioplegia (HTK) in patients undergoing intracardiac repair of Tetralogy of Fallot (TOF).

Methods: 80 consecutive patients undergoing repair of TOF were randomized into DN (n = 43) and HTK (n = 37) groups. Cardioplegia strategy consisted of a single dose of DN (20 ml/Kg) or HTK (6 ml/kg/min for 5 minutes). Primary outcome was cardiac index (CI) that was measured four times intra- and post-operatively. Secondary outcomes were time to peripheral rewarming, duration of mechanical ventilation, inotropic score (IS), intensive care unit (ICU) and hospital stay, serum levels of Troponin-I (Trop-I), interleukin -6 (IL-6) and tissue necrosis factor-alpha (TNF - α). Ultrastructural changes in the myocardium were assessed on biopsy.

Table: del Nido Cardioplegia (DN) Versus Histidine-Tryptophan-Ketoglutarate (HTK) Cardioplegia

Parameter	DN (n=43)	HTK (n = 37)	p Value
Arrest time (sec)	27.1 \pm 8.76	32.2 \pm 12.76	0.02
Warming time (hrs)	4.3 \pm 2.2	5.8 \pm 5.95	0.015
CI-1 hr	3.5 \pm 0.6	3.4 \pm 1.3	0.003
CI-6 hrs	4.2 \pm 0.9	3.8 \pm 0.9	0.002
CI-24 hrs	4.8 \pm 0.9	4.1 \pm 0.9	0.002
IS-24 hrs	0.54 \pm 2.2	2.3 \pm 3.3	0.007
Trop-I	4.7 \pm 4.3	5.9 \pm 3.2	0.035
IL-6	56.1 \pm 27	69.6 \pm 35.3	0.005
ICU stay (hrs)	36.2 \pm 16.7	48.5 \pm 16.4	0.02

Results: Both groups were comparable with regard to demographics, cardiopulmonary bypass and aortic cross clamp times and need for a transannular patch. Time taken for cardioplegic arrest was 24 \pm 9.67 versus 36.1 \pm 13.69 seconds in DN and HTK groups respectively (p = 0.03). Cardiac indices were significantly higher in DN group compared to HTK group at 1 (p = 0.003), 6 (0.002) and 24 hours (p = 0.002) following surgery. On

repeated measure regression analysis, the cardiac index was on an average 0.62 liter/min/m² higher in the DN group at any time point ($P = 0.001$). Duration of mechanical ventilation ($P = 0.04$), intensive care unit stay ($P = 0.02$) and hospital stay ($P = 0.001$) were significantly lower in the DN group. Patients in the DN group had lower Troponin I and IL6 release 24 hours following CPB ($P = 0.035$ and 0.005 respectively). Electron microscopic studies showed more myocardial edema and myofibrillar disarray in the HTK group ($p = 0.03$). DN cardioplegia was more cost-effective than HTK cardioplegia ($\$1.5 \pm 0.20$ versus $\$105.89 \pm 75.3$, $p = 0.002$).

Conclusions: Of the two long-acting cardioplegia solutions, the DN cardioplegia was associated with better preservation of cardiac index, less duration of mechanical ventilation, lower inotropic scores and lower occurrence of low cardiac state, less release of inflammatory markers and reduced costs and less ICU and hospital stay. Electron microscopy demonstrated less myocardial edema and better preservation of the myofibrillar architecture in the DN group. These findings need to be validated further in larger studies on patients with more complex diagnoses and in multiple set-ups.

9. Determinants of Acute Events Leading to Mortality After Shunt Procedure in Univentricular Palliation

Tomislav Santro¹, Ben Hobbes¹, *Yves d'Udekem², Diana Zannino³, Warwick Butt², *Igor E. Konstantinov², *Christian Brizard², Johann Brink²

¹University of Melbourne, Melbourne, Australia; ²Royal Children's Hospital, Melbourne, Australia; ³Murdoch Children's Research Institute, Melbourne, Australia

Invited Discussant: *Marshall L. Jacobs

Objective: We aimed to evaluate morbidity and mortality in patients destined for univentricular palliation and identify predictors of adverse outcomes after the shunt procedure.

Methods: A retrospective study of patients with univentricular lesions who underwent shunt placement, with or without a concomitant Norwood/DKS procedure, between 2004–2014 was conducted at a single institution. Shunts included modified Blalock-Taussig shunt (MBTS), RV-PA conduit and Central shunt.

Results: Overall, 293 patients met inclusion criteria, with 197 patients undergoing concomitant Norwood/DKS procedure. At time of shunt procedure, median age was 3 days (interquartile range, 2–7) and mean weight was 3.3 ± 0.8 kg. Overall, 30-day mortality was 8.5%, and in-hospital mortality was 15.4%. Interstage mortality was 6.8%. Progression to bidirectional cavo-pulmonary shunt (BCPS) was achieved in 76.8% of patients. Acute events occurred in 79 (27%) patients, with 65% (51/79) occurring in the first 72 hours after surgery. These events precipitated 27 emergency chest openings and 40 ECMO, leading to 34 (11.6%) in-hospital deaths. Of all in-hospital deaths, 76% had a preceding acute event. Main causes of acute events were 20 shunt thrombosis, 6 pulmonary overcirculation and others. Shunt thrombosis was suspected in 28 (9.6%) patients, and 44 (15%) had pulmonary overcirculation. On multivariable analysis, risk factors associated with 30-day mortality or in-hospital mortality were incidence of an acute event (odds ratio [OR] = 15, $p < 0.001$), higher shunt size/weight ratio (OR = 1.2 per 0.1 unit increase, $p = 0.014$) and preoperative shock/acidosis (OR = 3.95, $p = 0.005$).

Predictors of acute events were higher preoperative platelet count (OR = 1.3 per 10 unit increase, $p = 0.045$). Higher postoperative pH was protective (OR = 0.61 per 0.1 unit increase, $p < 0.001$). Risk factors of shunt thrombosis associated with an acute event were increased postoperative hematocrit (OR = 2.22 per 0.1 unit increase, $p = 0.04$) and 3.0 mm shunt size (OR = 4.83, $p = 0.001$). DKS/Norwood procedure, shunt type, morphological diagnosis, or presence of extracardiac or genetic anomaly were not significant risk factors for 30-day mortality, in-hospital mortality, or acute events.

Conclusions: Over one-fifth of patients shunted during univentricular palliation will die before the next stage. The majority of these deaths are associated with an acute event occurring early after surgery. Patients with higher preoperative platelet counts may be at greater risk of having an acute event. However, higher postoperative pH may be protective. Risk of shunt thrombosis may be greater in patients with higher postoperative hematocrit and smaller shunt size. Patients undergoing Norwood/DKS are not necessarily at higher risk following shunt procedure. Strategies to improve survival should therefore focus on prevention and management of acute events.

10. Myocardial Recovery in Children with Heart Failure Supported with Ventricular Assist Device

Eva Maria Delmo Walter¹, Mariano Francisco del Maria Javier, III², André Rüffer³, Robert Anton Cesnjevar⁴, Alexander Horke¹, Dietmar Böthig¹, *Roland Hetzer²
¹Hannover Medical School, Hannover, Germany; ²Cardio Centrum Berlin, Berlin, Germany; ³University Hospital Erlangen, Erlangen, Germany; ⁴University Hospital Erlangen, Erlangen, Germany

Invited Discussant: *David L. Morales

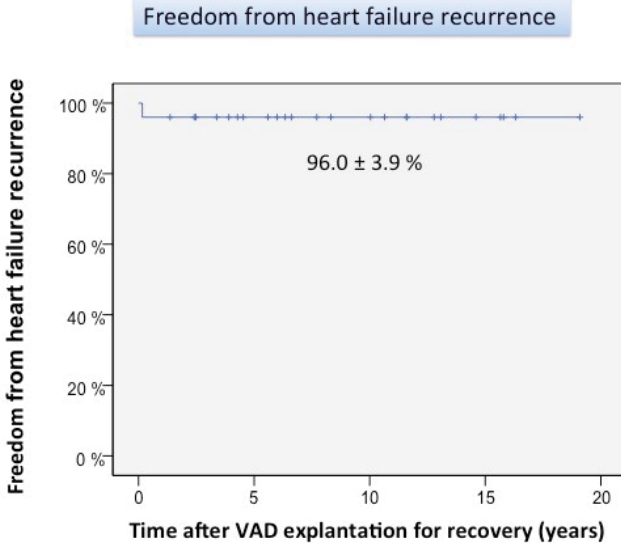
Objective: By unloading the ventricle with a ventricular assist device (VAD), complete myocardial recovery maybe achieved. Until now, there are **no factors** identified which could **predict** the potential to recovery. Likewise, if recovery occurs, there is no guarantee that it lasts after VAD explantation. Data on ventricular unloading-promoted myocardial recovery and post-weaning outcome in pediatric patients are scarce. Aiming at providing new data on this issue, we analyzed the weaning results in pediatric patients supported with VAD.

Methods: A multi-institutional data on VAD implantation in children with heart failure between April 1990 to November 2015 was retrospectively reviewed. Among 193 children and adolescents on whom Berlin Heart EXCOR was implanted, 25 patients (median age 1.25, range 0.058–16.3 years, 15 females) were eventually weaned from VAD (left = 19, biventricular = 6). Etiology of heart failure were myocarditis ($n = 11$), dilated cardiomyopathy ($n = 8$), postoperative heart failure ($n = 4$), intractable arrhythmia unresponsive to maximal medical therapy ($n = 1$) and acute graft failure ($n = 1$). Median disease duration before VAD implantation was 14 (range 1–700) days.

Results: Median duration of VAD support was 42 (range 11–700) days. Off-pump echocardiography and right heart catheterization were the cornerstones for assessment of myocardial recovery and weaning-decision making. Off-pump left ventricular (LV) ejection fraction (LVEF) $\geq 45\%$ and normalization of LV end-diastolic diameter (LVEDD) in consonance with normal hemodynamics at rest were considered as weaning

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requirements. Changes in LVEF, LVEDD and relative wall thickness (RWT) pre-implantation, before VAD explantation and follow-up were compared. LVEF and LVEDD have improved significantly ($p = 0.00$). RWT achieved numerical improvement but was not significant ($p > 0.75$). Presently, 22 (88.0%) among the weaned patients are alive with their native hearts 1.3–19.1 years after VAD explantation. Three (12.5%) patients died after weaning at 2.4, 3.3 and 15.6 years, respectively. One had a heart failure recurrence 3 months post-weaning and was transplanted.



Conclusions: Weaning from VADs is feasible including those with dilated cardiomyopathy. A high freedom of heart failure recurrence rate indicates that myocardial recovery after VAD explantation has been maintained. Post-weaning long-term cardiac stability appeared to be even higher than those reported for adult patients weaned from VADs.

11. Surgical Results of Unifocalization Revision

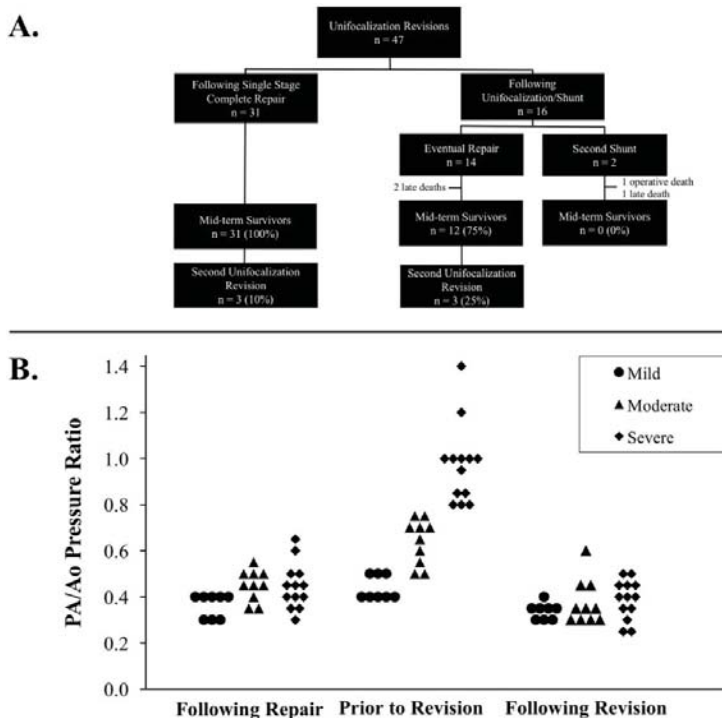
*Richard D. Mainwaring, William L. Patrick, Tatiana R. Rosenblatt, Michael Ma, Komal Kamra, Alisa Arunamata, *Frank L. Hanley
Stanford University, Stanford, CA

Invited Discussant: *Christian P. Brizard

Objective: The midline unifocalization has been developed for treatment of patients with pulmonary atresia with ventricular septal defect and major aortopulmonary collateral arteries (PA/VSD/MAPCAs). All of these patients will eventually require a re-operation due to the presence of a right ventricle to pulmonary artery conduit. However, some patients will also require revision of their unifocalization. The purpose of this paper was to evaluate the surgical results of unifocalization revision.

Methods: This was a retrospective study that evaluated a total of 254 patients who underwent midline unifocalization over a 16 year time period. 47 of the 254 (18%) patients have subsequently undergone unifocalization revision. The mean age at revision was 18 ± 5 months, and the median interval between unifocalization and unifocalization revision was 12 months. 31 of these patients had previously undergone a single stage complete repair, while 16 had unifocalization and placement of a central shunt. The median number of affected lung segments revised during surgery was 9 (range 4–18).

Results: The flow chart for all 47 unifocalization revision patients is summarized in Figure A. For the 31 patients who previously had a complete repair, there have been no early or late deaths. The peak systolic pulmonary artery to aortic pressure ratio was 0.44 ± 0.11 after the initial repair and increased by 0.38 to a mean of 0.82 ± 0.18 prior to revision. However, there was a wide range of pressure ratios prior to revision, including 8 patients categorized as mild (<0.50 , median of 6 segments affected), 10 categorized as moderate (>0.50 , <0.75 , median of 9 segments affected), and 13 who were severe (>0.75 , median of 12 segments affected). The mean pulmonary artery to aortic pressure ratio decreased to a mean of 0.41 ± 0.09 after unifocalization revision. These hemodynamic data are summarized in Figure B. Three of the 31 (10%) patients have subsequently undergone a second unifocalization revision.



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The 16 patients who previously had a unifocalization/shunt underwent unifocalization revision and complete repair in 14 and revision and repeat shunt in 2. Based on the number of affected lung segments requiring revision, the cases would be categorized as 4 mild, 8 moderate, and 4 severe. There was one operative mortality and three late deaths (25% total) in this cohort. Three (25%) of the 12 survivors have subsequently undergone a second unifocalization revision.

Conclusions: The data demonstrate that unifocalization revision can be performed with a successful outcome in the majority of cases. Patients who underwent an initial unifocalization/shunt had a much higher failure rate than patients who were initially repaired. These results suggest that unifocalization revision provides a valuable adjunct in the management of patients with PA/VSD/MAPCAs.

12. Intervention for Arch Obstruction in the Interstage Period Following Norwood: Prevalence, Risk Factors, and Practice Variability

Paul Joseph Devlin¹, Brian W. McCrindle¹, Pirooz Eghtesady², Bahaaladin Alsoufi³, Eugene H. Blackstone⁴, James M. Meza⁵, *William M. DeCamp⁶, *James K. Kirklin⁷, *Jeffrey P. Jacobs⁸, *Ali Dodge-Khatami⁹, *Kristine J. Guleserian¹⁰, James E. O'Brien, Jr.¹¹, *Erle H. Austin, III¹², *Peter J. Gruber¹³, Tara Karamlou¹⁴

¹The Hospital for Sick Children, Toronto, ON, Canada; ²St. Louis Children's Hospital, St. Louis, MO; ³Children's Healthcare of Atlanta, Atlanta, GA; ⁴Cleveland Clinic, Cleveland, OH; ⁵Duke University Medical Center, Durham, NC; ⁶Arnold Palmer Hospital for Children, Orlando, FL; ⁷University of Alabama at Birmingham, Birmingham, AL;

⁸Johns Hopkins All Children's Heart Institute, St. Petersburg, FL; ⁹University of Mississippi Medical Center, Jackson, MS; ¹⁰Nicklaus Children's Hospital, Miami, FL; ¹¹Children's Mercy Hospital, Kansas City, MO; ¹²Norton Children's Hospital, Louisville, KY; ¹³Children's Hospital of Philadelphia, Philadelphia, PA; ¹⁴Phoenix Children's Hospital, Phoenix, AZ

Invited Discussant: *J. William Gaynor

Objective: Arch obstruction after the Norwood procedure is common and it contributes to morbidity and mortality. We analyzed the prevalence, risk factors, and practice variability of intervention for arch obstruction after Norwood in a multicenter cohort of neonates with critical left heart obstruction.

Methods: From 2005–2017, 593 neonates in the CHSS (Congenital Heart Surgeons' Society) Critical Left Heart Obstruction cohort underwent a Norwood procedure. Competing risks methodology determined simultaneous risk and associated incremental risk factors for arch intervention and heart transplant or death. Variables analyzed included demographics, baseline echocardiography, and Norwood operative details.

Results: Of the 593 infants, 119 (20%) underwent 151 interventions for arch obstruction after Norwood: catheter (n = 115) or surgical (n = 36) prior to, or during, a stage II procedure at a median age of 3.9 months (IQR: 2.6–5.3). Of the catheter procedures, 21 (18%) occurred at pre-stage II catheterization, while 22 (61%) of the surgical aortic

repairs occurred during stage II procedure, heart transplant, or biventricular repair. From Norwood, competing risks analysis to first intervention demonstrated the distribution of patients among mutually-exclusive end-points (Figure 1). Intervention for arch obstruction was represented by a single early phase hazard. Interdigitation of the distal aortic anastomosis was protective against arch intervention ($p = 0.02$, reliability: 78%), while coarctectomy in general was not significant. Risk factors for arch intervention in the interstage period included the presence of a native tissue pulmonary artery to aorta anastomosis ($p = 0.02$, reliability: 78%), coronary sinusoids on preoperative echocardiography ($p = 0.05$, reliability = 66%), and longer cardiopulmonary bypass time ($p = 0.01$, reliability 67%). Variables that were not significant in the final multivariable model included shunt type, patch type, pre-operative aortic sizes, and aortic atresia. Among institutions, there was variation in the proportion of patients undergoing interstage arch intervention (range: 0–46% among the 18 institutions that contributed 5 or more patients to the cohort) and threshold (median pre-intervention gradient: 20.0 mmHg, IQR: 9.5–30.5, range 2.0–62.0, $n = 68/115$) for catheter arch intervention.

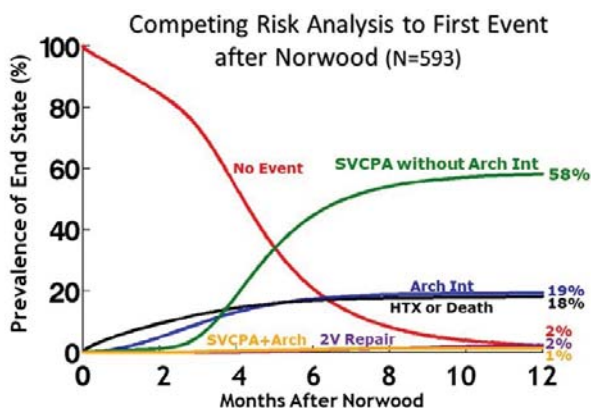


Figure 1: Competing risks modeling to first intervention after Norwood. The competing risks model demonstrates the time-related risk of patients assuming any of the mutually exclusive endstates after Norwood. Each of the lines is a parametric model derived from the intervals to the labeled end state for the entire group of 593 patients. SVCPA = Stage II procedure, Arch Int = Arch Intervention after Norwood, HTX = Heart Transplant, 2V = Biventricular.

Conclusions: Interdigitation of the distal aortic anastomosis and inclusion of patch material in the aortic anastomosis during the Norwood procedure decreased the high risk of subsequent aortic obstruction. Serial surveillance for arch obstruction, including assessing changes in systemic RV function and tricuspid insufficiency, is needed to further define the impact of arch obstruction. A standardized definition of arch obstruction is needed to improve analysis of its role in morbidity and mortality during the interstage period.



13. Characteristics and Operative Outcomes for Children Undergoing Repair of Truncus Arteriosus: A Contemporary Multicenter Analysis

Christopher W. Mastropietro¹, Venu Amula², Peter Sassalos³, Jason R. Buckley⁴, Ilias Iliopoulos⁵, Christine M. Riley⁶, Aimee Jennings⁷, Keshava Murty Narayana Gowda⁸, Adnan M. Bakar⁹, Michael Wilhelm¹⁰, Aditya Badheka¹¹, Elizabeth A.S. Moser¹, John M. Costello¹²

¹Indiana University, Indianapolis, IN; ²University of Utah, Salt Lake City, UT; ³University of Michigan, Ann Arbor, MI; ⁴Medical University of South Carolina, Charleston, SC; ⁵Cincinnati Children's Hospital, Cincinnati, OH; ⁶Children's National Health System, Washington, DC; ⁷Seattle Children's Hospital, Seattle, WA; ⁸Cleveland Clinic, Cleveland, OH; ⁹Cohen Children's Medical Center, New Hyde Park, NY; ¹⁰University of Wisconsin, Madison, WI; ¹¹Stead Family Children's Hospital, Iowa City, IA; ¹²Northwestern University Feinberg School of Medicine / Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL

Invited Discussant: *Thomas L. Spray

Objective: Using a multicenter dataset, we sought to describe the contemporary characteristics and operative outcomes of children who underwent repair of truncus arteriosus. We also aimed to identify risk factors for the occurrence of major adverse cardiac events (MACE) in the immediate postoperative period.

Methods: We conducted a retrospective review of children who underwent repair of truncus arteriosus between 2009 and 2016 at 12 tertiary care referral centers within the United States. Patients with concomitant aortic arch obstruction or interrupted aortic arch were excluded. MACE was defined as need for postoperative extracorporeal membrane oxygenation (ECMO), CPR, and/or operative mortality (as defined by the Society of Thoracic Surgeons Congenital Heart Surgery Database). Descriptive data are provided as median (25%, 75%) and counts (%). Linearity in the logit was examined for continuous variables prior to model-building; variables with evidence of non-linearity were converted to categorical variables. Risk factors for MACE were identified using multivariable logistic regression analysis and reported as odds ratios (OR) with 95% confidence intervals (CI).

Results: We included 160 patients, 56% (n = 90) of whom had Collette and Edwards Type 1 truncus arteriosus (i.e., an identifiable main pulmonary artery segment), 39% (n = 63) had Type 2, 4% (n = 6) had Type 3, and one patient had hemitruncus. Thirty patients (19%) were born prematurely, 45 (28%) had DiGeorge syndrome, and 55 (33%) had non-cardiac anatomic abnormalities. Median age at surgery was 9 days (6,20). Concurrent truncal valve repair or replacement was performed in 27 (17%) cases and 75 (46%) children received inhaled nitric oxide therapy postoperatively. MACE occurred in 34 patients (21%): 16 required postoperative ECMO (10%), 20 required CPR (12.5%), and operative mortality was 7.5% (n = 12) and did not vary significantly over time. Bivariate analyses assessing potential risk factors for MACE are provided in the Table. With multivariable logistic regression analysis (which included adjustment for center effect), factors independently associated with MACE were failure to diagnose truncus arteriosus prior to discharge from the nursery (OR: 2.9; 95% CI: 1.1–7.7), duration of cardiopulmonary bypass greater than 150 minutes (OR: 4.3; 95% CI: 1.5–12.1), and right ventricle-to-pulmonary artery (RV-PA) conduit (indexed to body surface area) greater than 50 mm/m² (OR: 6.3; 95% CI: 2.0–19.1).



Table. Comparison of Patients With and Without Major Adverse Cardiac Events (MACE) after Repair of Truncus Arteriosus (2009 – 2016).

^a Variable	All patients (N=159)	No MACE (n=125)	MACE (n=34)	p-value
Prenatal diagnosis (n)	95 (59%)	76 (60%)	19 (56%)	0.64
Prematurity (<37 weeks)	30 (19%)	21 (17%)	9 (27%)	0.19
Female sex (n)	80 (50%)	62 (49%)	18 (53%)	0.70
Age at diagnosis (days)	0 (0, 2.5)	0 (0, 2)	0 (0, 3)	0.41
Diagnosis before discharge (n)	121 (76%)	99 (79%)	22 (65%)	0.09
Chromosomal anomaly, any (n)	62 (39%)	50 (40%)	12 (35%)	0.64
DiGeorge/22q.11 deletion (n)	45 (28%)	39 (31%)	6 (18%)	0.13
Non-cardiac anatomic anomaly (n)	55 (34.4%)	41 (32.5%)	14 (41.2%)	0.35
^b Preoperative inotropic infusion (n)	22 (14%)	20 (16%)	2 (5.9%)	0.17
^b Preoperative ventilation (n)	32 (20%)	24 (19%)	8 (24%)	0.51
Preoperative shock (n)	15 (9.4%)	10 (7.9%)	5 (15%)	0.32
Age at surgery (days)	9 (6, 20)	8 (6, 16)	12.5 (6, 37)	0.11
Body surface area (m ²)	0.20 (0.18, 0.22)	0.20 (0.18, 0.22)	0.21 (0.17, 0.23)	0.69
Cardiopulmonary bypass (min)	146 (125, 180)	144 (124, 175)	158 (139, 223)	0.02
Aortic cross clamp (min)	85 (72, 105)	85 (70, 106)	84 (78, 102)	0.28
Hypothermic circulatory arrest (n)	15 (9.4%)	12 (9.5%)	3 (8.8%)	1.00
Intraoperative steroids (n)	117 (73%)	96 (76%)	21 (62%)	0.09
Truncal valve repaired (n)	27 (17%)	21 (17%)	6 (18%)	0.91
^c RV-PA conduit size (mm)	11 (9, 12)	10 (9, 12)	12 (9, 12)	0.04
^c RV-PA conduit size (mm/m ²)	52 (47, 57)	50.6 (45, 57)	53.9 (52, 58)	0.01

^a Continuous variables represented as median (25th%, 75th); categorical data represented as absolute counts (%)

^b Within 24 hours of surgery

^c n=156 patients - Four patients did not require right ventricle-to-pulmonary artery (RV-PA) conduits: 3 underwent direct anastomosis of main PA or PA confluence to RV, and one patient with hemitruncus. None of these patients experienced MACE

Conclusions: In a contemporary multicenter analysis, 21% of children undergoing repair of truncus arteriosus experienced MACE. Early diagnosis, shorter duration of cardiopulmonary bypass, and use of relatively smaller diameter RV-PA conduits, which are likely associated smaller ventriculotomy incisions, are modifiable factors that may decrease morbidity and mortality after repair of truncus arteriosus.

* AATS Member ♦ AATS New Member † AmSECT Member

14. Thirty-Year Experience in Pediatric Heart Transplantation for the Failing Fontan

Joshua Michael Rosenblum, Brendan P. Lovasik, Scott Gillespie, William T. Mahle,

*Kirk R. Kanter

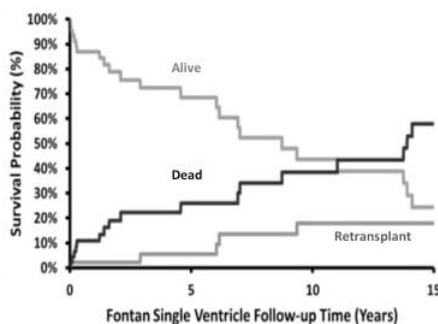
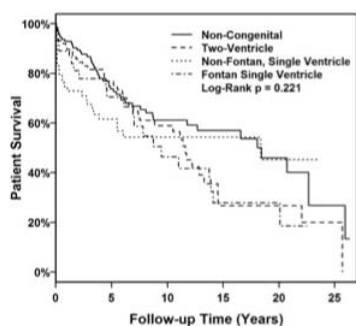
Emory University, Atlanta, GA

Invited Discussant: ♦Ryan R. Davies

Objective: Patients with failing Fontan circulation may require heart transplantation, often with inferior outcomes compared with either non-Fontan or non-congenital recipients. We examined long-term survival in pediatric heart transplant recipients with failed Fontans as compared with other heart recipients.

Methods: We reviewed 319 consecutive primary heart transplants (mean age 3.23 y; IQR 2.69–3.88 y) from 1/1988 to 5/2017. Underlying diagnosis was idiopathic cardiomyopathy (CM) in 126 (39.5%), two-ventricle physiology (2V) in 88 (27.6%), non-Fontan single ventricle (1V) in 59 (18.5%), and Fontan in 46 (14.4%). Preoperative characteristics were similar between groups, although 1V patients were significantly younger than Fontan patients at the time of transplant (0.8 y vs. 8.9 y, $p < 0.001$).

Results: Over the study period, the number of annual heart transplants increased, with increasing numbers of Fontan and 2V recipients, especially over the last 5 years. CM patients were more likely to be listed status 1A although there were no statistically significant differences in time on list between the groups ($p = 0.139$). Pretransplant mechanical ventilation was required in 16% of patients, and mechanical circulatory support was needed in 11.3%, with the highest need in CM patients (25/126, 19.8%). In the Fontan group, protein-losing enteropathy and plastic bronchitis were present in 11 patients (24%) and resolved in 9 (82%) of those patients after transplant. Bypass time and donor ischemia time were significantly longer in the Fontan group (mean 201 min and 209 min, respectively, $p < 0.001$) compared to all other recipient groups. Fontan and 1V patients had significantly longer post-transplant ICU stays, ventilator requirements, vasoactive needs, and total hospital stays as compared to 2V and CM patients ($p < 0.001$). Thirty-day survival was excellent in the Fontan (97.8%) and CM groups (98.4%), but lower in the 2V (93.2%) and 1V (89.8%) groups. Median follow-up in the entire cohort was 12.86 y, 18.4 y in the CM group, 11.6 y in the 2V group, 18.4 y in the 1V group, and 9.5 y in the Fontan group. Survival was similar among groups, although after 10 years the CM and 1V patients had better survival (Figure). In the Fontan group, competing risk analysis showed retransplant-free survival at 5, 10, and 15 years was 70%, 45%, and 25% (Figure).



Conclusions: Transplantation is a reasonable option for patients with a failing Fontan. While others have shown inferior outcomes after transplant for a failed Fontan, we show similar long-term outcomes to congenital and non-congenital cardiomyopathy patients. Further studies are needed to evaluate the expanding role of mechanical support as a bridge to transplantation or as destination therapy for these challenging patients.

Late-Breaking Clinical Trial

LB2. Targeted Increase in Pulmonary Blood Flow in a Bidirectional Glenn Circulation (Super Glenn Procedure)

Aditya Kaza, Samuel Casella, James Lock, Sitaram Emani, Chris Baird, Pedro del Nido
Boston Children's Hospital, Boston, MA

Invited Discussant: *William M. DeCamp

5:15 pm

AATS/AmSECT Welcome Reception

Exhibit Hall, SDCC

3:15 pm

**General Thoracic Surgery
Simultaneous Scientific Session**

Room 25ABC, SDCC

6 minute presentation, 9 minute discussion

Moderators: *Jessica S. Donington and *David R. Jones

15. Adjuvant Chemotherapy Improves Survival in Patients with Nodal Metastases After Neoadjuvant Therapy and Esophagectomy

Justin Drake, Kurt Tauer, David Portnoy, *Benny Weksler
University of Tennessee, Memphis, TN

Invited Discussant: ♦Daniela Molena

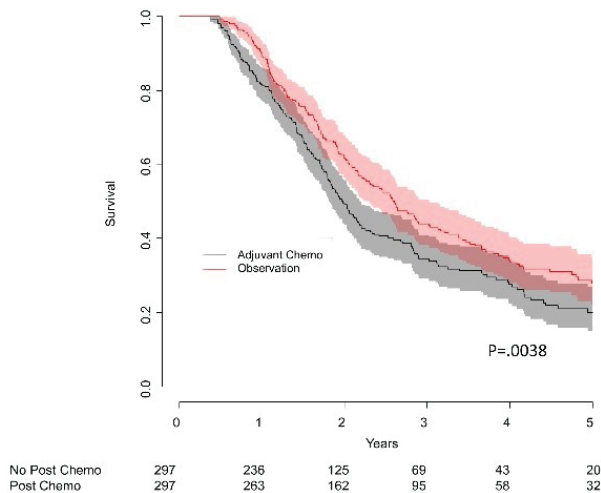
Objective: To determine the role of adjuvant chemotherapy in patients with esophageal adenocarcinoma who are found to have nodal metastases after neoadjuvant therapy and esophagectomy.

Methods: The National Cancer Database (NCDB) was queried for all patients with esophageal adenocarcinoma who underwent esophagectomy with complete resection, received neoadjuvant chemotherapy and radiotherapy, and were found to have lymph node metastases. Patients who received adjuvant chemotherapy were compared with patients who did not receive adjuvant therapy and were followed with observation only. Propensity score matching was performed to create a well-balanced cohort based on age, race, sex, treatment facility, Charleston-Deyo comorbidity score, tumor grade, tumor size, number of positive lymph nodes, and AJCC T stage. Survival was analyzed by the Kaplan-Meier method with log-rank analysis. Significance was set at $p = 0.05$.

Results: We identified 2132 patients from 2006 to 2012 who received induction chemoradiotherapy followed by esophagectomy but had positive lymph nodes on final pathology. In the unmatched cohort, 297 of these patients received adjuvant chemotherapy, and 1835 patients did not. Patients in the adjuvant chemotherapy group were significantly younger (57.9 vs. 61.2 years), had more positive lymph nodes (3.4 vs. 2.8), and

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were more likely to be male and have private insurance. The median survival in the unmatched cohort was 2.6 years for patients who received adjuvant chemotherapy and 2.1 years for patients with observation only ($p = 0.0013$). Five-year survival was 27.9% in the patients who received adjuvant chemotherapy and 21.5% in the patients who did not. Propensity score matching was performed to create a balanced cohort of 297 well-matched pairs. In the matched cohort, the median survival was 2.0 years in the observation only group versus 2.6 years in patients who received adjuvant chemotherapy ($p = 0.0038$). Five-year survival was 20.2% in the patients who were followed with observation only as compared with 27.9% in the patients who received adjuvant chemotherapy (Figure 1).



Conclusions: In a large, propensity-matched cohort from the NCCDB, adjuvant chemotherapy significantly improved survival for patients with node-positive esophageal adenocarcinoma after induction therapy and complete resection. This finding contradicts current guidelines recommending observation only for this group of patients.

16. Local Failure After Stereotactic Body Radiation Therapy (SBRT) or Wedge Resection for Colorectal Pulmonary Metastases

David B. Nelson, Quynh-Nu Nguyen, Jeremy J. Erasmus, Nabihah Tayob, Kyle G. Mitchell, *Wayne L. Hofstetter, Boris Sepesi, *Garrett L. Walsh, *Ara A. Vaporciyan, *Stephen G. Swisher, Mara B. Antonoff, *Jack A. Roth, *David C. Rice, *Reza J. Mehran

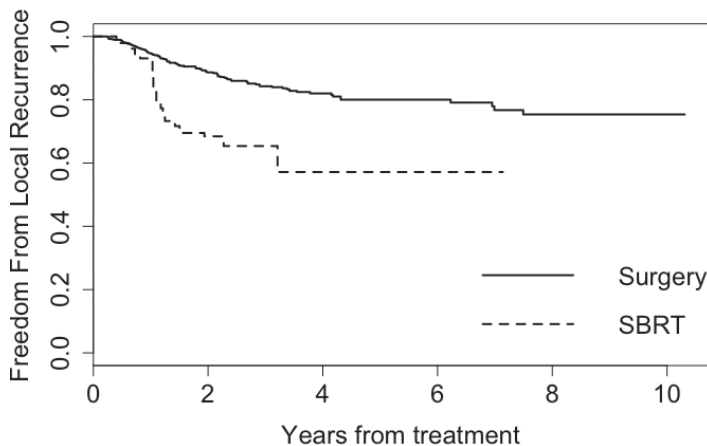
MD Anderson Cancer Center, Houston, TX

Invited Discussant: *Hiran C. Fernando

Purpose: Several therapeutic options are currently available for local therapy of colorectal pulmonary metastases. However, outcomes reported for these modalities have been limited. We sought to evaluate the risk of local failure after wedge resection or stereotactic body radiation therapy (SBRT) in the treatment of pulmonary metastases from a colorectal primary origin.

Methods: A retrospective review of patients who were treated with SBRT or wedge resection from 2006 to 2016 at a single institution was performed. Local recurrence was defined as an enlarging nodule either adjacent to the staple line or within the radiation field on CT imaging. Propensity for treatment was estimated using the following variables: size, disease-free interval, grade, lymphovascular invasion, perineural invasion, CEA level, receipt of pre-procedure chemotherapy, and KRAS mutational status. Hierarchical Cox regression with inverse probability weighting was used to estimate risk of local failure. Risk of local failure was calculated per nodule treated with repeating events analysis, adjusting for clustering by patient.

Results: 381 patients met inclusion criteria, who underwent 762 wedge resections and 64 courses of SBRT for definitive treatment of 826 pulmonary nodules. Median survival was 5.8 years after the first treatment. Local recurrence within 2 years for each nodule was 12.3% (95% CI 6.8–17.5) after surgery and 30.5% (95% CI 23.8–36.5) after SBRT. Local failure was increased with larger tumor size (HR 1.62 per each additional cm, $p = 0.007$) and treatment with SBRT (HR 3.05, $p < 0.001$). Additionally, SBRT showed a greater risk of failure if the tumor was poorly differentiated (HR = 13.01, $p < 0.001$), as opposed to if the tumor was well-moderately differentiated (HR = 2.31, $p = 0.037$), with a statistically significant interaction between tumor grade and local treatment strategy. (p [interaction] = 0.049). Factors that were not associated with local recurrence included KRAS mutational status, disease-free interval, lymphovascular invasion and response to pre-procedure chemotherapy.



Conclusions: Colorectal pulmonary nodules that are treated with SBRT have an increased risk of local failure as compared to wedge resection, especially among poorly differentiated tumors. SBRT should be reserved for patients with comorbidities precluding surgical resection.

17. Pushing the Limits of DCDD Lung Transplantation: What Is the Impact of the Interval Between Withdrawal of Life Sustaining Therapies to Asystole?

Robert Qaqish, Konrad Hoetzenecker, Yui Watanabe, Jonathan Yeung, Ricardo Zamel, Manyin Chen, Andrew Pierre, *Kazuhiro Yasufuku, Laura Donahoe, *Marc de Perrot, *Thomas K. Waddell, *Shaf Keshavjee, *Marcelo Cypel

University of Toronto, Toronto, ON, Canada

Invited Discussant: *Sudish C. Murthy

Objective: Acceptance of lungs from donors after circulatory determination of death (DCDD) has been generally restricted to donors that arrest within 60 min after withdrawal of life sustaining therapies (WLST). Herein, we aimed to determine the effect of the interval between WLST to asystole and recipient outcomes. Secondly, we aimed to compare outcomes between DCDD transplants with recipients who received organs from donation after neurological determination of death (DNDD).

Methods: A single center retrospective review was performed analyzing clinical outcomes from a single institution in transplant recipients who received DCDD donor lungs and those who received lungs from DNDD donors. DCDD donors were then grouped based on their interval between WLST and asystole: 0–19 min (rapid), 20–59 min (intermediate), and ≥60 min (long). Recipient outcomes from each of these groups were compared.

Results: A total of 156 DCDD and 998 DNDD cases were reviewed between 2007–2017. There were no significant differences in the two groups in terms of age, gender, diagnosis, type of transplant (bilateral vs. single) and cardiopulmonary support. Median survival of recipients who received DCDD versus DNDD donor lungs was 8.0 and 6.9 years, respectively (Figure 1A, $p = 0.99$). The incidence of primary graft dysfunction grade 2 and 3 at 72 hours post-transplant was 15.4% (24/156) and 14.1% (22/156), respectively for DCDD recipients and 17.7% (177/998) and 9.0% (90/998), respectively for DNDD recipients ($p = 0.31$). *Ex-vivo* lung perfusion (EVLP) was utilized in 102 (65%) DCDD and 135 (14%) DNDD donor lungs ($p < 0.0001$). Within the DCDD and DNDD groups, no significant differences in recipient survival was found in those that received lungs that underwent EVLP versus those that did not. Median total hospital length of stay (23 d IQR:30 d vs. 25 d IQR:31 d, $p = 0.98$), ICU stay (4 d IQR:14 d vs. 4 d IQR:12 d, $p = 0.66$ Figure 1B) and mechanical ventilation days (2 d IQR:5 d vs. 2 d IQR:5 d $p = 0.90$) were similar in both DCDD and DNDD groups, respectively. Time between WLST and asystole was available for 131/156 (84%) donors from the DCDD group. Mean and median time from WLST to asystole was 27.8 min and 16 min, respectively. Seventeen donors required >60 min to arrest with the longest duration being 154 min before asystole was recorded. All of these donors were evaluated on EVLP before transplant. Recipients of DCDD lung donors who arrested between 0–19 min (82 donors), 20–59 min (32 donors) and >60 min (17 donors) did not demonstrate any significant differences in terms of short and long-term survival (Figure 1C), ICU stay (Figure 1D), mechanical ventilation days or total hospital stay.

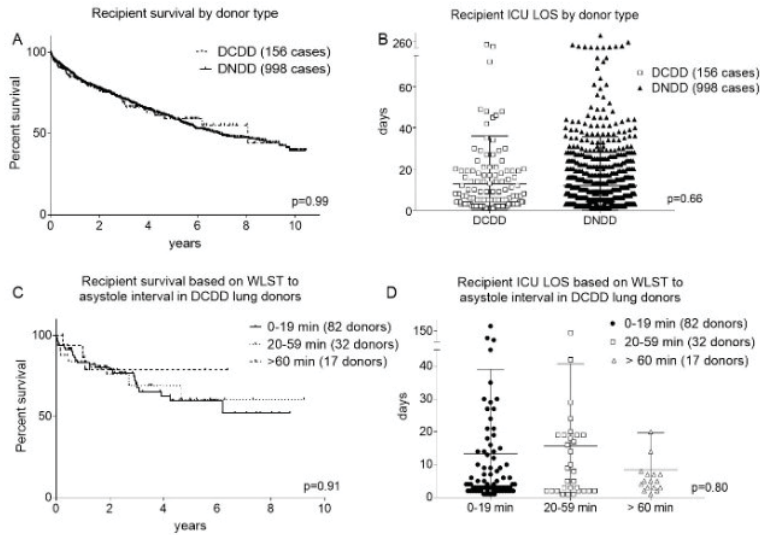


Figure 1: A) Lung transplant recipient survival plot comparison by donor type ($p=0.99$ by Log-rank), B) Recipient intensive care unit (ICU) length of stay (LOS) based on donor type ($p=0.66$ by Mann-Whitney), C) Lung transplant survival plot comparison based on DCDD donor interval from withdrawal of life sustaining therapies (WLST) to asystole ($p=0.91$ by Log-rank), D) Recipient ICU LOS based on DCDD donor interval from WLST to asystole ($p=0.80$ by Kruskal-Wallis).

Conclusions: Short and long-term outcomes in recipients who received DNDD versus DCDD donor lungs are similar. Long WLST to asystole intervals had no influence on recipient outcomes. The maximum acceptable duration of this interval has yet to be established.

Late-Breaking Clinical Trial

LB3. Prospective Study of Quality of Life After Esophagectomy with a Focus on Minimally Invasive Esophagectomy

Arjun Pennathur, Ryan M. Levy, Manuel Villa Sanchez, Matthew J. Schuchert, Omar Awais, Julie Ward, William E. Gooding, Rodney J. Landreneau, Inderpal Sarkaria, Rajeev Dhupar, Neil A. Christie, *James D. Luketich
University of Pittsburgh, Pittsburgh, PA

Invited Discussant:

* AATS Member ♦ AATS New Member † AmSECT Member

18. Wide Disparity in Compliance with National Comprehensive Cancer Network Guidelines in the Treatment of Malignant Pleural Mesothelioma

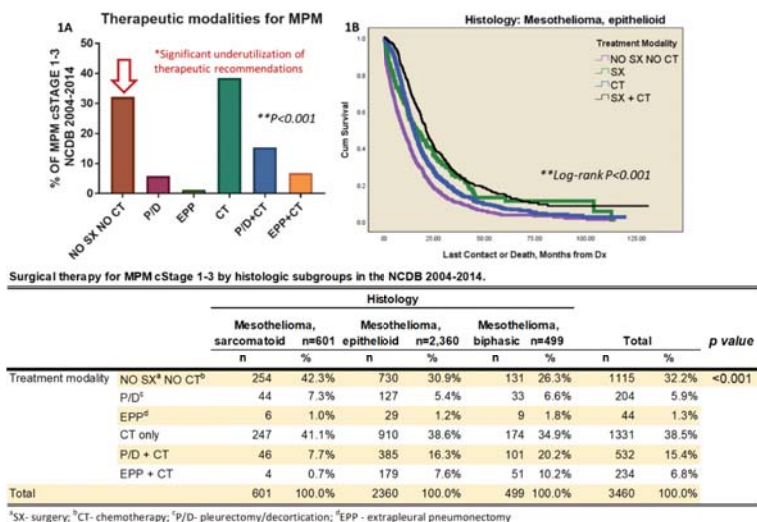
Fernando Espinoza-Mercado, David Berz, Jerald Borgella, Rodrigo Alban, Hrag Bairamian, Taryne Imai, Harmik J. Soukiasian

Cedars-Sinai Medical Center, Los Angeles, CA

Invited Discussant: ♦Bryan M. Burt

Objective: Current national comprehensive cancer network (NCCN) guidelines support the use of surgery in resectable epithelioid malignant pleural mesothelioma (MPM) (pleurectomy/decortication P/D or extra-pleural pneumonectomy EPP) for clinical stage I-III. Our objective is to assess the compliance with the recommended guidelines and their impact on overall survival (OS), using the National Cancer Database (NCDB).

Methods: The NCDB participant user file (2004–2014) was queried for patients diagnosed with MPM clinical stages I-III. Histologic subtypes were categorized and compared based on treatment modality (Table). Socio-demographic data, as well as comorbidity scores, were analyzed using a multivariable logistic regression model to identify factors independently predictive of those treated with surgery. OS was evaluated using Kaplan-Meier survival estimates and Cox proportional hazard modeling. A subgroup analysis was also performed based on facility type.



Results: 3,834 patients with clinical stages I-III met criteria for analysis. They were comprised of epithelioid (68.5%), sarcomatoid (16.6%), and mixed subtype (14.8%). Treatment was quite varied in the epithelioid cohort; 30.9% had no treatment, 38.6% received chemotherapy only, 6.6% underwent surgery only. The standard of care was significantly underutilized, with only 23.9% undergoing surgery plus chemotherapy ($p < 0.001$) (Figure 1A). Median survival estimates were: 10.2 months for no treatment, 15.2 months for chemotherapy only, 16.7 months for surgery only, and 21.5 months for surgery plus chemotherapy (Log-rank $p < 0.001$ Figure 1B). A significant increase

in OS was observed in patients undergoing surgery plus chemotherapy, irrespective of the surgical approach; P/D (hazard ratio [HR] 0.45, 95% CI 0.40–0.52, $p < 0.001$) and EPP (HR 0.44, 95% CI 0.37–0.53, $p < 0.001$; reference: no treatment). After adjusting for stage and comorbidities, academic institutions had the highest compliance with guidelines (adjusted odds ratio [AOR] 2.27 95% CI 1.65–3.11, $p < 0.001$) compared to non-academic institutions. Treatment based on histologic subgroup analysis revealed non-compliance with NCCN guidelines in 14% of sarcomatoid cases (stage I-III) underwent P/D, 1.7% EPP. Mixed subtype cases (stage I-III), 21.3% had P/D and 8.1% EPP, both with a modest OS benefit.

Conclusions: There is a lack of compliance with the NCCN recommendations for treatment of epithelioid mesothelioma, particularly in the non-academic setting. Our findings demonstrate a survival advantage for patients undergoing surgery plus chemo as recommended by the NCCN guidelines for this patient population. Adherence to the recommended therapy, of surgery plus chemotherapy, provides long-term OS benefit.

19. Redefining the Optimal Local Therapy for Early Stage Small Cell Lung Cancer

Kathryn E. Engelhardt¹, *Malcolm M. DeCamp¹, *Chadrick E. Denlinger²,

*Shari Lynn Meyerson¹, Ankit Bharat¹, David D. Odell¹

¹Northwestern University, Chicago, IL; ²Medical University of South Carolina, Charleston, SC

Invited Discussant: *Stephen C. Yang

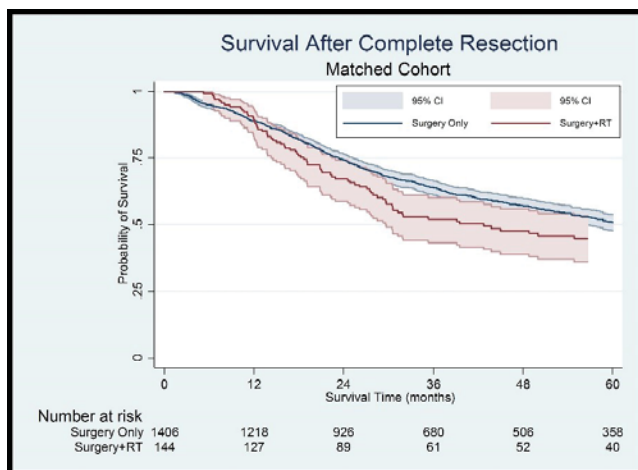
Objective: Surgery is indicated for localized small cell lung cancer (SCLC) but the role of adjuvant radiation (RT) in completely resected (R0), node-negative (N0) cancers is unclear. We sought to determine if there is an overall survival (OS) benefit to the addition of thoracic RT following R0 resection of pathologic (p) T1/2N0M0 SCLC.

Methods: Using the National Cancer Database, we performed a retrospective cohort analysis. Patients who underwent R0 resection for pT1/2N0M0 SCLC, stratified by receipt of adjuvant RT, were compared on the basis of OS using Kaplan-Meier and hierarchical Cox Proportional hazards models. We limited our analysis to patients who received thoracic RT (and excluded patients who only received RT to distant sites, e.g., brain, spine). To reduce confounding bias, we repeated our analysis on two additional cohorts: a young, healthy cohort (zero comorbidities, age <70 years) as well as a propensity score matched cohort, matched on the basis of tumor characteristics, receipt of chemotherapy, patient demographics, patient comorbidities, and treating facility (1:1 matching, replacements allowed, caliper distance 0.1).

Results: Of 28,686 patients diagnosed with pT1/2N0M0 SCLC from 2004–2014, 1668 (5.8%) underwent R0 resection of their primary tumor; of these resected patients, 160 (9.6%) had adjuvant thoracic RT. In unadjusted analysis (Figure), there was no significant difference in OS between groups (Median survival: surgery alone = 60.0 months vs. surgery + RT = 39.5 months; $p = 0.1052$). In multivariable analysis, RT was not associated with better survival ($p = 0.115$). In addition, increasing age (HR 1.03; $p < 0.001$), 2 or more comorbid conditions (HR = 1.31; $p = 0.01$), sublobar resection (as compared to lobectomy, HR = 1.54; $p < 0.001$), and being treated at a high-volume academic center (HR = 1.64; $p = 0.03$) were associated with worse survival whereas receipt of

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chemotherapy (HR = 0.77; $p = 0.002$), female sex (HR = 0.85; $p = 0.04$) and black race (HR = 0.78; $p = 0.04$) were associated with improved survival. After limiting our sample to healthy young patients, there was still no significant difference in unadjusted ($p = 0.97$) or adjusted ($p = 0.821$) survival associated with receipt of radiation therapy. Furthermore, after matching patients in each cohort, we found no difference in unadjusted ($p = 0.132$) or adjusted ($p = 0.115$) survival between matched groups.



Conclusions: Surgery remains a vastly underutilized local treatment for node negative SCLC. The addition of thoracic radiation therapy to complete resection does not appear to confer a survival benefit for these patients. Surgical resection should be considered optimal local therapy in pN0 patients avoiding the expense and potential morbidity of thoracic RT.

20. Lack of Correlation Between Short and Long-Term Outcomes Following Lung Cancer Surgery

*Felix G. Fernandez¹, Andrzej Kosinski², ♦Betty C. Tong², *Anthony P. Furnary³, *Mark W. Onaitis⁴, *Daniel J. Boffa⁵, *Cameron D. Wright⁶, Patricia Copwer², *Jeffrey P. Jacobs⁷, Robert Habib⁸, *Joe B. Putnam, Jr.⁹

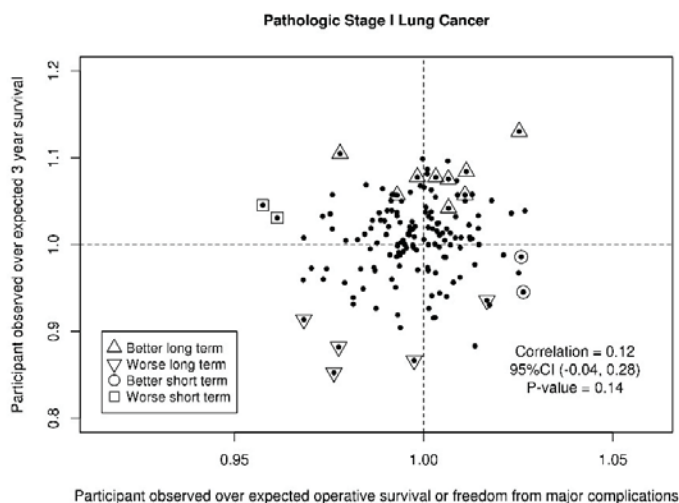
¹Emory University, Atlanta, GA; ²Duke University, Durham, NC; ³Starr-Wood Cardiac Group, Portland, OR; ⁴University of San Diego California, La Jolla, CA; ⁵Yale University, New Haven, CT; ⁶Massachusetts General Hospital, Boston, MA; ⁷Johns Hopkins All Childrens Hospital, St. Petersburg, FL; ⁸Society of Thoracic Surgeons, Chicago, IL; ⁹MD Anderson Baptist Cancer Center, Jacksonville, FL

Invited Discussant: *Varun Puri

Objective: Outcomes for lung cancer surgery are currently measured by perioperative (short-term) morbidity and mortality. However, the oncologic efficacy of the surgery is reflected by long-term survival. We examined whether correlation exists between measures of short-term performance and long-term performance (survival) for lung cancer surgery.

Methods: The Society of Thoracic Surgeons (STS) General Thoracic Surgery Database (GTSD) linked to Medicare survival data was queried for pathologic stage I lung cancer resected between 2009–13. Multivariable modeling was used to create 2 separate models: 1) short-term: avoidance of perioperative major morbidity and mortality (in-hospital or <30 days post-operative) and 2) long-term: conditional survival at 3 years. Standardized incidence ratios (SIRs) were calculated to assess each participant's risk-adjusted rate against that of a hypothetical average participant for the short- and long-term time points. 90% Bayesian credible intervals were used to determine high, average and low performers. The correlation of program SIRs for short- and long-term performance was assessed with the Pearson's correlation coefficient.

Results: The study population included 12,586 patients from 151 participating programs. A total of 2 (1.3%) programs were worse than expected and 2 (1.3%) better than expected at avoiding perioperative major morbidity and mortality (short-term outcome). On the other hand, for 3-year survival (long-term outcome), 5 (3.3%) programs achieved worse than expected and 9 (6%) better than expected survival. Interestingly, there was no significant correlation observed between a program's ability to avoid perioperative adversity (short-term outcome) and the program's ability to achieve 3-year survival (long-term outcome), as shown in the Figure. For the long-term survival metric, better-than-expected performers operated on fewer current smokers compared to average- and lower-than-average performers: 13.7% (217/1,582), 18.2% (1,807/9,913) and 20.9% (88/421), respectively.



Conclusions: Avoidance of perioperative morbidity and mortality is not, by itself, an adequate measure of performance in lung cancer surgery. Short-term performance is indicative of the safety of lung cancer surgery but does not measure oncologic quality. The absence of long-term survival data represents a critical gap in current lung cancer surgery performance measurement. Lung cancer surgery performance metrics should assess both the safety of surgery and 3-year or greater survival.

21. Operative Experience with Pulmonary Resection Following Neoadjuvant Nivolumab in Patients with Resectable Non-Small Cell Lung Cancer

Stephen R. Broderick¹, Matthew Bott², *Bernard Park², James Isbell², *Prasad Adusumilli², *Malcolm Brock¹, Errol Bush¹, Jamie Chaff³, Patrick Forde¹, *Robert Downey², *Richard Battafarano¹, *Valerie Rusch², *Stephen C. Yang¹, *David R. Jones²

¹Johns Hopkins Medical Institutions, Baltimore, MD; ²Memorial Sloan Kettering Cancer Center, New York, NY

Invited Discussant: *Michael Lanuti

Objective: T-cell checkpoint inhibitors have become an important treatment option in metastatic non-small cell lung cancer (NSCLC). We recently conducted a phase I/II trial investigating the use of nivolumab, a monoclonal antibody to the PD-1 checkpoint receptor, as neoadjuvant therapy in patients with resectable NSCLC. The primary study results regarding tolerability and efficacy have been previously reported. This report is a multi-institutional analysis of the operative and perioperative experience of pulmonary resection in these patients.

Methods: Patients with untreated clinical stage IB-IIIa NSCLC underwent neoadjuvant therapy with two cycles of nivolumab (3 mg/kg) at four and two weeks prior to resection. All patients underwent invasive mediastinal staging and pre and post-treatment PET/CT imaging. The primary study endpoint was safety and feasibility of neoadjuvant nivolumab followed by pulmonary resection. A retrospective chart review of enrolled patients was performed to collect additional surgical details for this analysis.

Results: Twenty of 22 enrolled patients underwent resection. Of the two unresected patients, one was determined unresectable and another had small cell histology. There were no delays to planned surgical resection. Median time from first treatment to surgery was 33 days (range 17–43 days). Operative procedures included 1 wedge resection, 15 lobectomies, 1 bilobectomy, 1 sleeve lobectomy, and 2 pneumonectomies. Six resections (30%) were completed using VATS/robotic techniques. Of 13 procedures attempted by VATS/robotic, 7 (54%) were converted to thoracotomy. The most common indication for conversion was fibrosis around the hilar structures. Median operative time was 228 minutes (range 132–341). Median EBL was 100cc (range 25–1000). Median length of hospital stay was 4 days (range 2–17). There were no 90-day mortalities. The overall major morbidity rate was 10/20 (50%). The most common postoperative complication was supra-ventricular tachycardia occurring in 6/20 (30%) patients. There was a single incidence each of myocardial infarction, pneumonia, prolonged air leak, empyema and urinary retention. Major pathologic response (<10% viable tumor) was identified in 9/21 (43%) patients. Pathologic downstaging was achieved in 8/21 (38%) patients.

Conclusion: Neoadjuvant therapy with nivolumab was not associated with unexpected morbidity or mortality. A substantial proportion of patients experienced major pathologic response. In over one-half of the cases attempted by VATS/Robotic approach, hilar fibrosis, perhaps related to treatment, was an indication for conversion to thoracotomy. Future studies with expanded patient cohorts will help to further define the advantages and limitations of this treatment strategy.

5:30 pm – 6:45 pm

Joint AATS/PASCaTS Forum: *Enhancing Cardiovascular Education and Skill Training in Resource-Limited Underserved Regions*

CT Theater II
Booth #1235, Exhibit Hall
Not for Credit

See page 37 for details.

6:15 pm – 6:45 pm

Training at the Edge: Fear, Stress and the Future of Advanced Surgical Training

CT Theater I
Booth #134, Exhibit Hall
Not for Credit

See page 37 for details.

MONDAY, APRIL 30

MONDAY, APRIL 30, 2018

6:30 am **Update on Maintenance of Certification for the American Board of Thoracic Surgery** Room 25ABC, SDCC
Separate Registration Required *Not for Credit*
See page 38 for details.

7:20 am **Business Session, AATS Members Only** Ballroom 20A, SDCC

7:30 am **Plenary Scientific Session** Ballroom 20A, SDCC
7 minute presentation, 12 minute discussion
Moderators: *Duke E. Cameron and *Marc R. Moon

22. Clinical Outcomes 10 Years After On-Pump Versus Off-Pump Coronary Bypass Grafting by Volume Qualified Surgeons

*Joanna Chikwe, Timothy Lee, Shinobu Itagaki, Natalia Egorova, *David H. Adams
Mount Sinai Medical Center, New York, NY

Invited Discussant: Michael P. Vallely

Objectives: To identify predictors of long-term survival, freedom from repeat revascularization and myocardial infarction in patients undergoing off-pump versus on-pump coronary artery bypass grafting (CABG) in contemporary clinical practice.

Methods: A total of 42, 570 consecutive patients who underwent CABG from January 1, 2005 through December 31, 2011 in 18 cardiac surgery centers were identified from a mandatory clinical state registry of cardiac surgery. Reoperative and emergency patients were excluded. Only patients operated on by surgeons who had completed

* AATS Member ♦ AATS New Member † AmSECT Member

at least 100 off-pump or on-pump cases respectively were included in each cohort. Outcomes were compared using multivariable Cox regression models, propensity score methods and instrumental variables. The primary outcome was all-cause mortality. Secondary outcomes included stroke, myocardial infarction, and repeat revascularization, and were identified by linkage to a mandatory clinical cardiac catheterization state registry and administrative data from the Department of Health. Median follow-up time was 6.8 years (range, 0–11.0 years); the last follow-up date for mortality was December 31, 2015.

Results: Of 22,245 patients who met the study criteria, 15,295 who underwent on-pump CABG were compared to 6,950 who underwent off-pump CABG. A total of 49 out of 83 surgeons performing off-pump CABG, and 71 out of 86 surgeons performing on-pump CABG met the surgeon volume qualifying criteria. The median number of CABGs completed by these surgeons at the time of the index procedure was 905 for off-pump CABG, and 953 for on-pump CABG respectively. At 10 years, off-pump CABG was associated with higher mortality (33.4% vs. 29.6%, respectively; hazard ratio, 1.11; 95% confidence interval [CI], 1.04 to 1.18; $P = .002$) compared to on-pump CABG (Figure 1); this mortality difference persisted with adjustment using propensity scores and instrumental variables. Off-pump CABG was associated with a higher risk of incomplete revascularization (15.7% vs. 8.8%, $P < 0.001$) which was an independent predictor of late mortality (hazard ratio, 1.10; 95% CI, 1.03 to 1.17; $P = .006$), and higher rates of repeat revascularization (15.4% vs. 14.0%; hazard ratio, 1.17; 95% CI, 1.01 to 1.37; $P = .048$) at 10 years. There were no significant differences in rates of myocardial infarction or stroke between the groups.

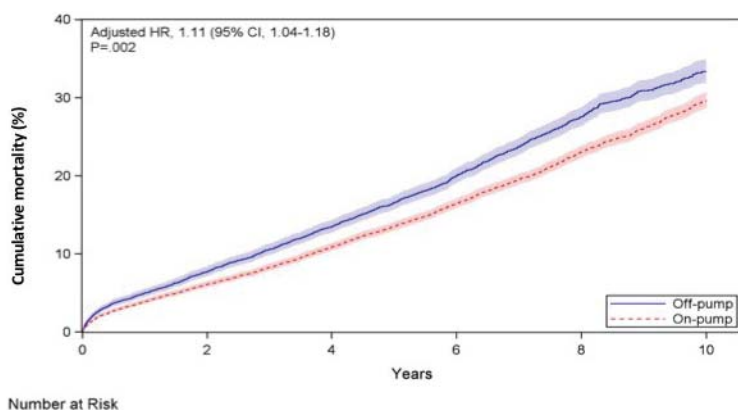


Figure 1: Ten-year mortality following off-pump versus on-pump coronary artery bypass grafting.

Conclusions: In a risk-adjusted analysis of a mandatory clinical registry of patients undergoing CABG by volume qualified surgeons, off-pump surgery was associated with increased incomplete revascularization, repeat revascularization and mortality at 10 years compared to on-pump. On-pump CABG remains a gold standard for most patients undergoing surgical revascularization.



23. Single Centre Results with Normothermic Ex Vivo Lung Perfusion (EVLP): Does the Indication for EVLP Affect Organ Utilization and Patient Outcomes After Lung Transplantation?

*Marcelo Cypel, Jonathan C. Yeung, Laura Donahoe, Manyin Chen, Ricardo Zamel, Konrad Hoetzenecker, *Kazuhiro Yasufuku, *Marc de Perrot, Andrew Pierre, *Thomas K. Waddell, *Shaf Keshavjee

Toronto General Hospital, Toronto, ON, Canada

Invited Discussant: *G. Alexander Patterson

Objectives: *Ex vivo* lung perfusion (EVLP) is being increasingly applied as a method to evaluate and treat donor lungs for transplantation. However, with the previous limited worldwide experience no studies have been able to evaluate the impact of indication for EVLP on organ utilization rates and recipient outcomes after lung transplantation (LTx). We examined these outcomes in a large cohort, single center experience of clinical EVLP cases.

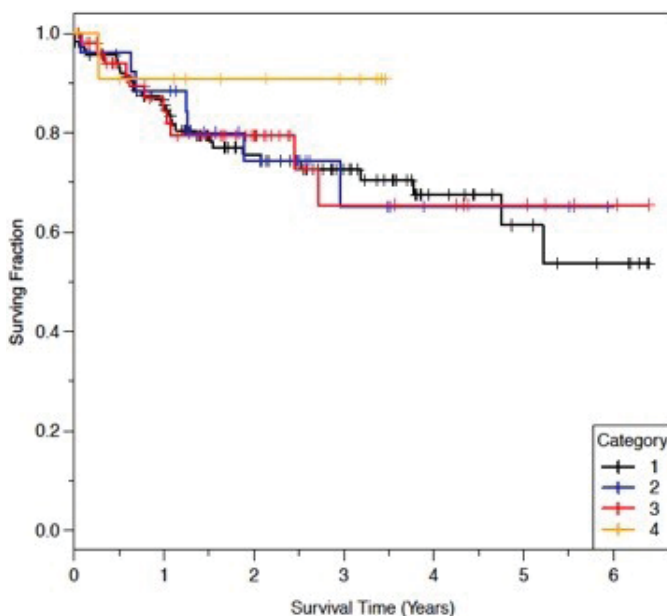
Methods: All EVLP procedures between Jan 2011 and July 2017 were examined. EVLPs were divided into 4 categories based on indication for the procedure: 1) high-risk brain death donors (BDD); 2) standard donation after cardiac death (DCD); 3) high-risk DCD; and 4) logistics (need for prolongation of preservation time or organ retrieval by a different transplant team).

Results: During the study period, 805 lung transplants were performed in our institution. In this period 286 EVLPs were performed resulting in 200 transplants (70% overall utilization rate). Utilization rate after EVLP category was: 1) 112/158 (70%), 2) 24/32 (75%), 3) 51/81 (62%), and 4) 12/15 (80%) ($p = 0.42$, Fisher's exact). Recipient age ($p = 0.27$) and medical diagnosis ($p = 0.31$) were not different by category. Kaplan-Meier survival by EVLP indication group demonstrated no differences (Figure). Thirty-day mortality was 2.6%, 4%, 1.9%, and 0% in categories 1 to 4 respectively ($p = 0.87$, Fisher's exact). Median time on mechanical ventilation, ICU stay and hospital stay in days were: 2.2, 4.1, and 20 (category 1); 2.1, 3.7, and 21 (category 2); 3.1, 5.7, and 22 (category 3); and 2.1, 5.1, and 16 (category 4), ($p = 0.08$; $p = 0.28$; $p = 0.73$, Kruskal-Wallis rank sum).

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Conclusions: Clinical implementation of EVLP has allowed our program to expand the annual lung transplantation activity by 55% in this time period. It has enhanced confident utilization of DCD lungs and BDD lungs with a 70% utilization of post EVLP treated donor lungs and excellent outcomes, while addressing significant challenges in donor lung assessment and logistics of real life clinical lung transplantation.

24. Valve-Sparing Aortic Root Replacement in Children: Outcomes from 100 Consecutive Cases

Charles D. Fraser, III¹, Rui H. Liu¹, Xun Zhou¹, Nishant D. Patel¹, Cecillia Lui¹, Alejandro Suarez Pierre¹, *Marshall L. Jacobs¹, Harry C. Dietz, III¹, Narutoshi Hibino¹, *Duke E. Cameron², Luca A. Vricella¹

¹The Johns Hopkins Hospital, Baltimore, MD; ²Massachusetts General Hospital, Boston, MA

Invited Discussant: *James S. Tweddell

Objective: Valve-sparing root replacement (VSRR) is an attractive alternative to composite mechanical or biologic prostheses for aortic root aneurysms in children. Data on outcomes following VSRR in pediatric patients are limited. We present our institutional experience with 100 consecutive pediatric VSRR procedures.

Methods: All children (age <18) who underwent VSRR at our institution from May 1997 through August 2017 were identified; echocardiographic and clinical data were obtained from hospital and follow-up records. The primary endpoint was mortality, and secondary endpoints included complications, further cardiovascular interventions, and subsequent valvular dysfunction.



Results: Median age at operation was 13.6 years (IQR:9.42–15.9); 38 (38%) had Marfan syndrome and 39 (39%) had Loeys-Dietz syndrome. Mean preoperative max sinus diameter was 4.4 ± 0.71 cm (Z-score 7.8 ± 3.2). Seven (7%) had >2 + aortic insufficiency preoperatively. Twelve (12%) had bicuspid aortic valves. Most patients (n = 81, 81%) underwent reimplantation procedures with a Valsalva-graft. Four (4%) underwent David I reimplantation with a straight-tube graft, 12 (12%) had a Yacoub remodeling procedure, and 3 (3%) had a Florida sleeve procedure. Perioperative VSRR mortality was 3% (n = 3). Four patients underwent reoperation for bleeding. Mean follow-up was 1333 days (IQR:26–3659). All three patients who had a Florida sleeve required subsequent reimplantation VSRR. Six patients required late reintervention for development of pseudoaneurysms. Eight patients underwent additional aortic surgery: 6 required ascending aorta and aortic arch replacements while 2 required isolated aortic arch replacement. Average time to reoperation for subsequent aortic surgery was 7.23 ± 4.56 years. In total, 10 patients developed >2+ aortic insufficiency (AI) and required subsequent aortic valve replacement (AVR). Of the 85 patients undergoing a reimplantation procedure, 5 (5.9%) underwent late AVR versus 5 (33.3%) of the 15 patients who had a remodeling procedure (p = 0.001).

Conclusions: Valve sparing root replacement is a safe and effective option for children with aortic root aneurysms and avoids the potential complications of valve prostheses. The reimplantation procedure is preferred. Late aortic insufficiency and pseudoaneurysm formation remain a late concern.

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25. Ross Procedure: A 25-Year Longitudinal Analysis

*Tirone E. David, Maral Ouzounian, Carolyn David, Cedric Manlhiot
Toronto General Hospital, Toronto, ON, Canada

Invited Discussant: *D. Craig Miller

Objective: To examine the long-term results of the Ross procedure in a cohort of patients who have been followed prospectively for more than one-quarter of a century.

Patients and Methods: From 1990 to 2004, 212 consecutive patients with median age [IQR] of 34 years [28–41] years underwent the Ross procedure; 82% had congenital aortic valve disease. The technique of aortic root replacement was used in one-half of the patients. Patients have been followed prospectively with echocardiographic studies for a median [IQR] of 17.5 years [14.1 to 20.6]. Follow-up was complete.

Results: There have been 16 deaths: 3 valve-related, 1 cardiac-related, 11 other causes, and 1 unknown. Twenty-three patients have required Ross-related reoperations: 11 in the pulmonary autograft, 6 in both valves, and 6 in the pulmonary homograft. The table below shows the freedom from various events at 15 and 20 years. There were 65 patients still at risk at 20 years. Dilated aortic annulus (HR: 1.33, 95% CI: 1.08–1.64, p = 0.008) and preoperative aortic insufficiency (AI) (HR vs. aortic stenosis: 4.45, 95% CI: 1.31–15.2, p = 0.02) were associated with reoperation in the pulmonary autograft; the latter also being associated with increased risk of developing post-operative AI (HR: 2.32, 95% CI: 1.11–4.86, p = 0.03). The technique of implantation of the autograft was not associated with survival, reoperation or development of AI.

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Table: Freedom from Adverse Events (Proportion [95% Ci]) Obtained Using Kaplan-Meier Estimates

Variable	15 Years (95% CI)	20 Years (95% CI)
Freedom from death of any cause	94.4% (90.1–96.9)	88.7% (81.3–93.2)
Freedom from Ross-related reoperation	92.9% (88.3–95.8)	88.0% (81.2–92.5)
Freedom from autograft reoperation	94.5% (90.3–96.9)	90.5% (84.0–94.4)
Freedom from homograft reintervention	97.0% (93.3–98.6)	94.5% (89.4–97.2)
Freedom from aortic insufficiency ≥3+	88.1% (82.7–91.9)	81.4% (74.0–86.9)
Freedom from homograft insufficiency ≥3+ and/or peak gradient ≥40 mmHg	84.9% (79.0–89.2)	81.3% (74.4–86.4)

Conclusions: This study showed a slow and progressive deterioration of function of the pulmonary autograft over time but patients’ survival and freedom from reoperations were excellent. Dilated aortic annulus and preoperative AI were associated with risk of autograft failure.

8:50 am Awards

9:00 am – Coffee Break in the Exhibit Hall

9:40 am

9:05 am – 9:35 am

Operating Room Support Team Turnover Increases the Risk for CT Theater I
Sharp Count Errors During Cardiac Surgery Booth #134, Exhibit Hall
6 minute presentation, 20 minute discussion *Not for Credit*

See page 39 for details.

9:40 am Invited Guest Speaker: *Maximize the Data, Ballroom 20A, SDCC*
Minimize the Fraud: A Plea to Change the
Way We Publish

**Martin J. Elliott, Great Ormond St. Hospital for Children*



10:20 am

Plenary Scientific Session

Ballroom 20A, SDCC

Moderators: *David H. Adams and *Marc R. Moon

7 minute presentation, 12 minute discussion

26. Thirty Years and 1,663 Consecutive Norwood Procedures: Has Survival Plateaued?

Christopher E. Mascio¹, Mallory L. Irons², Richard F. Ittenbach³, J. William Gaynor¹, Stephanie Fuller¹, Michelle Kaplinski¹, Andrea T. Kennedy¹, James M. Steven¹, Susan C. Nicolson¹, *Thomas L. Spray¹

¹Children's Hospital of Philadelphia, Philadelphia, PA; ²University of Pennsylvania, Philadelphia, PA; ³Cincinnati Children's Hospital, Cincinnati, OH

Invited Discussant: *Marshall L. Jacobs

Objective: Hypoplastic left heart syndrome (HLHS) is one of the most common and challenging lesions requiring surgical intervention in the neonatal period. The Norwood procedure (NP) for HLHS was first reported in 1980. Advances have been made in peri-operative care and morbidity and mortality have continued to improve. The objective of this study is to present 30 years of NP outcomes for HLHS at a single institution.

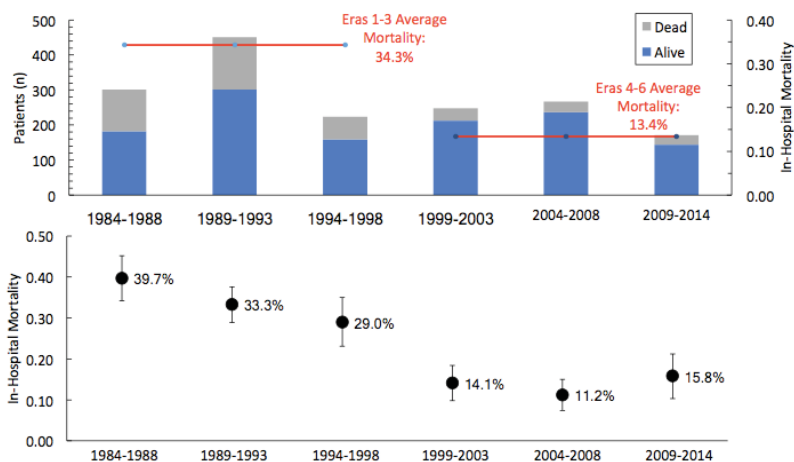
Methods: This retrospective cohort study included 1663 consecutive patients with HLHS (and variants) who underwent NP at our institution between January 1984 and May 2014. During the study period, there were 3 primary transplants and 16 primary hybrid procedures performed. There were no exclusion criteria. The study period was divided into 6 eras (Era 1:1984–1988, Era 2:1989–1993, Era 3:1994–1998, Era 4:1999–2003, Era 5:2004–2008, Era 6:2009–2014). The primary outcome was in-hospital mortality after NP. Secondary outcomes included the effects of era of operation on mortality. Binomial point estimates complete with 95% confidence intervals were computed for the entire cohort as well as by era.

Results: The median weight (min, max) and age at the time of NP were 3.2 (0.9, 5.1) kg and 5.0 (1.0, 932.0) days respectively. Preterm birth was present in 10.8% (180/1663). Males comprised 61.2% (1017/1663) of all patients. The frequency of various HLHS subtypes were as follows: aortic atresia/mitral atresia 28.9% (480/1663), aortic atresia/mitral stenosis 14.7% (244/1663), aortic stenosis/mitral atresia 1.14% (19/1663), aortic stenosis, mitral stenosis 13.9% (230/1663), HLHS variant 30.7% (509/1663). Preoperative intubation occurred in 43.9% (730/1663). Median length of stay was 17.0 (0.0, 413.0) days. The overall in-hospital mortality was 25.7% (CI_{0.95} 23.6, 27.8). The mortality by era was 39.7% (CI_{0.95} 34.2, 45.2), 33.3% (CI_{0.95} 28.9, 37.6), 29.0% (CI_{0.95} 23.1, 35.0), 14.1% (CI_{0.95} 9.8, 18.4), 11.2% (CI_{0.95} 7.4, 15.0), and 15.8% (CI_{0.95} 10.3, 21.2), respectively. There was a significantly lower mortality in Eras 4–6 compared to Eras 1–3 (*p* all ≤ 0.04; see Figure).

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Conclusions: Patients with HLHS are commonly born at term and the majority are male. The most common subtype is aortic atresia/mitral atresia, while HLHS variants make up nearly one third of those undergoing NP. Survival has plateaued despite improvements in diagnosis, perioperative care, and surgical techniques. It is likely that unidentified patient factors are important determinants of the risk of mortality.

Late-Breaking Clinical Trial

LB15. Radial Artery Versus Saphenous Vein in Coronary Artery Bypass Surgery

♦[Mario F. Gaudino](#)¹, [Umberto Benedetto](#)^{2*}, [Stephen Fremes](#)³, [Giuseppe Biondi-Zoccai](#)⁴, [Art Sedrakyan](#)⁵, [John D. Puskas](#)⁶, [Gianni D. Angelini](#)², [Brian Buxton](#)⁷, [Giacomo Frati](#)⁴, [David L. Hare](#)⁷, [Philip Hayward](#)⁸, [Giuseppe Nasso](#)⁹, [Neil Moat](#)¹⁰, [Miodrag Peric](#)¹¹, [Kyung Jong Yoo](#)¹², [Giuseppe Speziale](#)⁹, [Leonard N. Girardi](#)¹, [David P. Taggart](#)¹³, for the RADIAL Investigators†

¹Cornell Medicine, New York, NY; ²Bristol Heart Institute, Bristol, UK; ³Schulich Heart Centre, Sunnybrook Health Science, University of Toronto, Toronto, Canada; ⁴Sapienza University, Rome, and Department of AngioCardioNeurology, IRCCS Neuromed, Pozzilli, Italy; ⁵Healthcare Policy and Research, Cornell Medicine, New York, NY; ⁶Icahn School of Medicine at Mount Sinai, New York, NY; ⁷University of Melbourne, Melbourne, Australia; ⁸The Austin Hospital, Melbourne, Vic, Australia; ⁹Anthea Hospital, Bari, Italy; ¹⁰Royal Brompton & Harefield Trust, London, UK; ¹¹Dedinje Cardiovascular Institute and Belgrade University School of Medicine, Belgrade, Serbia; ¹²Yonsei University College of Medicine, Seoul, Korea; ¹³University of Oxford, Oxford, UK

Invited Discussant: *[James Tatoulis](#)

27. Mandatory Public Reporting of Cardiac Surgery Outcomes: The Massachusetts Experience, 2002–2014

*David M. Shahian¹, David F. Torchiana¹, ♦Daniel Engelman², *Thoralf M. Sundt, III¹, Richard S. D'Agostino³, Ann Lovett⁴, Matt Cioffi⁴, James Rawn⁵, Vladimir Birjiniuk⁶, Sharon-Lise T. Normand⁴

¹Massachusetts General Hospital, Boston, MA; ²Baystate Medical Center, Springfield, MA; ³Lahey Health System, Burlington, MA; ⁴Harvard Medical School, Boston, MA; ⁵Brigham and Women's Hospital, Boston, MA; ⁶Mt. Auburn Hospital, Cambridge, MA

Invited Discussant: *Anelechi C. Anyanwu

Objectives: As national healthcare reform emphasizes accountability and transparency, the 13-year Massachusetts experience with mandatory public reporting of CABG outcomes provides important insights.

Methods: Annual (2002–2014) CABG data for 45,264 CABG procedures from 14 programs were obtained from the Massachusetts Data Analysis Center and DPH, including risk factors, observed (OM) and expected (EM) mortality rates, market share, and data coding changes after peer adjudication. STS provided national registry data.

Results: Hospital-level observed and expected mortality: Massachusetts OM and EM decreased from 2002 to 2014 (OM 2.19% to 1.59%, 27.4% decrease, p-trend <0.0001); STS CABG OM decreased 19.8% from 2.58% to 2.07%. Annual Massachusetts OM and EM were consistently lower than STS national rates.

Surgeon reporting: Surgeon-level reporting from 2005 to 2010 identified three outliers, all employed by outlier hospitals. After surgeon reporting was discontinued, Massachusetts OM and EM increased and stabilized slightly below STS rates (OM 1.59% vs. 2.07% in 2014).

Risk factor prevalence: Massachusetts rates of critical risk factors generally decreased over the study period and most were consistently lower than corresponding STS rates (Table).

Table: Massachusetts and STS Risk Factor Prevalences

Risk Factor	2002	2004	2006	2008	2010	2011	2012	2013	2014
STS Emergent/emergent-salvage %	4.4	4.5	4.7	4.5	4.3	4.5	4.7	4.5	4.4
MA Emergent/emergent-salvage %	3.9	3.1	2.7	3.0	2.5	2.6	2.5	2.6	2.5
STS Shock %	1.9	1.9	2.0	2.0	1.9	1.9	1.9	1.8	1.7
MA Shock %	2.2	1.1	0.8	0.7	0.5	0.4	0.7	0.8	0.6
STS Prior CABG %	5.5	4.7	4.0	3.7	3.3	3.2	3.0	2.7	2.4
MA Prior CABG %	3.8	2.6	1.9	1.9	1.7	1.7	1.1	1.0	1.1
STS Moderate/severe chronic lung disease %		9.1	9.4	9.8	10.3	10.3	10.6	10.6	10.1
MA Moderate/severe chronic lung disease %	4.6	5.6	5.9	6.3	5.8	5.8	4.8	4.7	5.5

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Outlier status and subsequent market share: Between 2002–2014, two programs were identified as high mortality outliers, and one temporarily closed. This program lost market share the year after outlier designation (6.5% to 4.9%). After structural, process, and personnel changes, market share increased the next year (7.1%) and thereafter. The other outlier program had higher market share the subsequent year.

Outlier status and subsequent EM: One program experienced lower EM for several years after outlier designation, while the other had increasing EM. Within five years, EMs at both programs had converged to the state mean.

Audit and peer adjudication of submitted data: Audit demonstrated that submitted 30-day mortality and case completeness data were highly accurate.

Peer adjudication of risk factor coding and case classification were conducted annually, with detailed results available from 2007 to 2014. This resulted in significant downcoding of high-risk variables every year, including 8.6% to 19.9% (mean 13.3%) of cases coded as emergent/emergent salvage, and 17.1% to 58.3% (mean 39.4%) of cases originally coded as shock. 56.1% to 62.4% of CABG + other cases were changed to isolated CABG.

Conclusions: Massachusetts OM and EM were consistently lower than STS national rates, as were prevalences of most risk factors. Possible explanations, which the data cannot differentiate, include risk aversion; the effect of peer adjudication and downcoding of high-risk variables; or differences between Massachusetts and national experiences regarding appropriate case selection, use of PCI for high risk cases, or medical treatment practices.

11:20 am New Member Induction Ballroom 20A, SDCC

11:40 am Presidential Address: *Gentle Handling* Ballroom 20A, SDCC
**Duke E. Cameron, Massachusetts General Hospital, Boston, MA*

12:30 pm Adjourn for Lunch in the Exhibit Hall

12:40 pm – Ethics Forum Luncheon: Room 23BC, SDCC
1:50 pm *The Patient Said He Would Rather Die: Should You Let Him?*
Separate Registration Required

See page 41 for details.

12:40 pm – 1:50 pm
21st Annual C. Walton Lillehei Resident Forum CT Theater I
 6 minute presentation, 4 minute discussion Booth #134, SDCC
Co-Chairs: *Benjamin D. Kozower and *Christian Pizarro *Not for Credit*



L1. Epigenetic Induction of the Tumor Suppressor Thioredoxin-Interacting Protein (TXNIP) Sensitizes Esophageal Adenocarcinoma (EAC) to Increased DNA Damage and Apoptosis Following Treatment with Cisplatin

Paul L. Feingold, Deborah Surman, Kate Brown, Yuan Xu, Lucas McDuffie, Vivek Shukla, Emily S. Reardon, Daniel R. Crooks, Jane B. Trepel, Min-Jung Lee, Lenard M. Neckers, Jeremy L. Davis, Jonathan M. Hernandez, Choung D. Hoang, *David S. Schrupp, R. Taylor Ripley

National Cancer Institute, NIH, Bethesda, MD

Invited Discussant: *Prasad S. Adusumilli

Objective: In 2017, an estimated 17,000 individuals will be diagnosed with esophageal adenocarcinoma (EAC) and less than 20% of these patients will survive 5 years. PET-avidity is indicative of high glucose utilization and is nearly universal in EAC. TXNIP is membrane protein that blocks glucose uptake, and exhibits pro-oxidative stress and pro-apoptotic functions by inhibiting oxidant scavenging and thiol reducing capacity of thioredoxin (TXN). TXNIP is frequently downregulated in cancers. TXNIP expression in EAC has been associated with improved disease-specific survival, lack of lymph node involvement, reduced perineural invasion, and increased tumor differentiation. We hypothesized that TXNIP may act as a tumor suppressor in EAC cells (EACC) and sensitize these cells to standard chemotherapeutic agents.

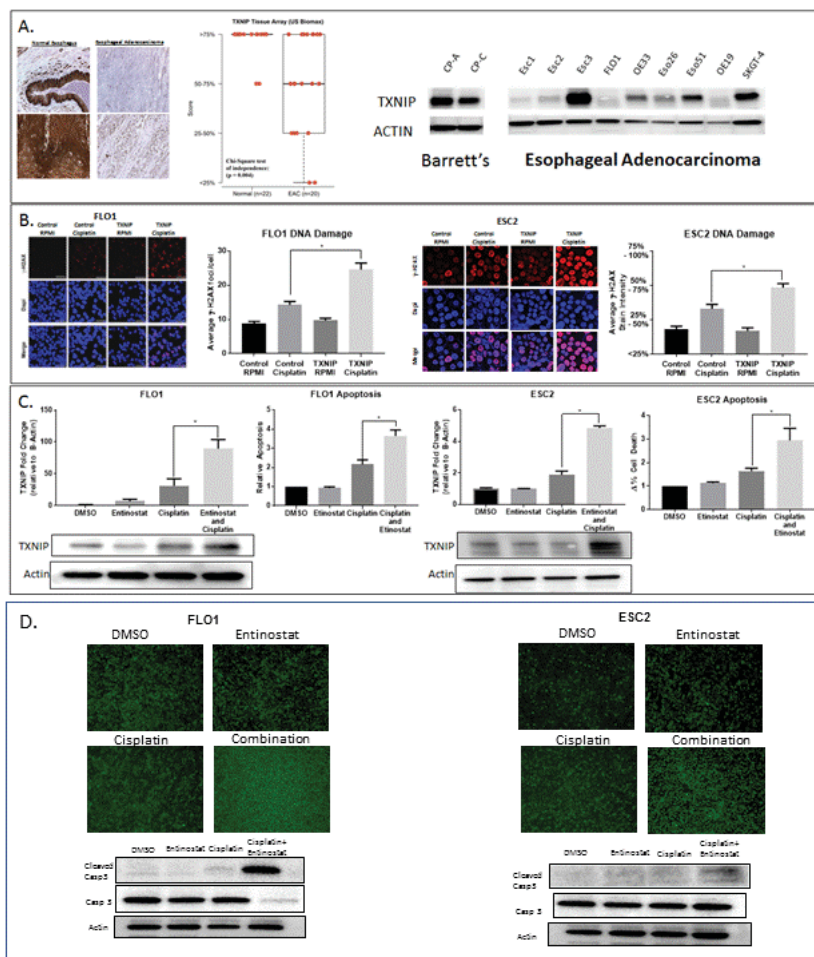
Methods: EACC lines (Flo1, Esc2, OE33) and a Barrett's epithelial cell line (CPC) were used for functional assays. TXNIP and related gene expression levels were evaluated using qRT-PCR, immunoblot, or immunofluorescence techniques. Epigenetic regulation of TXNIP expression was evaluated by quantitative chromatin-immunoprecipitation (qChIP) techniques. TXNIP was stably over-expressed or knocked down using lentiviral RNA transduction techniques. Murine xenograft methods were used to examine growth of EACC following over-expression or knock-down of TXNIP. Apoptosis and DNA damage were measured by Annexin V, γ H2AX, and comet assays. Activation of the intrinsic (mitochondrial) apoptotic cascade was quantitated using a green fluorescence protein (GFP)-caspase 3 reporter assay.

Results: In cultured cell lines and an esophageal tissue array, TXNIP expression was higher in Barrett's epithelia and normal tissue compared to EAC (A) ($P = 0.004$). Constitutive over-expression of TXNIP decreased in-vitro proliferation, soft agar clonogenicity, and tumor xenograft growth of EACC. Additionally, TXNIP overexpression increased DNA damage as well as apoptosis in EACC following cisplatin treatment (B). In contrast, knockdown of TXNIP abrogated the effects of cisplatin. qChIP assays demonstrated that TXNIP promoter activity was mediated in part by histone deacetylases (HDACs). Consistent with these findings, the HDAC-inhibitor, Entinostat, which is currently in clinical trials, upregulated TXNIP and synergistically increased cisplatin-mediated DNA damage and apoptosis in EACC (C). The synergistic antitumor effects of Entinostat and cisplatin coincided with activation of the intrinsic apoptotic pathway (D – GFP indicates caspase 3 cleavage).

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Conclusions: TXNIP is a tumor suppressor that is epigenetically down-regulated in EACC and dramatically sensitizes these cells to cisplatin. Collectively, our findings support phase I/II evaluation of “epigenetic priming” strategies to enhance the efficacy of conventional cisplatin-based chemotherapeutic regimens for EAC.



L2. Intraoperative, Intratumoral Gene-Mediated Cytokine Immunotherapy Modifies the Tumor Microenvironment and Synergizes with Checkpoint Inhibition

Jarrod Predina, Andrew D. Newton, Astero Klampatsa, Christopher Corbett, Shayoni Nag, Steven M. Albelda, *Sunil Singhal
University of Pennsylvania, Philadelphia, PA

Invited Discussant: *Mark W. Onaitis

Background: Immunotherapy, specifically checkpoint inhibition, is an emerging therapeutic option for NSCLC patients. Initial results have been bimodal, with ~10% of patients obtaining benefit and the remaining representing “non-responders”. One explanation for limited efficacy is a potent immunosuppressive microenvironment. We hypothesize that intratumoral immune stimulation with gene-mediated cytotoxic immunotherapy (GMCI) can modify the local tumor environment and improve checkpoint inhibition. Based on previous studies, we also postulate that intraoperative delivery by surgeons is a feasible approach.

Methods: GMCI using an adenoviral vector carrying the herpes simplex virus thymidine kinase gene followed by the prodrug ganciclovir (AdV-tk/GCV) was evaluated in murine models of resectable NSCLC. Syngeneic NSCLC tumors were established in immunocompetent mice (n = 120). Neoadjuvant GMCI was coupled with PD1 and CTLA4 inhibitors. In addition to time to recurrence and survival, immunologic underpinnings were explored by flow cytometry, functional assays and ELISA. Given the promising preclinical results, a 3+3 Phase I dose-escalation trial (n = 12) of GMCI was initiated in subjects with resectable NSCLC (NCT03131037). Primary aims were safety/feasibility; secondary aims involved elucidating immunologic mechanisms by comparing pre-vector baseline specimens with post-vector specimens obtained at resection.

Results: In syngeneic models of NSCLC, neoadjuvant GMCI resulted in increased CD8 T-cell trafficking (6% vs. 19%; p = 0.01), an improved fraction of IFN γ producing CD8 T-cells (6% vs. 13%; p = 0.02) and increased Th1 mediators (IFN γ and IL-2; p < 0.05). GMCI resulted in an improved time to recurrence (11 vs. 24 days; p = 0.01) and a 3-fold increase of survival (p = 0.001). Compared to PD1-inhibition or CTLA4-inhibition monotherapy, the addition of GMCI resulted in improved cure rates when combined with PD1-inhibitors (0% vs. 62%; p < 0.001) and for CTLA4-inhibitors (0% vs. 82%; p < 0.001). GMCI upregulated tumor-PDL1 expression (11% vs. 23%; p = 0.04) which may explain synergistic results of GMCI with checkpoint inhibitors. In an ongoing Phase I Trial, patients have been enrolled with vector delivery by EBUS and VATS. No drug toxicity has been observed at tested dosing levels. GMCI is associated with increased tumor necrosis (13% vs. 43%; p = 0.08) and infiltrating CD8 T-cells (2% vs. 7%; p = 0.06). Target accrual is expected by June 2018.

Conclusions: Intraoperative neoadjuvant intratumoral GMCI transforms the tumor microenvironment and synergizes with checkpoint inhibition in mice. Initial human studies investigating this approach are ongoing. These studies may suggest that surgeons need to actively participate in the delivery of immunotherapy prior to surgery in order to optimize the immunotherapy-surgery-chemotherapy sequence.

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L3. Lung Graft-Resident Foxp3+ Cells Maintain Tolerance by Suppressing Antibody-Mediated Rejection

Jason M. Gauthier¹, Wenjun Li¹, Ryuji Higashikubo¹, Hsi-Min Hsiao¹, Satona Tanaka¹,

*Alexander S. Krupnick², *Varun Puri¹, Ramsey R. Hachem¹, Andrew E. Gelman¹,

*Daniel Kreisel¹

¹Washington University, Saint Louis, MO; ²University of Virginia, Charlottesville, VA

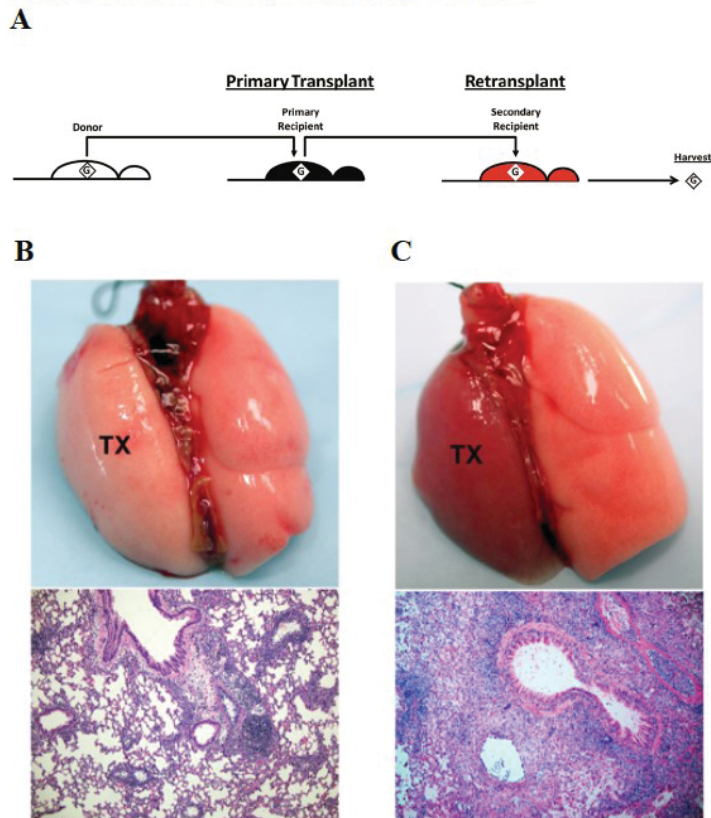
Invited Discussant: *Michael S. Mulligan

Objective: Immune responses to transplanted lungs are generated locally within the graft setting them apart from other organs. We have previously reported that bronchus-associated lymphoid tissue (BALT), rich in Foxp3+ regulatory T cells, is induced in tolerant mouse lung allografts. Here we hypothesized that graft-resident Foxp3+ cells play an important role in maintaining a tolerant state.

Methods: Balb/c lungs were transplanted into immunosuppressed (perioperative co-stimulatory blockade (anti-CD40L/CTLA4-Ig)) B6 Foxp3 GFP mice. At least 30 days later fluorescently labeled B6 B and CD4 T cells were injected into recipients and grafts were imaged with intravital two-photon microscopy 24 hours later. Separately, Balb/c lungs were transplanted into immunosuppressed B6 Foxp3-DTR (diphtheria toxin receptor) mice. At least 30 days later the Balb/c lungs were re-transplanted into immunosuppressed B6 wildtype (anti-CD40L/anti-ICOS), non-immunosuppressed B6 wildtype, B6 nude (T cell-deficient), or B6 mu knockout (B cell-deficient) secondary hosts, which were treated with saline or DT at the time of re-transplantation to deplete graft-resident Foxp3+ cells. Seven days after re-transplantation grafts were evaluated histologically, flow cytometry was used to characterize cell populations in the graft and measure serum alloantibody titers, and gene expression levels were measured by RT-PCR.

Results: Intravital imaging of tolerant lung grafts revealed interactions between recipient B and CD4 T cells and Foxp3 cells residing in BALT. Selective depletion of Foxp3 cells from tolerant lungs at the time of re-transplantation into non-immunosuppressed B6 recipients resulted in acute rejection with histological hallmarks characteristic of antibody-mediated rejection (AMR), associated with elevations in serum antibody titers (IgM titers (1:4) = 7,193 vs. 1,226 mfi, $p < 0.05$; $n = 4$ each) [Figure 1]. Up to 15.5% of graft-infiltrating recipient CD4 T cells showed a follicular helper cell (Tfh) phenotype (CXCR5+ICOS+) in both conditions ($p > 0.05$; $n = 4$ each). Expression levels of CD40, CD40 Ligand, ICOS and ICOS Ligand were significantly elevated in Foxp3-depleted grafts. Re-transplantation of Foxp3-depleted grafts into T or B cell-deficient secondary recipients or recipients treated with anti-CD40 and anti-ICOS-L, a regimen that prevents activation of B cells by Tfh cells, significantly reduced serum alloantibody titers and prevented AMR ($n = 4$ each).

Figure 1: Depletion of lung graft-resident Foxp3+ cells results in AMR. (A) Drawing depicting re-transplantation (G=lung graft). Gross appearance (top) and H&E histology (bottom) of Balb/c lungs, initially transplanted into B6 Foxp3-DTR mouse and at least 30 days later re-transplanted into secondary B6 host, treated with (B) saline or (C) DT at the time of re-transplantation. Grafts were evaluated 7 days after re-transplantation. Tx denotes left lung graft.



Conclusion: We have uncovered a novel mechanism of lung transplant tolerance. Surprisingly, graft-resident Foxp3+ cells maintain a tolerant state by locally blocking the activation of B cells, thereby preventing AMR. Given that AMR contributes to poor outcomes and is largely refractory to current interventions, our results provide a platform for the development of new therapeutic strategies for lung recipients.

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L4. Aggressive Tissue Aortic Valve Replacement in Younger Patients: Implications from Microsimulation Analysis

Neel K. Ranganath, Michael S. Koeckert, Deane E. Smith, Kazuhiro Hisamoto,
*Mathew R. Williams, Didier F. Loulmet, *Aubrey C. Galloway, *Eugene A. Grossi
New York University, New York, NY

Invited Discussant: Percy Boateng

Objective: Successful advances in transcatheter aortic valve replacement (TAVR) has led to the consideration of a tissue valve AVR in younger patients who previously would have been recommended a mechanical valve due to better long-term prosthetic durability. Part of this current enthusiasm is the presumption that these younger patients would have more flexibility in treatment options, such as a primary TAVR(s) followed later by surgical AVR, vice-versa, and/or subsequent valve-in-valve procedures. We created a microsimulation model using the best published reports concerning functional longevity of pericardial tissue valves to predict outcomes of patients after tissue aortic valve replacement and re-replacements.

Methods: We used a validated microsimulation model incorporating the annual risk of death (by age and gender) as well as risk of death from re-interventions (STS re-operation risk was used for re-intervention mortality risk) in patients with critical aortic stenosis. The annual risk of all cause death (age and gender adjusted) was extracted from Social Security Administration data. The long term AVR freedom from structural valve degeneration (SVD) was based on best published data for freedom from re-operation stratified by patient age at implant. These data were used to create Weibull distributions to determine the annual risk of valve re-replacement for SVD based on the duration of prosthetic implant. Simulation was performed for 50,000 individuals with equal gender distribution. Kaplan-Meier curves were generated to represent survival and freedom from re-intervention. All simulations were run within the MATLAB environment.

Results: See Table. Earlier decades of life were associated with higher incidences of third and fourth AVR procedures. For those patients receiving a primary AVR in their 4th or 5th decades of life who eventually require four AVR procedures, the cumulative procedural mortality risk was 7.8% and 9.1%, respectively.

Table: Life Expectancy, Re-replacement AVRs, and Average Number of Valves Received by Age at Primary Tissue AVR Implantation

Age at Primary AVR	Life Expectancy After Primary AVR in Years	Required 2 nd AVR (%)	Required 3 rd AVR (%)	Required 4 th AVR (%)	Average Number of Valves Received per Patient
40	40.95	38626 (77.3)	21385 (42.8)	5405 (10.8)	2.32
50	31.54	34552 (69.1)	12714 (25.4)	1760 (3.5)	1.98
60	22.54	26904 (53.8)	5383 (10.8)	396 (0.8)	1.65
70	14.50	16356 (32.7)	1477 (3.0)	57 (0.1)	1.36

Conclusions: This microsimulation estimates the risk of aortic valve re-replacement in healthy younger patients undergoing primary tissue AVR. Despite the simulation being based on “best possible” published data for SVD risk, there is significant morbidity and mortality attached to the strategy of using tissue prosthetics in younger patients. These results can be a starting point for patient education and healthcare economic planning.



L5. In Vivo Functional Assessment of a Novel Bioinspired Scaffold-Based Tissue Engineered Heart Valve

Garrett Cohan¹, Antonio D'Amore¹, Yasumoto Matsumura¹, Drake Pederson¹, Samuel Luketich¹, Vesselin Shanov², *Tirone David³, William Wagner¹, *Vinay Badhwar⁴

¹University of Pittsburgh, Pittsburgh, PA; ²University of Cincinnati, Cincinnati, OH; ³Toronto General Hospital, Toronto, ON, Canada; ⁴West Virginia University, Morgantown, WV

Invited Discussant: David Hoganson

Objective: Pursuit of ideal heart valve solutions aim to provide thrombosis-free durability. A scaffold-based polycarbonate urethane urea (PCUU) tissue engineered heart valve (TEHV) previously confirmed *in-situ* autologous histologic leaflet resurfacing in a small animal model. This proof-of-concept study examined the acute *in vivo* function of a stented TEHV in a porcine model.

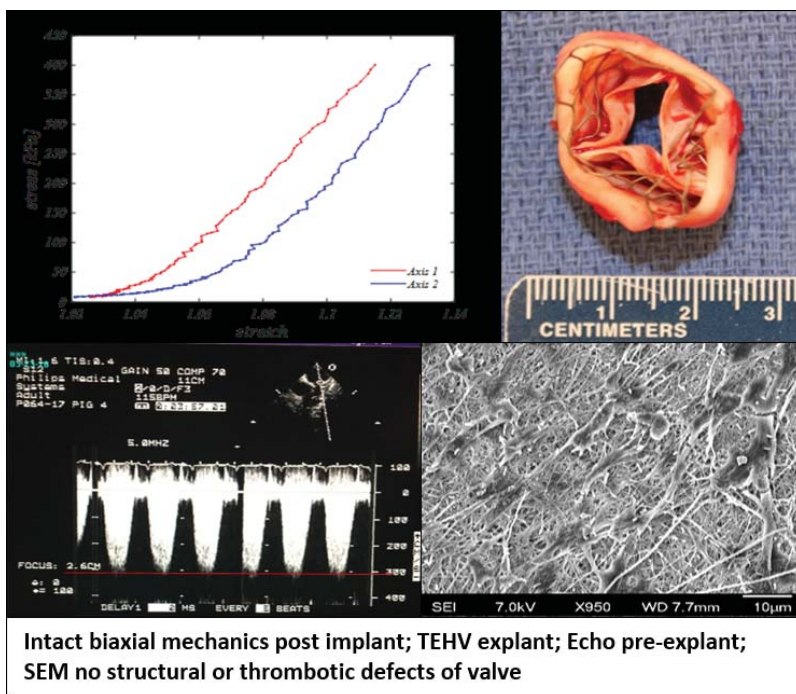
Methods: Tri-leaflet valves were fabricated by electrospinning PCUU using double component fiber deposition modeled to harmonize with human aortic valve collagen fibril alignment. The TEHV was mounted on an AZ31 magnesium alloy bioavailable stent frame. Leaflet thickness and bench pulse-duplicator mechanics mirrored native valve leaflets. Five 80 kg Yorkshire pigs underwent open TEHV implantation on cardiopulmonary bypass (CPB) in the pulmonary position with running 4-0 polypropylene. TEHV function was echocardiographically evaluated immediately post-implant and at the planned study end-point and harvest between 6 and 12 hours postoperatively. Explanted valves underwent biaxial mechanical testing. Ultrastructural analysis and thrombosis detection were performed histologically and by scanning electron microscopy (SEM).

Results: All 5 animals underwent successful valve implantation. All were weaned from CPB, closed and recovered until harvest study end-point except 1 animal that was found to have congenital tricuspid valve dysplasia with atrial septal defect that was humanely sacrificed post-implant. Post-CPB echocardiography in all 5 cases revealed normal valve leaflet function with preserved ventricular function, no regurgitation, and an average peak velocity of 2.5 m/s. Velocities and valve performance were unchanged immediately prior to harvest. SEM of the TEHV leaflets confirmed retained microstructural architecture with no platelet activation or thrombosis. However, on 2 of the 5, there was microscopic evidence of fibrin deposition on the stent frame, but not on the TEHV. Histologic and biaxial stress examination revealed retained post-implant mechanics of TEHV fibers without functional or ultrastructural degradation (Figure).

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Conclusions: A bioinspired heart valve scaffold for in-situ tissue engineered leaflet replacement is acutely functional and devoid of leaflet microthrombosis, establishing proof-of-concept. Further investigation in a chronic animal model will be required to ascertain ideal stent frame characteristics to establish full native valve tissue replacement and thrombosis-free durability.

L6. Human Neonatal Thymus Mesenchymal Stem Cells Can Improve Survival in the Setting of Chronic Right Ventricle Pressure Overload

Josue Chery¹, Shan Huang², Shuyun Wang², Zhize Yuan², Lianghai Gong², Joshua Wong², Jeffrey Lee², Sean Johnson², Dingding Xiong², Ming-Sing Si²

¹Virginia Commonwealth University Medical Center, Richmond, VA; ²University of Michigan, Ann Arbor, MI

Invited Discussant: *Sunjay Kaushal

Objective: Right ventricle (RV) failure secondary to pressure overload is encountered in many congenital heart defects and is characterized by the loss of myocardial capillary density and mitochondrial dysfunction. We previously found that human neonatal thymus mesenchymal stem cells (ntMSCs) promote angiogenesis. Others have found that the trophic effects of MSCs from other tissue sources are related to their ability



to transfer mitochondria to adjacent cells. We hypothesized that ntMSCs could donate their mitochondria to adjacent cardiomyocytes (CMs) and endothelial cells (ECs) *in vitro* and improve right ventricle (RV) function and survival in the setting of chronic pressure-overload.

Methods: Human ntMSCs were isolated using an explant culture method, and their surface marker phenotypes were characterized by flow cytometry as previously described. Neonatal rat CMs and human ECs were cocultured with ntMSCs and mitochondrial transfer was evaluated with Mitotracker dyes, flow cytometry and confocal microscopy. Cell sheets made from 4×10^6 ntMSCs were generated by culturing on a thermoresponsive polymer coated surface of a 35 mm dish. RNU nude rats underwent PA banding (PAB) to induce RV pressure overload. Two weeks later, all animals underwent a redo left thoracotomy and the animals randomized to the treatment group had cell sheets applied to the epicardial surface of the RV while the control group received no treatment. The primary study endpoint was survival to 400 days after PAB. Animals underwent echocardiograms 7 days after PAB and prior to euthanasia. RV histological and immunohistochemistry studies were performed.

Results: Human ntMSCs transferred mitochondria to CMs and ECs *in vitro* during coculture. Approximately 16% of cocultured CMs and ECs received mitochondria from ntMSCs, and mitochondria transfer appeared to occur via tunneling nanotubes. Control and treated animals had similar PA band gradients prior to redo thoracotomy. All treatment animals ($n = 14$) survived to the study endpoint, whereas untreated control animals ($n = 13$) had a significantly decreased survival at the study end point (100% vs. 45%, $p < 0.028$ by log rank test). Treatment animals had significantly less RV fibrosis and improved RV capillary density as compared to controls (8.5 vs. 13.2%, $p < 0.05$). PA band gradients were greater in the treatment group at the end of the study, suggesting greater cardiac output.

Conclusions: Human ntMSCs may impart some of their cardiac beneficial effects by promoting angiogenesis and donating mitochondria to stressed CMs and ECs. Human ntMSCs can significantly improve the survival in a RV pressure overload model that mimics this chronic condition seen in patients with some forms of congenital heart disease. Collectively, our results indicate that ntMSCs may be a promising cell therapy that can preserve RV function in the setting of pressure overload.

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MONDAY AFTERNOON, APRIL 30, 2018

2:00 pm

Adult Cardiac Surgery Simultaneous Session

Ballroom 20A, SDCC

6 minute presentation, 9 minute discussion

Moderators: *Niv Ad and *Leonard N. Girardi

28. Three-Year Outcomes of Aortic Root Surgery in Marfan Syndrome Patients: A Prospective, Multi-Center, Comparative Study

*Joseph S. Coselli¹, Irina V. Volguina¹, *Scott A. LeMaire¹, Heidi M. Connolly²,
*Thoralf M. Sundt, III³, *Hartzell V. Schaff², Dianna M. Milewicz⁴, Harry C. Dietz⁵,
*D. Craig Miller⁶ on behalf of the Aortic Valve Operative Outcomes in Marfan Patients
Study Group

¹Baylor College of Medicine, One Baylor Plaza, Houston, Texas; ²Mayo Clinic, Rochester, Minnesota; ³Massachusetts General Hospital, Boston, Massachusetts; ⁴The University of Texas Health Science Center at Houston McGovern Medical School, Houston, Texas; ⁵Johns Hopkins University School of Medicine, Baltimore, Maryland; ⁶Stanford University, Stanford, California

Invited Discussant: *Eric E. Roselli

Objective: To compare the 3-year outcomes of aortic valve-sparing (AVS) versus valve-replacing (AVR) aortic root replacement in patients with Marfan syndrome.

Methods: A total of 316 patients who met the diagnostic criteria for Marfan syndrome (original Ghent nosology) were enrolled in a prospective, international registry at 19 centers between March 2005 and November 2010. Enrollees underwent AVS (n = 239, 76%) or AVR (n = 77, 24%) aortic root procedures and were followed up clinically and echocardiographically to assess 3-year mortality and valve-related adverse events. The median follow-up for all patients was 3.0 years (range, 0.1–9.8 y, IQR 2.8–3.3 y). For the 303 surviving patients, 3-year vital status was obtained for 298 (98%), clinical follow-up for 256 (84%), and echocardiographic readings for 229 (77%).

Results: Three-year survival rates were $96 \pm 1\%$ and $95 \pm 3\%$ in the AVS (9 deaths) and AVR groups (4 deaths, $p = 0.6$), respectively. The incidence of valve-related death was similar in the AVS and AVR groups (4/239 [1.7%] vs. 1/77 [1.3%]; $p = 0.8$). The AVS group had a lower rate of freedom from nonstructural dysfunction/structural valve deterioration (NSVD/SVD, $79 \pm 4\%$ vs $99 \pm 1\%$, $p = 0.007$) but a higher rate of freedom from bleeding ($97 \pm 1\%$ vs. $92 \pm 3\%$, $p = 0.03$). There were no significant differences in major adverse valve-related events (MAVRE), valve-related morbidity, embolism, endocarditis, or reoperation (Table). After AVS procedures, reintervention on the aortic valve was performed in 2 patients for severe aortic regurgitation (1 for endocarditis, and 1 graft infection). One reintervention after an AVR procedure was done for malignant lymphoma overgrowth in the perivalvular area. At 3 years and beyond, 24 (10%) patients in the AVS group and no patients in AVR group developed aortic regurgitation grade $\geq 2+$ ($P = 0.008$).



Table. Events at three-year follow-up

Events	AVS* (n=277)	AVR* (n=77)	P-value
Overall survival	96%±1% (9)	95%±3% (4)	0.6
Freedom from valve-related morbidity	76%±4% (40)	87%±4% (9)	0.3
Freedom from MAVRE	73%±4% (46)	84%±4% (11)	0.4
Freedom from bleeding	97%±1% (6)	92%±3% (6)	0.03
Freedom from NSVD/SVD	79%±4% (30)	99%±1% (1)	0.007
Freedom from reintervention	98%±1% (4)	98%±2% (1)	0.8
Freedom from embolism	97%±1% (6)	96%±2% (3)	0.5
Freedom from endocarditis	99.6%±0.4% (1)	99%±1% (1)	0.4
Freedom from ≥2+ aortic regurgitation	80%±4% (24)	100% (0)	0.008

*Event rate estimates reported with standard error and, in parentheses, the number of events.

Conclusions: At 3 years after aortic root replacement, valve-sparing and valve-replacing approaches were not associated with differences in survival, overall valve-related morbidity, or MAVRE. The valve-replacing group had more major bleeding events, and the valve-sparing group more frequently had valve dysfunction. We plan to continue follow-up of this well-defined cohort for 20 years to evaluate the mid- and long-term durability of AVS versus AVR root replacement in patients with Marfan syndrome.

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29. Surgical Aortic Valve Replacement with New Generation Bioprostheses: Sutureless Versus Rapid-Deployment

Augusto D'Onofrio¹, Stefano Salizzoni², Claudia Filippini², Chiara Tessari¹, Lorenzo Bagozzi¹, Antonio Messina³, Giovanni Troise³, Manfredo Rambaldini⁴, Magnus Dalèn⁵, Francesco Alamanni⁶, Massimo Massetti⁷, Carmelo Mignosa⁸, Claudio Russo⁹, Loris Salvador¹⁰, *Roberto Di Bartolomeo¹¹, Daniele Maselli¹², *Ruggero De Paulis¹³, *Ottavio Alfieri¹⁴, Carlo De Filippo¹⁵, Michele Portoghese¹⁶, *Uberto Bortolotti¹⁷, Mauro Rinaldi², *Gino Gerosa¹

¹University of Padova, Padova, Italy; ²University of Torino, Torino, Italy; ³Poliambulanza Hospital, Brescia, Italy; ⁴Carlo Poma Hospital, Mantova, Italy; ⁵Karolinska University Hospital, Stockholm, Sweden; ⁶University of Milan, Milano, Italy; ⁷Catholic University, Roma, Italy; ⁸Morgagni Hospital, Catania, Italy; ⁹Niguarda Hospital, Milano, Italy; ¹⁰San Bortolo Hospital, Vicenza, Italy; ¹¹University of Bologna, Bologna, Italy; ¹²S. Anna Hospital, Catanzaro, Italy; ¹³European Hospital, Roma, Italy; ¹⁴San Raffaele Hospital, Milano, Italy; ¹⁵Giovanni Paolo II Hospital, Campobasso, Italy; ¹⁶University of Sassari, Sassari, Italy; ¹⁷University of Pisa, Pisa, Italy

Invited Discussant: *Vinod H. Thourani

Objective: There are only two commercially available new generation devices for sutureless/rapid deployment aortic valve replacement (AVR): Intuity (Edwards Lifesciences, Irvine, CA, USA) and Perceval (LivaNova, London, UK) bioprostheses. The former is a rapid deployment valve with a balloon-expandable skirt for anchoring into the

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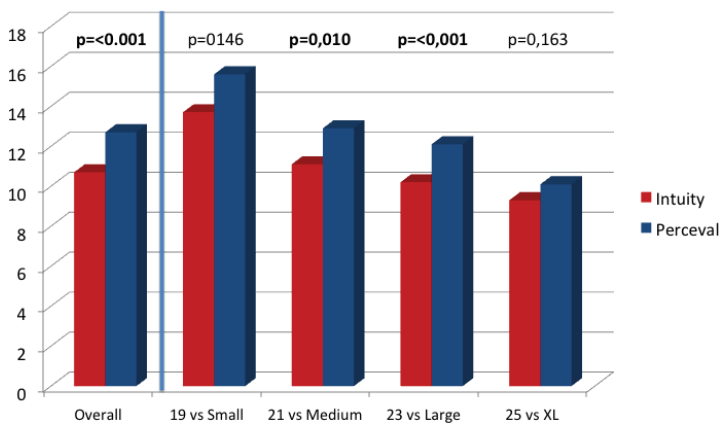


left ventricle outflow tract, the latter is a true sutureless self-expandable device with a nitinol frame; both have pericardial leaflets. Since there are no studies comparing these two devices, aim of this retrospective multi-center study was to compare early clinical and hemodynamic outcomes of patients undergoing AVR with the Intuity and with the Perceval bioprostheses.

Methods: We analyzed data of patients who underwent isolated or combined AVR with the Perceval and with the Intuity bioprostheses at 18 cardiac surgical institutions. Data were retrospectively collected by each center in a dedicated database. Preoperative variables were defined according to EuroSCORE and STS Score definitions and postoperative outcomes were defined according to VARC-2 criteria.

Results: We included in this study 911 patients operated on from March 2011 until May 2017. The Intuity and the Perceval valves were implanted in 562 (61.7%) and in 349 (38.3%) patients, respectively. Perceval patients were older (79.3 ± 6.4 vs. 74.8 ± 7.7 , $p < 0.001$) and with a worse surgical risk profile (STS PROM 4.2 ± 3.1 vs. 2.5 ± 1.9 ; $p < 0.001$). Overall 30-day mortality occurred in 18 patients (2%), 3 (0.9%) and 15 (2.7%) in the Perceval and in the Intuity group, respectively ($p = 0.086$). The rate of postoperative new permanent pacemaker implantation was 5.6% (51 patients), of these 16 (4.6%) and 35 (6.2%) patients were in the Perceval and in the Intuity group, respectively ($p = 0.294$). The incidence of mild, moderate and severe postoperative aortic regurgitation was 6.9%, 0.3% and 0.3%, respectively in the Perceval group while it was 12.1%, 1.4% and 0%, respectively in the Intuity group ($p = 0.007$). Peak transaortic gradients were 24.1 ± 9.1 and 19.4 ± 7.5 mmHg ($p < 0.0001$) while mean gradients were 12.7 ± 5.2 and 10.7 ± 4.3 ($p < 0.0001$) in the Perceval and in the Intuity group, respectively. The figure below shows mean transvalvular gradients according to valve size in the two groups.

Mean trans-aortic gradient



Conclusions: According to our data, the sutureless Perceval-S and the rapid-deployment Intuity bioprostheses provide excellent early clinical and hemodynamic outcomes. Perceval shows a lower rate of postoperative mild aortic regurgitation while Intuity provides lower transaortic gradients.



30. Outcomes of Dialysis Patients Undergoing Valve Replacement Operations: A Multi-Center Experience Over 20 Years

Joshua Manghelli¹, Daniel Carter¹, Ali Khiabani¹, Farah Musharbash¹, Richard Schuessler¹, *Marc R. Moon¹, Nabil Munfakh¹, Joel Corvera², *Ralph J. Damiano, Jr.¹, Spencer Melby¹

¹Washington University, St. Louis, MO; ²Indiana University, Indianapolis, IN

Invited Discussant: *Farzan Filsoofi

Objectives: A significant number of patients on hemodialysis require valve replacement surgery. Valve type selection (mechanical vs. biological) can be difficult because long-term survival is diminished and bleeding risks while on anticoagulation are greater in patients with renal failure. This study analyzed long-term outcomes of dialysis-dependent patients undergoing aortic and/or mitral valve replacement to delineate optimal valve type for replacement.

Methods: Dialysis dependent patients undergoing aortic and/or mitral valve replacement at 3 institutions between 1998–2017 were examined. Patients who underwent transcatheter valve replacement or aortic root replacement were excluded. The primary outcome was long term survival. Secondary outcomes included survival by age groups, 30-day mortality, length of hospital stay, ventilator hours, need for reoperation, and 30-day readmission. Echocardiogram data was utilized to determine valve function following surgery.

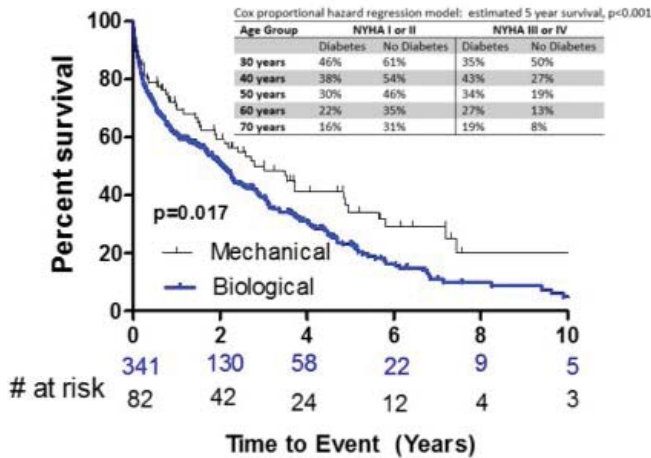
Results: A total of 423 patients were available for analysis. Three-hundred and forty one patients had biological and 82 had mechanical valves placed. Mean age was 60.1 ± 13.5 and 50.9 ± 12.8 for the biological and mechanical replacement groups, respectively ($p < 0.001$). There were no other significant differences in Society for Thoracic Surgeons baseline characteristics between groups. Overall complication and 30-day mortality rates were similar between groups. Thirty day readmission rates for biological and mechanical groups were 15% (50/341) and 28% (23/82), $p = 0.005$. Ten year survival was 5% and 20% with a median survival of 2.06 and 3.02 years for the biological and mechanical groups, respectively ($p = 0.017$, Figure). No one survived longer than 13 years. When adjusted for age, NYHA class, and diabetes using a multivariate cox regression model, survival was similar between groups (HR 1.229, CI 0.86–1.74, $p = 0.664$). Cox regression using variables found to be significant for long-term survival was employed to estimate 5-year survival by five age groups (30, 40, 50, 60, 70 years old), diabetes, and NYHA class ≥ 3 ($p = < 0.001$, Figure). Only patients 30 or 40 years old in NYHA I-II failure without diabetes had a $>50\%$ predicted 5-year survival. At a median follow up time of 17.5 months [IQR: 5, 38], data from 166 patients' echocardiograms showed that 12% (16/131) and 3% (1/35) of the biological and mechanical groups had evidence of structural valve deterioration, respectively ($p = 0.10$).

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Survival for Biological vs Mechanical Valves



Conclusion: Patients who require dialysis and undergo valve replacement surgery have poor long-term survival. Biological valves are a suitable choice for most patients, even while recognizing that valve deterioration can be rapid in patients with renal failure. Young patients without diabetes or NYHA III or IV symptoms may survive long enough to justify placement of a mechanical valve.

31. Endovascular Fenestration/Stenting First and Delayed Central Aortic Repair in Patients with Acute Type A Aortic Dissection and Critical Mesenteric Malperfusion: 20 Years' Experience

Elizabeth L. Norton¹, *Himanshu J. Patel¹, *G. Michael Deeb¹, Karen M. Kim¹, David M. Williams¹, Minhajuddin Khaja¹, Xiaoting Wu¹, Carlo Maria Rosati², Whitney E. Hornsby¹, Donald S. Likosky¹, Bo Yang¹

¹University of Michigan, Ann Arbor, MI; ²Indiana University, Indianapolis, IN

Invited Discussant: *Leonard N. Girardi

Objective: Critical mesenteric malperfusion (MP) represents the most immediately life-threatening factor in a subset of otherwise “relatively stable” (no rupture or shock due to cardiac tamponade) patients with acute type A aortic dissection (ATAAD). We examined the outcomes for this unique patient population treated with immediate endovascular revascularization (EVR) (fenestration/stenting), followed by central aortic repair (CAR) promptly after resolution of the critical visceral MP.

Methods: Retrospective review of a prospective single-center database of all patients (n = 602) who were admitted with ATAAD from 1996 to 2017. Management and outcomes of relatively stable patients with critical mesenteric MP (n = 83), compared with those patients without any critical MP syndrome who underwent immediate CAR (n = 453). We also compared the outcomes between first (1996–2007) vs. second (2008–2017) time periods. Primary endpoints were in-hospital mortality and long-term survival.



Results: Among those 83 patients, with median age 59 years (range: 29–90), 33 (40%) died before undergoing CAR: 11 (13%) due to aortic rupture (time from EVR to death: median 3 days; range 1–34 days) and 22 (27%) due to end organ failure (median 6; range 0–92 days), respectively. 48 (58%) patients eventually underwent CAR (time from first admission to CAR: median 7 days; range 0–279 days) and 2 (2%) survived without CAR.

In comparison with the 453 patients without any MP syndrome who underwent immediate CAR, mesenteric MP patients who underwent CAR (n = 48) had more chronic comorbidities (previous myocardial infarction, hypertension, chronic kidney disease) and acute organ dysfunction (acute kidney injury, acute stroke) (all p < 0.05). Postoperatively, patients with mesenteric MP had more post-op complications (prolonged ventilation, post-op renal failure requiring dialysis; all p < 0.05) and a longer post-op hospital stay (median: 16 vs. 10 days, p < 0.001); however, there was no significant difference in operative mortality after CAR (2% vs. 8% for patients without MP; p = 0.24), as well as in 1-, 5- and 10-year survival by Kaplan-Meier analysis (94%, 91% and 74% vs. 89%, 78% and 65%, respectively; p = 0.27).

Compared to the first decade, in the second decade, the in-hospital mortality improved with no patients with critical mesenteric MP died from aortic rupture before CAR (Table).

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	First Decade (1996–2007) n = 52	Second Decade (2008–2017) n = 31	p Value
Patients with critical mesenteric MP–n (%)	52 (21% of total 245 ATAAD)	31 (9% of total 357 ATAAD)	p < 0.001
Delayed CAR–n (%)	31 (60%)	17 (55%)	0.84
Survival without CAR–n (%)	0	2 (6%)	0.14
Days between EVR and CAR–median (range)	6 (0–157)	4 (1–279)	0.77
Mortality from aortic rupture before CAR–n (%)	11 (21%)	0	0.006
Mortality from organ failure before CAR–n (%)	4 (8%)	4 (13%)	0.46
Mortality from stroke before CAR–n (%)	6 (12%)	8 (26%)	0.17
Operative mortality of delayed CAR–n (%)	1 (3%)	0	1
In hospital mortality of all causes- n (%)	22 (42%)	10 (32%)	0.50

Conclusions: Critical mesenteric MP negatively affects outcomes of patients with ATAAD. An “endovascular revascularization first” approach could be valuable for these patients. Our outcomes continued to improve over the last decade.

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32. Risk Factors and Outcomes of Pacemaker Implantation After Concomitant Mitral Valve Surgery and Ablation of Atrial Fibrillation: Insights from a Surgical Ablation during Mitral Valve Surgery Trial

*Joseph J. DeRose¹, Donna Mancini², Helena L. Chang², *A. Marc Gillinov³, *Francois Dagenais⁴, *Gorav Ailawadi⁵, *Louis P. Perrault⁶, Michael K. Parides², Wendy C. Taddei-Peters⁷, *Michael J. Mack⁸, *Donald Glower⁹, Babatunde Yerokun⁹, *Pavan Atluri¹⁰, John C. Mullen¹¹, *John D. Puskas¹², Karen O'Sullivan², Nancy M. Sledz-Joyce², Hugo Tremblay¹³, Ellen Moquete², Bart S. Ferket², Alan J. Moskowicz², Alexander Iribarne¹⁴, Annetine C. Gelijns², Patrick O'Gara¹⁵, *Michael Argenziano¹⁶
¹Montefiore-Einstein Medical Center, Bronx, NY; ²Icahn School of Medicine at Mount Sinai, New York, NY; ³Cleveland Clinic, Cleveland, OH; ⁴Institut de Cardiologie et Pneumologie de Québec, Québec, QC, Canada; ⁵University of Virginia, Charlottesville, VA; ⁶Montreal Heart Institute, Montreal, QC, Canada; ⁷National Heart, Lung, and Blood Institute, Bethesda, MD; ⁸Baylor Scott & White Health, Plano, TX; ⁹Duke University, Durham, NC; ¹⁰University of Pennsylvania, Philadelphia, PA; ¹¹University of Alberta, Edmonton, AB, Canada; ¹²Mount Sinai Heart at Saint Luke's, New York, NY; ¹³Institut Universitaire de Cardiologie et de Pneumologie de Québec, Québec, QC, Canada; ¹⁴Dartmouth-Hitchcock Medical Center, Lebanon, NH; ¹⁵Brigham and Women's Hospital, Boston, MA; ¹⁶New York-Presbyterian Hospital, Columbia University, New York, NY

Invited Discussant: *Niv Ad

Objectives: The incidence of permanent pacemaker (PPM) implantation is increased following mitral valve surgery (MVS) with AF ablation compared to MVS alone. We sought to determine risk factors and outcomes associated with PPM implantation as observed within a randomized trial of MVS with and without AF ablation.

Methods: 243 patients without prior PPM and persistent/long-standing persistent AF were randomly assigned to undergo MVS alone (n = 117) or MVS + ablation (n = 126). Patients in the ablation group underwent further randomization to pulmonary vein isolation (PVI; n = 62) or biatrial maze (n = 64). Competing risk models were used to examine the association between PPM and potential risk factors (CHADs score, multi-valve surgery, randomization assignment (MVS alone vs. PVI vs. Maze), ablation device, AF history, NYHA, LVEF, cardiac rhythm, etiology of MR, CPB time, cross-clamp time, prior cardiac surgery, pre-op beta blocker and amiodarone). Cox proportional hazard models were used to assess the impact of PPM implantation on time to discharge, 30-day readmissions and 1-year mortality. All analyses followed the intent-to-treat principle.

Results: A PPM was implanted in 35 patients within 1 year of randomization (14.4%) with the majority of the implants occurring within 30 days of surgery (85.7%). This occurred in 9 (7.7%) patients randomized to MVS alone, 10 (16.1%) in MVS + PVI, and 16 (25%) in MVS + biatrial maze. The indications for PPM (heart block vs. sinus node dysfunction) were similar among patients having MVS + ablation and those having MVS alone. Ablation, multi-valve surgery, and NYHA class III/IV were independent

risk factors for PPM implantation (Figure 1). Length of stay post-surgery was longer in patients receiving a PPM, but when adjusted for age and randomization assignment (MVS vs. ablation) was not statistically significant (HR 0.81; 95% CI 0.61–1.08; $p = 0.14$). PPM implantation did not increase 30-day readmission rate (HR 1.43; 95% CI 0.50–4.05; $p = 0.50$). Adjusted for randomization assignment (MVS vs. ablation), age and NYHA class, the need for a PPM was associated with a higher risk of 1-year mortality (HR 3.21; 95% CI 1.01–10.17; $p = 0.05$).

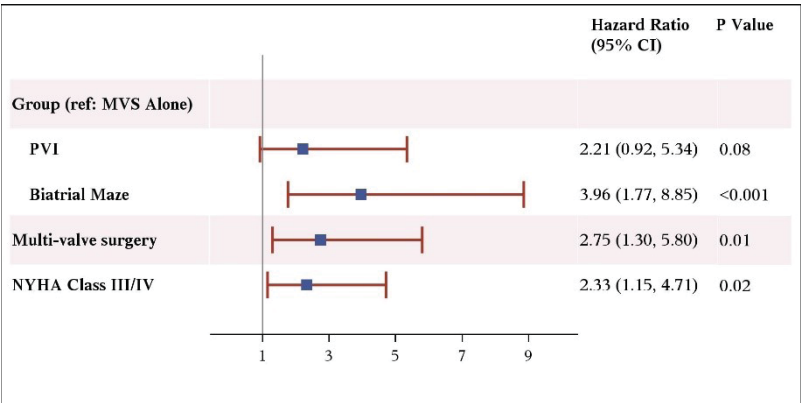


Figure 1: Risk Factors for PPM Implantation.

Conclusions: AF ablation (especially biatrial maze), multi-valve surgery and NYHA Class III/IV increase the risk for PPM insertion. PPM implantation following MVS alone with or without AF ablation is associated with a three-fold increase in 1-year mortality.

3:30 pm – Coffee Break in the Exhibit Hall
4:00 pm

3:35 pm – 4:00 pm

Deep Dive in Coronary Revascularization

3 minute presentations, 20 minute discussion

AATS CT Theater II
 Booth #1235, Exhibit Hall
Not for Credit

See page 44 for details.

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4:00 pm

**Adult Cardiac Surgery
Simultaneous Session**

Ballroom 20A, SDCC

5 minute presentation, 9 minute discussion

Moderators: *David H. Adams and *Ralph J. Damiano, Jr.

Invited Speaker: State of the Art: Mitral Repair

*Gilles D. Dreyfus, *Cardiothoracic Centre of Monaco*

33. Predictors and Clinical Significance of Functional Mitral Valve Stenosis Following Valve Repair for Degenerative Disease

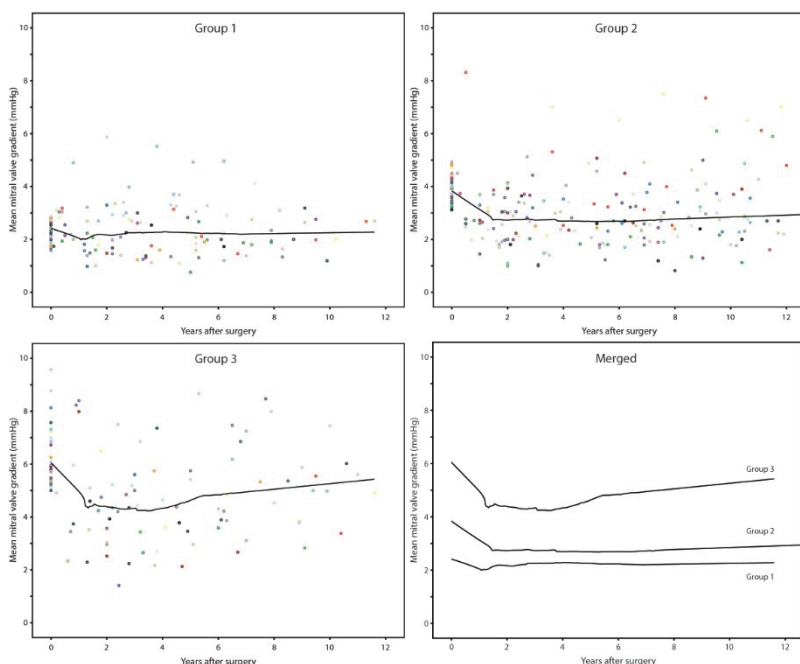
Anton Tomsic, Yasmine L. Hiemstra, Bardia Arabkhani, Thomas J. van Brakel, Michel I.M. Versteegh, Nina Ajmone Marsan, *Robert J.M. Klautz, Meindert Palmen
Leiden University, Leiden, Netherlands

Invited Discussant: *Gebrine El Khoury

Objective: Functional mitral valve stenosis can occur after mitral valve repair for degenerative disease. The predictors and clinical effect hereof remain insufficiently explored.

Methods: Between 1/2004 and 12/2010, 176 patients with no history of atrial fibrillation underwent valve repair for pure valve regurgitation due to degenerative disease. All patients underwent a semi-rigid annuloplasty ring implantation and no edge-to-edge repair was performed. The patient cohort was divided according to the postoperative mean mitral valve gradient measured on pre-discharge transthoracic echocardiography: **Group 1** (<3 mmHg; n = 57), **Group 2** ($3 \leq < 5$ mmHg; n = 86) and **Group 3** (≥ 5 mmHg; n = 33). A multinomial logistic regression model was built to determine the predictors of group allocation. Inverse probability weighted analysis was performed to explore the effect of group allocation on late events (all-cause mortality, freedom from atrial fibrillation, mitral valve reintervention and recurrent mitral regurgitation). The SF-36 questionnaire was used to measure the health-related quality of life.

Results: Logistic regression analysis revealed increasing body surface area as a risk factor for increased postoperative mean mitral valve gradients (10.74, 95% CI 1.45–79.47, $P = 0.020$ for Group 2 and OR: 57.83, 95% CI 3.61–919.28, $P = 0.004$ for Group 3). Increasing ring size was protective (OR: 0.79, 95% CI 0.69–0.91, $P = 0.002$ for Group 2 and OR: 0.71, 95% CI 0.58–0.86, $P < 0.001$ for Group 3) against increased mean mitral valve gradients. Surgical technique did not show a significant effect on mean mitral valve gradients. Clinical follow-up was 100% complete with a mean duration of 8.7 ± 2.8 years (echocardiographic follow-up 98% complete, mean duration 6.4 ± 3.3 years). Increased mitral valve gradients did not have a significant effect on survival, freedom from recurrent mitral regurgitation or freedom from atrial fibrillation. However, when patients with a postoperative gradient of ≥ 5 mmHg were compared to patients with a gradient < 5 mmHg, a higher reintervention rate was observed (4/145 versus 5/33, HR 6.2, 95% CI 1.50–25.67; $P = 0.012$) in the latter. In this group, 2 reinterventions were needed for mitral valve stenosis. Following repair, the transvalvular mitral valve gradients remained relatively stable (Figure). The health-related quality of life in Group 2 was comparable to Group 1. On the other hand, the functional status of patients from Group 3 was significantly impaired when compared to Group 1.



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Conclusions: Following mitral valve repair with a semi-rigid annuloplasty ring, increased resting mitral valve gradients are not uncommon. This is mainly related to the implanted ring size and patient body surface area. High postoperative mean resting mitral valve gradients (≥ 5 mmHg) might result in poorer freedom from reintervention and will predict worse quality of life following successful repair.

34. Anticoagulation After Mitral Valve Repair

Tessa Watt, Shannon Murray, Alexander Wisniewski, Shazli Khan, Matthew A. Romano, *Steven F. Bolling

University of Michigan, Ann Arbor, MI

Invited Discussant: *Marc R. Moon

Objectives: Current guidelines and recommendations involving anticoagulation following mitral valve repair (MVR) are not well established. A retrospective study of patients undergoing routine MVR was completed to assess the effectiveness of Coumadin postoperatively. Effectiveness will be evaluated based on composite postoperative incidents, bleeding events, and rates of mortality.

Methods: Retrospective study assessed 1097 routine MVR patients naïve to atrial fibrillation or prior coronary artery bypass, mitral valve or aortic valve surgery between April 2003 and March 2017. 775 patients were placed on Coumadin and 322 patients were not anticoagulated. Patients in the Coumadin group began their anticoagulation regimen 48 hours postoperatively within an Institutionalized Normalized Ratio (INR)

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of 2.0 – 2.5. The average age of patients on Coumadin was 57 years and those not on Coumadin was 54 years. Statistical analysis involved t-test of continuous variables and chi-squared test for categorical variables.

Results: There were significantly lower rates of composite postoperative incidents (Total CVA, TIA, PE, Pericardial Effusion, Cardiac Tamponade) for patients on Coumadin compared to those without (1.68% vs. 4.04%, $p = 0.0192$) despite similar rates of postoperative atrial fibrillation (POAF) (29.7% vs. 25.78%, $p = 0.1925$). Readmission rates were comparable between the two subsets of patients (9.20% vs. 9.34%, $p = 0.6879$). Reoperation for bleeding (0.13% vs. 0.31%, $p = 0.5210$) as well as readmission rates for gastrointestinal bleeding (0.66% vs. 1.8%, $p = 0.0651$) were comparable between the Coumadin and non-Coumadin group. Furthermore, there was no significant difference in 30-day mortality between the two groups (0.52% vs. 0.00%, $p = 0.1965$). See “Results Table”.

N = 1097	Coumadin (775)	Non Coumadin (322)	p-value:
Age (years)	57.34	54.51	
Male	442 (57.03%)	168 (52.17%)	0.140259
Readmission	71 (9.20%)	32 (9.34%)	0.687997
30 Day Mortality	4 (0.52%)	0 (0.00%)	0.196526
Post Op A-Fib	230 (29.7%)	83 (25.78%)	0.192589
ReOp for Bleeding	1 (0.13%)	1 (0.31%)	0.521002
Readmission for post- op GI bleeding	5 (0.66%)	6 (1.8%)	0.065167
Pericardial Effusion/ Tamponade	1 (0.13%)	3 (0.93%)	0.044593+
Strokes	9 (1.21%)	8 (2.54%)	0.106156
TIA	3 (0.39%)	1 (0.31%)	0.106156
PE	0 (0.00%)	1 (0.31%)	0.120639
Composite Postoperative Incidents	13 (1.68%)	13 (4.037%)	0.019292+
Tricuspid Valve Intervention Patients	120 (15.53%)	41 (12.73%)	0.140259

Conclusions: Coumadin anticoagulant therapy post MVR resulted in decreased rates of postoperative incidences of CVA, TIA, PE, pericardial effusion, and cardiac tamponade. Rates of POAF, readmission, readmission for postoperative gastrointestinal bleeding, incidences of reoperation for bleeding and 30-day mortality were comparable between the two patient groups. These findings suggest anticoagulation with Coumadin following MVR is a safe and effective means for reduction of postoperative complications and that a randomized trial is warranted in the future.

35. Impact of High Volume Marfan Syndrome Centers on Mitral Repair Rates in Patients with Marfan Syndrome

Antonio R. Polanco, Yuting P. Chiang, Jeremy J. Song, Alex M. D'Angelo, David J. Engel, Virendra I. Patel, *Hiroo Takayama
Columbia University, New York, NY

Invited Discussant: *A. Marc Gillinov

Objective: To evaluate trends in mitral valve (MV) operations performed on patients with Marfan Syndrome (MfS) patients and to determine the influence of an institution's MfS and MV volume on mitral repair (MVR) rates in the United States.

Methods: The Nationwide Inpatient Sample was queried from 1998–2011 and a total of 14,859 MfS patients were identified: of these 1,189 underwent a MV operation. Linear regression was performed to assess trends of MVR rates over time. Patients were stratified into tertiles depending on the institution's MfS surgical volume: low volume (<5 cases), medium volume (6–10 cases), high volume (>11 cases). Similarly, patients were stratified into low (<25 cases), medium (26–89 cases) and high (>90 cases) volume groups based on the institution's total MV volume. Multivariate analysis was used to determine the impact of institutional MV and MfS surgery volume on whether a patient received an MVR.

Results: The MVR rate was 40% and the MV replacement rate was 60% for the entire cohort. There was an increasing trend of MVR rates during the study period (19% in 1998–99 versus 46% in 2010–2011, $p < 0.05$). Additionally, an increasing trend was observed in the total annual number of MV operations performed at high volume MfS centers during the study period (88 in 1998–99 vs. 102 in 2010–2011, $p < 0.05$). Multivariate analysis revealed that MfS patients operated on at low volume MfS centers were less likely to undergo MVR (OR 0.49, $p < 0.05$) when compared to MfS patients at high volume centers. In contrast, MfS patients operated on at high volume MV centers did not undergo MVR more so than MfS patients operated on at lower volume MV centers.

Conclusion: The national MV replacement rate in the MfS population is surprisingly high, however the MVR rate is increasing as are the number of MV operations performed at high volume MfS surgical centers. This study suggests that MfS patients with indications for MV surgery should be referred to high volume MfS surgical centers to have the best opportunity for MVR.

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36. Preoperative Left Atrial Volume Is Associated with Postoperative Outcomes in Mitral Valve Repairs

Parvathi Balachandran, Brian D. Lahr, *Joseph A. Dearani, *Richard C. Daly,
*Simon Maltais, Sorin V. Pislaru, *Hartzell V. Schaff

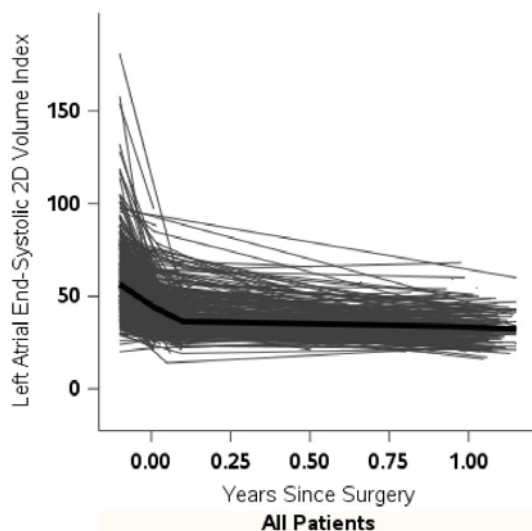
Mayo Clinic, Rochester, MN

Invited Discussant: *Tomasz A. Timek

Objective: To assess the preoperative factors determining left atrial reverse remodeling after mitral valve repair for degenerative disease.

Methods: We reviewed records of 836 patients who underwent mitral valve repair for degenerative disease from 2007 through 2015. We obtained left atrial end-systolic 2D volume index (LAVI) from echocardiograms taken pre and postoperatively to analyze reverse remodeling of the left atrium (LA) in these patients. We performed multivariable regression analysis to determine the baseline effects of LAVI, age, sex, body mass index (BMI), atrial fibrillation (AF), hypertension, pulmonary artery systolic pressure, and left ventricular end-systolic and diastolic dimensions on postoperative LA reverse remodeling (modeled separately for immediate and one-year postoperative remodeling). We also analyzed the association of preoperative LAVI with early postoperative AF and with long-term mortality using logistic and Cox regression, respectively.

Figure: Left Atrial End-Systolic Volume Index Values at Pre- and Postoperative Assessments.



Results: The largest decrease in LA volume occurred in the immediate postoperative period (mean change in LAVI -13.96 mL/m², CI -12.87 to -15.06 , $p < 0.001$). LAVI appeared to decrease further in the first month after operation (-19.97 mL/m², CI -18.70 to -21.25 , $p < 0.001$) but there was little change in LA size through the remainder of the year (Figure). Among the baseline factors included in the model, preoperative LAVI, age, and AF were independently associated with LA reverse remodeling for both the immediate and one-year postoperative endpoints. Reverse remodeling increased sig-



nificantly with younger age [mean change in LAVI in mL/m² at immediate postoperative assessment (age group), -12.21 (<55 y), -10.27 (55–70 y), -6.38 (>70 y), $p = 0.002$]. Preoperative AF was associated with decreased reverse remodeling in the immediate postoperative period [mean change in LAVI in mL/m² with AF, without AF (-5.6, -13.64, $p = 0.048$)] as well as at one year (-7.31, -21.64, $p = 0.005$). Preoperative LAVI measurements were positively correlated with follow-up values at both time points (Spearman $\rho = 0.580$ and 0.314 , $p < 0.001$ both) and independently associated with extent of LA reverse remodeling ($p < 0.001$ both). Higher preoperative LAVI was also significantly associated ($p = 0.018$) with increased risk of early postoperative AF and was marginally associated ($p = 0.051$) with increased risk of late mortality.

Conclusions: In patients with degenerative MR who have MV repair, preoperative LAVI was associated with the extent of LA reverse remodeling, and risk of early postoperative AF and late mortality. The major portion of reverse remodeling occurs within the first month after operation and is greatest in younger patients and those in sinus rhythm preoperatively.

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37. Long-Term Results of Mitral Repair for Degenerative Mitral Regurgitation with Complete Semirigid Rings Versus Posterior Flexible Bands: Does It Make Any Difference?

Andrea Baccelli¹, Elisabetta Lapenna², Benedetto Del Forno², Alessandro Castiglioni², Giovanni La Canna², Ilaria Giambuzzi¹, *Ottavio Alfieri², Michele De Bonis²

¹Università Vita-Salute San Raffaele, Milano, Italy; ²San Raffaele University Hospital, Milano, Italy

Invited Discussant: *Clifford W. Barlow

Objectives: To evaluate whether the type of ring used (complete semi-rigid ring vs. posterior flexible band) did have an impact on the long-term results of mitral repair for degenerative mitral regurgitation.

Methods: 223 consecutive patients submitted to mitral repair with posterior leaflet resection (with or without sliding plasty) for posterior leaflet prolapse were selected in order to have a homogeneous population. Depending on the type of annuloplasty ring used, they were divided into 2 groups: 120 patients received a posterior flexible band (PFB) and 103 patients a complete semi-rigid ring (CSR). The preoperative characteristics were comparable in the 2 groups, as shown in the table below. Follow-up was 100% complete (median length 11 ± 1.9 years). A comparative analysis of the 2 groups was performed in terms of postoperative and long-term outcomes. Echocardiographic follow-up at long term was available to assess durability of the repair. Kaplan-Meier methods were used to compare the overall survival of the 2 groups. Competing risk analysis was performed by calculating the Cumulative Incidence Function (CIF) of recurrence of mitral regurgitation and reoperation, with overall death as competing event.

Results: No operative deaths were observed. One patient (CSR group) died in-hospital within 30 days from operation of cardiogenic shock due to postoperative right ventricular dysfunction. Overall survival at 12 years was similar ($P = 0.62$). The CIF of cardiac death, with noncardiac death as a competing risk, showed no difference between the 2 groups ($P = 0.99$). At 12 years, the CIF of recurrent MR $\geq 3+$, with death as a competing

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risk, was $9 \pm 3\%$ in the PFB group and $8 \pm 3\%$ in the CSR group ($P = 0.34$), and the CIF of recurrence of $MR \geq 2+$ was $17 \pm 4\%$ and $9 \pm 3\%$, respectively ($P = 0.11$). The type of ring had no impact on survival and recurrence of MR.

	Flexible Band	Semirigid Ring	P-value
N. pts	120	103	
Age, mean (\pmSD), years	57.03 \pm 11.2	56.8 \pm 11.8	0.89
BMI, mean (\pm SD)	24.7 (\pm 3.0)	24.6 (\pm 3.2)	0.74
Female, n (%)	31(25.8%)	22 (21.3%)	0.46
COPD, n (%)	5 (5.2%)	3 (3.6%)	0.7
Smoking, n (%)	12 (12.5%)	8 (7.3%)	0.4
Hypertension, n (%)	35 (30.2%)	30 (30.6%)	0.94
LVEF, mean (\pmSD)	60.7 (\pm 8.3)	62.0 (\pm 6.5)	0.23
Atrial fibrillation, n (%)	4 (3.3%)	2 (1.9%)	0.52
NYHA III-IV, n(%)	21 (18.5%)	12 (12.2%)	0.31

Baseline characteristics by surgical cohort.

Conclusions: Our data show that, in a homogenous population of patients requiring mitral repair for posterior leaflet prolapse, all treated with the same leaflet repair approach, the type of annuloplasty ring (posterior flexible band vs. complete semi-rigid ring) has no impact at all on the immediate results, overall survival, incidence of cardiac death and recurrence of mitral regurgitation.

38AC. A Population Based Evaluation of Phase of Care Contributing to Mortality After Surgical and Transcatheter Aortic Valve Replacement

*Himanshu J. Patel¹, Patricia F. Theurer², Frances L. Shannon³, *Gaetano Paone⁴, John Heiser¹, Melissa J. Clark², *Richard L. Prager¹

¹University of Michigan, Ann Arbor, MI; ²Michigan Society of Thoracic and Cardiovascular Surgeons, Ann Arbor, MI; ³William Beaumont Hospital, Royal Oak, MI; ⁴Henry Ford Hospital, Detroit, MI

Invited Discussant: Dawn S. Hui

Objective: The recent implementation of phase of care mortality analysis (POCMA) in a statewide quality collaborative suggested its importance in evaluation of the root cause of mortality following cardiac surgery. We present a population based analysis of POCMA use for surgical (SAVR) and transcatheter (TAVR) aortic valve replacement.

Methods: The study cohort consisted of 9671 patients who underwent isolated aortic valve replacement (60.4% SAVR) in the state of Michigan (2011–2016). Data were derived from a statewide quality collaborative database comprising all 33 non-federal cardiac surgical sites in Michigan. POCMA was assessed by the implanting surgeon and defined within 5 phases of care (preoperative, intraoperative, postoperative intensive care unit or floor, and discharge). The root cause leading to mortality was identified as occurring in one of these phases. Furthermore, the seminal event was characterized as potentially avoidable or not.

Results: There was a significant trend favoring increased TAVR use towards predominance ($p < 0.001$), such that 57.2% of the 2301 AVR procedures in 2016 in Michigan were performed with a transcatheter approach. Mortality was 2.4% (137/5805) after SAVR, and 4.5% (171/3182) after TAVR. The rates of mortality decreased over the time interval for TAVR (2011 7.9% vs. 2016 3.1%) but was stable for SAVR (2011 1.4% vs. 2016 2.0%). By POCMA, 41% of TAVR mortality was accounted for in the intraoperative phase (vs. 19% SAVR, $p < 0.001$, Figure 1A). In contrast, mortality after SAVR by POCMA was more frequently in the ICU (33% vs. TAVR 17%, $p = 0.005$) or postoperative floor (17% vs. TAVR 7%, $p = 0.02$, Figure 1A) phases. Finally, 28.5% of deaths after SAVR and 40.8% after TAVR were identified as avoidable. Avoidable deaths by phase of mortality are shown in Figure 1B.

Figure 1A: SAVR/TAVR POCMA Profile

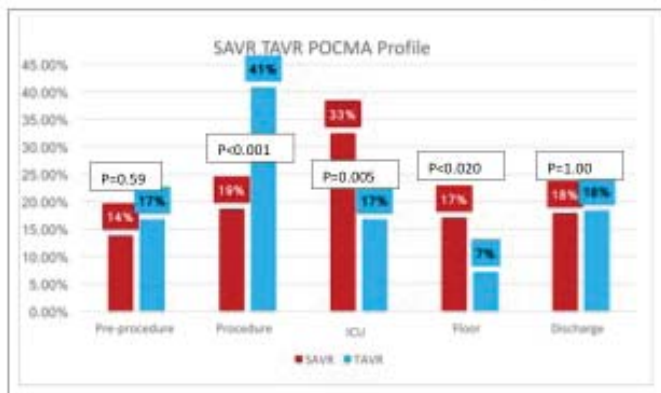
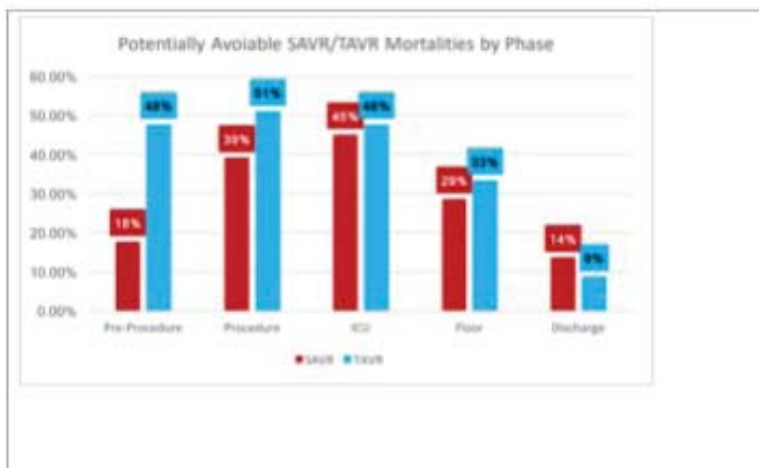


Figure 1B: Potentially Avoidable Mortalities SAVR/TAVR



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Conclusion: This statewide population based analysis of root cause of mortality after surgical and transcatheter aortic valve replacement identified important differences in phases of care contributing to the seminal event. These data provide heart teams with a platform for quality improvement initiatives as indications for each therapeutic option continue to evolve.

5:30 pm Adjourn

5:35 pm – Executive Session, AATS Members Only Ballroom 20A, SDCC
6:15 pm

2:00 pm Controversies in CABG 2018 Room 28ABC, SDCC
7 minute presentation, 8 minute discussion
Moderators: *John D. Puskas and *James Tatoulis

Conduits in CABG

38. A Meta-Analysis of the Adjusted Observational Studies Comparing the Radial Artery and the Saphenous Vein As the Second Conduit for CABG

♦Mario F. Gaudino¹, Mohamed Rahouma¹, Ahmed Anwar Abouarab¹, Jeremy Leonard¹, Mohamed Kamel¹, Derrick Tam², *Leonard Girardi¹, *Stephen Frenes²
¹Weill Cornell Medicine, New York Presbyterian Hospital, New York, NY; ²Sunnybrook Health Science Center, Toronto, ON, Canada

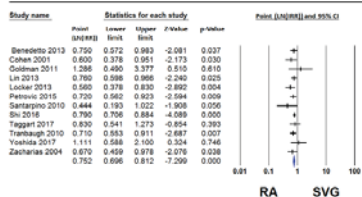
Invited Discussant: *James Tatoulis

Objective: No meta-analysis comparing the survival of patients receiving radial artery (RA) or the saphenous vein (SV) as the second conduit for coronary artery bypass surgery (CABG) has been published to date. The published meta-analyses in fact included only randomized trials are underpowered to detect differences in survival.

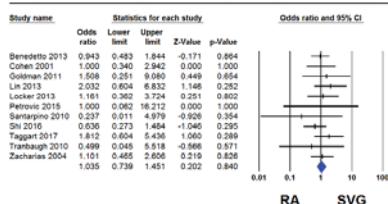
Methods: PubMed and OVID's version of MEDLINE were searched (1972–2017) for full articles, with sample size of ≥ 100 patients in each group and follow-up >30 days, comparing the use of the RA vs. the SV for isolated CABG. Only matched and adjusted studies were included. Time-to-event outcomes for long-term mortality were extracted as incidence rate ratio (IRR) along with their 95% confidence intervals. Odds ratio (OR) was extracted for perioperative stroke, early or late myocardial infarction (MI) and repeated revascularization. Random model, leave-one-out-analyses and meta-regression were used.

Results: Among 1,241 searched articles, 12 studies (19,491 patients) were included in the meta-analysis. The weighted mean follow-up was 7.4 years. Operative mortality was 1.9% in RA group vs. 0.9% in SV group (OR 1.04, 95% CI 0.74–1.45). No difference in perioperative MI or stroke was found (OR 0.73, 95% CI 0.48–1.09 and OR 0.66, 95% CI 0.41–1.06). Long term mortality was 14.9% in RA group vs. 30.13% in SV group (IRR 0.75, 95% CI 0.70–0.81, $P < 0.001$). No difference in late MI or repeated revascularization and (OR 0.75, 95% CI 0.44–1.28 and OR 0.89, 95% CI 0.62–1.28). At meta-regression the survival advantage for the RA was independent from age, gender, diabetes and left ventricular function.

Long term mortality; Radial artery vs. Saphenous vein grafting



Peri-operative mortality; Radial artery vs. Saphenous vein grafting



Conclusion: The use of the RA as the second conduit for CABG is associated with a 25% relative risk reduction in mortality at a mean follow-up of 7.4 years.

39. Bilateral Internal Thoracic Artery Grafting: A Propensity Analysis of the Left Internal Thoracic Artery Versus the Right Internal Thoracic Artery As a Bypass Graft to the Left Anterior Descending Artery, Including Angiographic Results

Shinji Ogawa¹, Tomohiro Tsunekawa², Koshi Sawada¹, Yoshihiro Goto¹, Soh Hosoba¹, Yutaka Koyama³, Mototsugu Tamaki³, Takayoshi Kato², Hideki Kitamura³, Shinji Tomita², Yasuhide Okawa³

¹Toyohashi Heart Center, Toyohashi, Japan; ²Gifu Heart Center, Gifu, Japan; ³Nagoya Heart Center, Nagoya, Japan

Invited Discussant: *Faisal G. Bakaeen

Objective: Despite evidence that bilateral internal thoracic artery (BITA) grafting improve clinical outcomes and long-term survival after coronary artery bypass grafting (CABG), whether the strategy of *in situ* right internal thoracic artery (RITA) to left anterior descending artery (LAD) is as effective as the *in situ* left internal thoracic artery (LITA) to LAD is unclear. We directly compared *in situ* BITA grafting and examined early and long-term outcomes, including patency of each graft.

Methods: We reviewed 877 patients who underwent primary isolated CABG using *in situ* BITA at three Japanese centers between 1999 and 2014. Among these patients, *in situ* RITA for LAD grafting was used in 683 patients compared with *in situ* LITA to LAD in 194 patients. We compared long-term patency of each graft. Propensity score matching was carried out to investigate early and long-term outcomes including mortality, need for repeat revascularization and myocardial infarction.

Results: Using angiography, 1496 BITA conduits were examined; a mean of 2.0 ± 2.8 years postoperatively. Five-year RITA to LAD, LITA to LAD and LITA to non-LAD patencies were identical (93% vs. 91% vs. 90%), respectively. However, five-year RITA to non-LAD patency was low (83%). After statistical adjustment, a total of 183 propensity matched pairs were available for comparison. In the propensity matched cohort, the mean follow-up time was 5.7 ± 3.9 years. RITA to LAD enabled more distal anastomoses than LITA to LAD with *in situ* BITA (2.4 ± 0.04 vs. 2.2 ± 0.03 , $P < .0001$). Kaplan-Meier analysis revealed that RITA to LAD and LITA to LAD were equal regarding death or repeat revascularization or myocardial infarction (log rank $P = .82$).

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Conclusions: Long-term patencies and outcomes of *in situ* RITA to LAD grafting are effective, equivalent to LITA to LAD. This strategy also enables more distal anastomoses with *in situ* BITA. More extensive use of the *in situ* RITA to LAD in CABG is recommended.

40. CABG with 3 Arterial Grafts Does Not Improve Outcomes Compared to 2 Arterial Grafts at 5 Year Followup

Rodolfo Rocha¹, Derrick Tam¹, Reena Karkhanis¹, Rashmi Nedadur¹, Jiming Fang², Jack Tu², *Stephen Fremes¹

¹University of Toronto, Toronto, ON, Canada; ²Institute of Clinical Evaluative Sciences, Toronto, ON, Canada

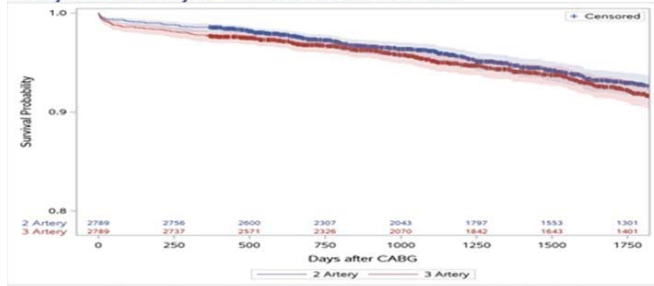
Invited Discussant: *G. Hossein Almassi

Objective: Coronary artery bypass surgery (CABG) with 2 arterial grafts improves survival compared to CABG with 1 arterial graft. However, there is no consensus whether a third arterial graft provides additional benefit. We sought to analyze the longitudinal outcomes of 2 vs. 3 arterial grafts during CABG.

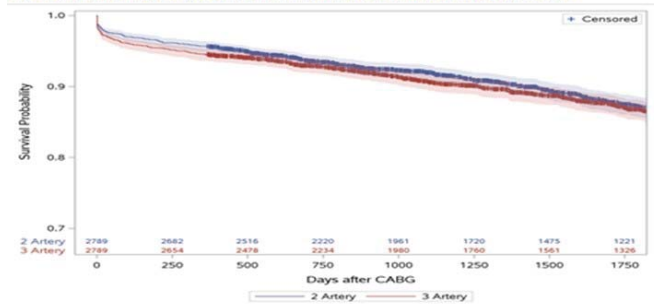
Methods: We performed a retrospective cohort analysis of all primary isolated CABG performed in Ontario, Canada, from October, 2008 to March 2016, through the Cardiac Care Network clinical database. Propensity score matching of 33 pre-operative patient characteristics, including surgical risk factors and extent of coronary disease. Primary outcome was mortality. Secondary outcomes were major adverse cardiac and cerebrovascular events (MACCE) (combined outcome of mortality, myocardial infarction and stroke) and repeated revascularization. Tertiary outcomes were in-hospital complications.

Results: A total of 50,230 patients underwent isolated CABG during our study period. 8253 (16.4%) and 3044 (6.1%) patients had 2 or 3 arterial grafts respectively. Mean and maximum follow-up was 4.2 and 8.5 years respectively. We obtained 2789 pairs after PS matching. In the matched cohorts, the total number of bypass grafts was lower for 2 art vs. 3 art (3.7 ± 0.8 vs. 3.8 ± 0.8 , $p < 0.01$, respectively). In-hospital outcomes were similar, including mortality (2 art 0.5% vs. 0.8% 3 art, $p = 1.00$), acute myocardial infarction (2 art 0.6% vs. 1.1% 3 art, $p = 1.00$), stroke (2 art 0.5% vs. 0.6% 3 art, $p = 0.81$), MACCE (2 art 1.6% vs. 2.2% 3 art, $p = 0.57$), new onset atrial fibrillation (2 art 13.4% vs. 13.7% 3 art, $p = 0.53$), new onset dialysis (2 art 0.6% vs. 0.8% 3 art, $p = 1.00$), blood transfusion (2 art 43.1% vs. 45.4% 3 art, $p = 0.51$), and length of stay (7.3 ± 7.8 vs. 7.2 ± 7.4 days, $p = 0.56$). At 5 years (Figure 1), there were no differences in survival (2 art 94.3% vs. 3 art 93.3%) (HR 1.16 [0.94–1.43], $p = 0.28$), freedom from MACCE (2 art 89.5% vs. 3 art 88.5%) (HR 1.08 [0.92–1.27], $p = 0.14$) or freedom from repeat revascularization (2 art 95.5% vs. 3 art 95.8%) (HR 0.92 [0.71–1.19], $p = 0.37$).

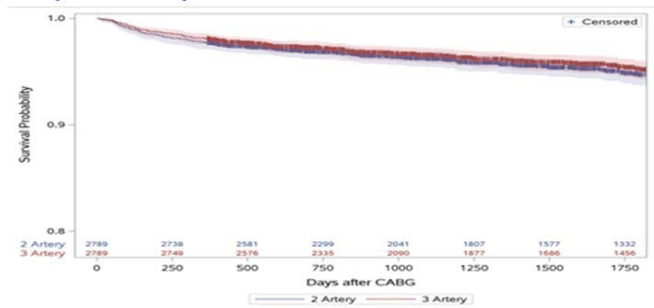
1a: Adjusted KM for 5-year survival for 2 art vs 3 art CABG



1b: Adjusted KM for 5-year freedom from MACCE for 2 art vs 3 art CABG



1c: Adjusted KM for 5-year freedom from revascularization for 2 art vs 3 art CABG



Conclusions: CABG with 3 arterial grafts did not increase intra-operative risk nor improved clinical outcomes at 5-year follow-up, compared to CABG with 2 arterial grafts.

41. Angiographic Evaluation of Arterial Graft Function and Competitive Flow: Analysis from Two Prospective Randomized Control Series

Hidetake Kawajiri¹, *Laurent de Kerchove², Parla Astarci², Philippe Noirhomme²,
*Gebrine El Khoury², *Juan Grau¹, David Glineur¹

¹University of Ottawa Heart Institute, Ottawa, ON, Canada; ²Cliniques Universitaires
St. Luc, Brussels, Belgium

Invited Discussant: *Song Wan

Objective: Competitive flow has been described as an important factor leading to arterial graft occlusion. Unfortunately, this observation comes from retrospective series. We investigated short (6 months) and mid-term (3 years) angiographic evaluation of graft function from patients enrolled in two prospective randomized trials.

Methods: From 2003 to 2005, 352 consecutive patients who underwent isolated CABG at a single institution were enrolled in two prospective randomized trials of those patients, 71 who underwent follow-up coronary angiography at 6 months and 3 years were included in our study. In total, 181 grafts: ITA, n = 131; RGEA, n = 24; and SVG, n = 26, were evaluated. Graft function was classified as functional, [patent, TIMI grade 3 flow to target vessel] and nonfunctional (1, competitive flow; 2, string sign/occlusion). To investigate the impact of graft function on mid- and long-term results, freedom from MACCE were compared between patients in (group F: functional) and patients in (group NF: none functional, competitive flow)

Results Graft Function: Of the 181 grafts, 94.2% of the left ITA, 90.0% of the right ITA, 70.8% of the RGEA, and 100% of the SVG grafts were functional at 6 months. At 3 years, 84.6% of the grafts with competitive flow at 6 months remain open. without occlusion. Two Y-grafts converted from functional to nonfunctional because of proximal disease regression. Regarding ITA graft function analysis, target vessel stenosis < 75% was a significant risk factor for non-functionality on univariate (p = 0.007) and multivariate (p = 0.006) analyses. Sequential grafting, BITA-Y composite grafts, and graft/target vessel diameter <1.5 mm were not significant risks.

Impact of Competitive Flow on Mid-Term Outcomes: On long-term outcome analysis (mean follow-up, 7.0 ± 1.2 years), there was no significant difference in freedom from MACCE (91.7% vs. 78.6 %; log rank, p = 0.40), freedom from revascularization (91.7% vs. 88.6%, p = 0.98), and freedom from stroke (100% vs. 96.0%, p = 0.44) between groups F and NF at 7 years.

Conclusions: More than 80% of the grafts with competitive flow at 6 months remained open at 3 years. Furthermore, the presence of competitive flow in those grafts did not influence MACCE on mid- and long-term clinical outcomes.



OPCAB and ONCAB: Making Sense of the Data

42. Real-World Outcomes of On-Pump Versus Off-Pump Coronary-Artery Bypass Grafting: Results from Korean National Claim Registry

♦Joon Bum Kim¹, Ae Jung Jo², Hyo Jeong Kim², Songhee Cho², Min Jung Ko², Sung Cheol Yun¹, Duk-Woo Park¹

¹University of Ulsan College of Medicine, Seoul, Republic of Korea; ²National Evidence-Based Healthcare Collaborating Agency, Seoul, Republic of Korea

Invited Discussant: Ramachandra C. Reddy

Objective: While several prospective randomized trials have shown conflicting results regarding the comparative effectiveness of on- and off-pump coronary artery bypass grafting (CABG), researches on long-term outcomes in large-scale, real-world clinical settings are limited. This study aims to evaluate long-term comparative effectiveness of on-pump and off-pump CABG through a large-scale nationwide database.

Methods: Using the nationwide claims database of the National Health Insurance Service of Korea, which is representative of the whole population of Korea and contains comprehensive information pertaining to healthcare services, we identified patients who underwent isolated CABG from January 2004 to December 2013. The primary outcome was all-cause mortality. Secondary outcomes were the rates of myocardial infarction (MI), stroke, or repeat revascularization. Propensity-score matching with multivariable adjustment was used to assemble a cohort of patients with similar baseline characteristics and to reduce treatment selection bias. Complete information on mortality status was linked with the data from the Statistics Korea.

Results: Overall 23,828 eligible patients, 12,084 in the off-pump (50.7%) and 11,744 in the on-pump (49.3%) groups were enrolled. The proportions of off-pump procedures has gradually increased from 40.6% (907/2,235) in 2004 to 55.4% (1,254/2,265) in 2013 ($P < 0.001$). After propensity-score matching, 6,483 matched pairs were included in the final outcome analyses. At 30 days, there was no significant difference in adjusted mortality between off- and on-pump group (hazard ratio [HR], 1.00; 95% confidence interval [CI], 0.87–1.16; $P = 0.948$). During long-term follow-up (100% completeness, median 5.3 yrs, maximum 13.2 yrs), however, off-pump CABG, as compared with on-pump CABG, was associated with higher risk of mortality (HR, 1.09; 95% CI 1.03–1.15; $P = 0.0014$). The risks of MI (HR, 1.30; 95% CI, 1.16–1.45; $P < 0.0001$) and repeat-revascularization (HR, 1.50; 1.37–1.63; $P < 0.0001$) were also significantly higher in the off-pump CABG group than in the on-pump CABG group while stroke risk was similar between groups (HR, 0.99, 0.87–1.13; $P = 0.9011$). Similar results were noted with the use of different analytic methods (Table). The main results remained consistent across multiple subgroups based on demographic and clinical risk profiles, and center-specific factors.

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Table: Adjusted Hazard Ratios for Adverse Outcomes in Off-Pump CABG as Compared with On-Pump CABG

	Propensity Matching + Multivariable Adjustment		Inverse-Probability Weighting + Multivariable Adjustment	
	HR (95% CI)	p Value	HR (95% CI)	p Value
30-day mortality	1.00 (0.87–1.16)	0.9482	1.23 (1.13–1.33)	<.0001
Death (overall period)	1.09 (1.03–1.15)	0.0014	1.14 (1.1–1.18)	<.0001
Myocardial infarction (overall period)	1.30 (1.16–1.45)	<.0001	1.23 (1.15–1.32)	<.0001
Stroke (overall period)	0.99 (0.87–1.13)	0.9011	1.02 (0.94–1.11)	0.6501
Revascularization (overall period)	1.50 (1.37–1.63)	<.0001	1.52 (1.44–1.61)	<.0001

Conclusions: In this contemporary, nationwide, clinical-practice claim registry, off-pump CABG was associated with higher long-term risks of mortality, MI, and repeat revascularization, as compared with on-pump CABG.

43. Off-Pump Coronary Artery Bypass Grafting Does Not Improve Long Term Survival or Freedom from Dialysis in Patients with Renal Failure

Rodolfo Rocha¹, Bobby Yanagawa¹, Jack Tu², Mohamad Hussain¹, Jiming Fang², Robert J. Cusimano¹

¹University of Toronto, Toronto, ON, Canada; ²Institute of Clinical Evaluative Sciences, Toronto, ON, Canada

Invited Discussant: ♦Mario F. Gaudino

Objectives: Off-pump coronary artery bypass grafting (OPCAB) may be beneficial in patients with renal dysfunction, by avoiding the detrimental effects of cardiopulmonary bypass. We sought to analyze the long term outcomes of OPCAB vs. on-pump (ONCAB) in patients with renal dysfunction.

Methods: Retrospective cohort analysis of all primary isolated CABG performed in Ontario, Canada, from October 2008 to March 2016, through the Cardiac Care Network clinical database. 50,115 cases were identified. Mean and maximum follow-up was 4.2 and 8.5 years. Patients were stratified based on preoperative estimated glomerular filtration rate (eGFR). Propensity score matching of 33 pre-operative patient characteristics, including surgical risk factors and extent of coronary disease, was performed to form identical pairs and compare OPCAB vs. ONCAB in each subgroup: eGFR ≥90 (2295 pairs), 89–60 (4393 pairs), 59–30 (1578 pairs), < 30 ml/min (278 pairs).

Results: No difference was observed between OPCAB and ONCAB for in-hospital mortality, stroke, myocardial infarction, transient renal dysfunction requiring dialysis, new onset atrial fibrillation and length of stay for patients with eGFR ≥90, 89–60 and <30 ml/min. In the eGFR 59–30 ml/min subgroup, stroke (0.7% vs. 2.0%, $p < 0.01$) and transient renal failure requiring dialysis (1.2% vs. 2.5%, $p = 0.01$) were lower for OPCAB vs. ONCAB. Five-year survival was similar for all sub-groups. Despite the lower rate of transient renal failure requiring dialysis for the 59–30 ml/min eGFR subgroup with OPCAB, 30-day, 1-year and 5-year freedom from renal failure requiring dialysis was similar,

between OPCAB and ONCAB, for all subgroups comparing OPCAB vs. ONCAB: eGFR ≥ 90 ml/min (99.3% vs. 99.3%; HR 1.01 [0.51–1.97], $p = 0.98$); 89–60 ml/min (99.2% vs. 99.4%; HR 1.30 [0.80–2.13], $p = 0.29$); 59–30 ml/min (96.6% vs. 96.8%; HR 0.97 [0.66–1.42], $p = 0.88$); <30 ml/min (33.8% vs. 42.1%; HR 1.17 [0.95–1.44], $p = 0.14$) (Figure 1).

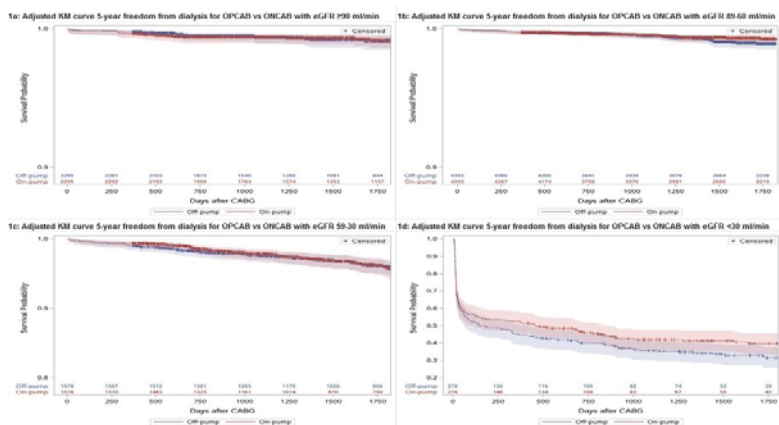


Figure 1: Adjusted Kaplan-Meier curve for 5-year freedom from dialysis for OPCAB vs. ONCAB for eGFR subgroups.

Conclusions: OPCABs advantage was limited to in-hospital transient need for dialysis only in a specific subgroup (eGFR 59–30 ml/min), but did not prevent or delay dialysis, nor improved long-term survival for any subgroup of patients stratified by eGFR on follow-up.

3:30 pm – Coffee Break in the Exhibit Hall
4:00 pm

44. Off-Pump Versus On-Pump in Redo Coronary Artery Bypass Grafting: A Propensity Score Analysis of Long Term Follow Up

Magdalena Iuliana Rufa, Adrian Ursulescu, Ragi Nagib, Marc Albert, Samir Ahad, Stefan Reichert, Ulrich Franke

Robert Bosch Hospital, Stuttgart, Germany

Invited Discussant: *Michael E. Halkos

Objective: Redo CABG is associated with an increased mortality reported up to 16%. The encountered challenges are: access to the heart with potential for cardiac lesions during dissection, injury and management of patent grafts, availability of conduit material, embolization of atheromatous debris from venous grafts, myocardial protection. The aim of this study was to analyze early and long-term results after redo-CABG with special focus on the feasibility and safety of the off pump technique in redo-CABG in a high volume off-pump center.

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Methods: From January 2006 to June 2015 isolated redo-CABG was performed in 304 patients (179 = on-pump redo-CABG, 125 = off-pump redo-CABG). We used propensity score (PS) matching with 3 preoperative parameters (sex, age, LV EF) to adjust for differences in baseline characteristics. By one-to-one PS matching we selected 114 pairs for each group. Predictors for mortality were tested using a multivariable logistic regression model. Follow up data on mortality and MACCE criteria were collected by a questionnaire or direct telephone contact. Mean follow-up rate was 46.7 months. The follow up rate for mortality was 97.5%, where as for MACCE of only 66%.

Results: 83.9% (255) were male, with a mean age of 69.9 years. The mean EuroSCORE (additiv) I was 9.4. 13.5% (41) presented with reduced renal function and 35.5% (108) were diabetics.

There were no significant differences in patient background between the two groups after PS matching. There was a significant difference in the total number of grafts in favor of the on-pump redo-CABG (2.4 ± 0.9 vs. 1.9 ± 0.8 , $p = 0.000$), where as 69.3% (79/114) of the patients in the off-pump redo-CABG group received only arterial grafts. Patients in off-pump redo-CABG group necessitated shorter ICU and hospital stay, (4.4 vs. 1.4, $p = 0.000$) and (12.8 vs. 9.8, $p = 0.000$), respectively.

Patients in the on-pump redo-CABG group had a higher rate of IABP usage (17 (14.9%) vs. 3 (2.6%), $p = 0.001$), of reoperation for bleeding (9 (7.9%) vs. 2 (1.8%), $p = 0.031$) and of postoperative CPR (12 (10.5%) vs. 1 (0.9%), $p = 0.002$).

The 30-day and 1-year survival rates were significantly higher in the off-pump redo-CABG group, 99.1% (113/114) vs. 85.1% (97/114) ($p = 0.000$) and 94.8% (93/98) vs. 83.7% (93/111) ($p = 0.01$), respectively.

Variable	Unadjusted Data			PS Matching		
	On-Pump Redo-CABG (n = 179)	Off-Pump Redo-CABG (n = 125)	p Value	On-Pump Redo-CABG (n = 114)	Off-Pump Redo-CABG (n = 114)	p Value
Number of grafts (n)	2.3 ± 0.8	1.9 ± 0.8	0.000	2.4 ± 0.9	1.9 ± 0.8	0.000
Total arterial grafts (n)	49 (27.3%)	85 (68%)	0.000	29 (25.4%)	79 (69.3%)	0.000
Length of ICU stay (days-mean)	5.2	1.4	0.000	4.4	1.4	0.000
Length of hospital stay (days-mean)	13.6	10.2	0.003	12.8	9.8	0.001
Postoperative renal failure requiring dialysis (n/%)	13 (7.2%)	2 (1.6%)	0.003	10 (8.8%)	1 (0.9%)	0.005
Usage of IABP (n/%)	26 (14.5%)	3 (2.4%)	0.000	17 (14.9%)	3 (2.6%)	0.001
Reoperation for bleeding (n/%)	13 (7.2%)	2 (1.6%)	0.003	9 (7.9%)	2 (1.8%)	0.031
Postoperative CPR (n/%)	17 (9.4%)	2 (1.6%)	0.005	12 (10.5%)	1 (0.9%)	0.002
30-d-mortality (n/%)	19 (10.6%)	1 (0.8%)	0.001	17 (14.9%)	1 (0.9%)	0.000
1-y-mortality (n/n follow up)	27/171	6/108	0.01	18/111	5/98	0.01
3-y-mortality (n/n follow up)	40/151	8/52	0.104	26/96	6/45	0.069

Conclusions: The off-pump technique is safe and feasible for redo-CABG procedures. Off-pump redo-CABG operations showed a significantly lower rate of postoperative complications and better results concerning the unadjusted, as well as the adjusted early and midterm mortality.

45. Twenty-Year Experience with Off-Pump Coronary Artery Bypass Surgery: Lessons Learned from Early Postoperative Angiography

*Ki-Bong Kim, Cheong Lim, Jae-Sung Choi, Jun Sung Kim, Ho Young Hwang, Se Jin Oh, Jae Woong Choi

Seoul National University Hospital, Seoul, Republic of Korea

Invited Discussant: David Glineur

Objective: We have performed off-pump coronary artery bypass grafting (off-pump CABG; OPCAB) in most of our patients requiring surgical revascularization, and also performed early postoperative angiography to assess accuracy and patency of anastomoses after OPCAB.

Methods: Of 3,071 patients who underwent isolated CABG (including 100 redo-CABGs) between January 1998 and June 2017, 2,906 patients (94.6%) underwent OPCAB. Conduits used were left internal thoracic artery (ITA; n = 2,748), right ITA (n = 868), right gastroepiploic artery (n = 997), radial artery (n = 17), and saphenous vein (SV; n = 1,481). Average number of distal anastomoses was 3.2 ± 1.0 . Since the introduction of transit-time flow measurement (TTFM) in 2000, we revised the abnormal grafts (occluded or competitive) intraoperatively. Early (≤ 7 days) angiography was performed in 2,800 patients (96.4%) at 1.5 ± 1.2 postoperative days. Surgical intervention was performed if a bypass conduit for the major coronary artery was occluded or if multiple occlusions of distal anastomoses occurred.

Results: Operative mortality was 1.1% (32/2,906). Early postoperative angiography showed an overall patency rate of 98.2% (8,681/8,843); 99.0% (5,439/5,492) for arterial and 96.6% (3,244/3,359) for venous conduits ($P < .001$). The patency rates of venous conduits were 87.0% (227/261) for free grafts and 97.6% (3,017/3,092) for composite grafts, respectively ($P < .001$). After the introduction of TTFM, patency of arterial grafts became significantly higher (97.2% [457/470] vs. 99.2% [4,982/5,022]; $P < .001$); however, patency of free venous grafts was not significantly improved (86.1% [179/208] vs. 90.6% [48/53], $P = .384$). Early reoperation for graft revision according to angiographic findings was performed in 74 patients (2.6%). The patients who underwent CABG before the introduction of TTFM showed a higher incidence of reoperation than those who underwent CABG after the introduction of TTFM (7.2% [16/221] vs. 2.3% [58/2,552], $P < .001$).

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**Table:** Postoperative Angiographic Patency Rates by Conduits

Variables	Total (n = 2,800)	Before TTFM ^a (n = 225)	After TTFM ^a (n = 2,575)	^a P
Arterial conduit ^b	99.0% (5,439/5,492)	97.2% (457/470)	99.2% (4,982/5,022)	<0.001
Internal thoracic artery	99.2% (3,856/3,887)	97.1% (398/410)	99.5% (3,458/3,477)	<0.001
Right gastroepiploic artery	98.6% (1,564/1,586)	97.8% (45/46)	98.6% (1,519/1,540)	0.479
Radial artery	100% (19/19)	100% (14/14)	100% (5/5)	–
Venous conduit ^b	96.6% (3,244/3,359)	86.1% (179/208)	97.5% (3,065/3,145)	< 0.001
Free vein graft ^c	87.0% (227/261)	86.1% (179/208)	90.6% (48/53)	0.384
Composite vein graft ^c	97.6% (3,017/3,092)	–	97.6% (3,017/3,092)	–
Total	98.2% (8,681/8,843)	93.8% (636/678)	98.5% (8,045/8,165)	<0.001
^b P	<0.001 ^b < 0.001 ^c	<0.001 ^b	<0.001 ^b	
^c P			0.010 ^c	

Conclusions: Early patency of free venous grafts was significantly lower than that of arterial and that of venous composite grafts. Intraoperative flowmetry and revision of abnormal grafts improved early arterial graft patency, and reoperation according to early angiographic findings may further improve graft patency at the time of discharge.

Non-Sternotomy CABG and Hybrid Revascularization

46. Very Long Term Results of Minimally Invasive Coronary Artery By-Pass: Twenty Years Experience

Alberto Repossini¹, Lorenzo Di Bacco¹, Flavia Nicoli¹, Bruno Passaretti²,
Alessandra Stara¹, *Claudio Muneretto¹

¹University of Brescia, Brescia, Italy; ²Cliniche Gavazzeni Humanitas, Bergamo, Italy

Invited Discussant: Gianluca Torregrossa

Objective: Minimally Invasive Direct Coronary Artery By-pass (MIDCAB), meaning Left Mammary Artery on Left Anterior Descending (LIMA-LAD) graft, is a safe and less traumatic approach, but there are conflict data on long-term patient outcomes and long-term patency of the graft. Aim of this study is to evaluate long-term outcomes of a large cohort of patient from a single center experience.

Methods: From January 1997 to June 2016 1060 patients underwent MIDCAB (off-pump minithoracotomy): 646 patients (61%) with isolated proximal-LAD-disease (MIDCAB), 217 pts. (20.5%) with multi-vessel (MVD) disease as a part of Hybrid Coronary Revascularization (HCR) and 197 pts with MVD (18,5%) in association with medical therapy (MIDCAB+MT). Long-term follow-up information about health status, major cardiac and cerebral adverse events, and freedom of angina was collected annually. Follow-up was 98.8% complete.

Results: Mean Age was 71 ± 12.5 years, mean ejection fraction was 52.6% ± 15.2% and EuroSCORE II was 3.4% ± 4.9. Early all-cause death (30-days) occurred in 9 patients (0.8%) while 3 patients (0.3%) had a perioperative stroke. A routine postoperative angiogram in the first 250 patients showed 100% early graft patency rate with 99.3% of



Fitzgibbon grade A anastomosis. A repeat angiogram at 10 years follow-up was available in all patients and demonstrated 96.8% graft patency rate. At 13.9 ± 5.6 years mean follow-up there were no surgical re-intervention been performed for LIMA-LAD graft failure, but 14 patients underwent LAD or LIMA-LAD PCI. Kaplan-Meier over-all survival showed at 5-years follow-up actuarial survival of 87.1% (95% confidence interval [CI]: 81% to 92.5%), at 10-years 84.3% (95% CI: 77.1% to 91.4%) and at 15 years follow-up of 79.8% (95% CI: 72.2% to 87.3%). Freedom from cardiac related mortality showed at 5-years follow-up actuarial survival of 92.1% (95% confidence interval [CI]: 87.5% to 96.7%), at 10 years 88% (95% CI: 82.4% to 93.6%) and at final 15 years follow-up of 85.3% (95% CI: 79% to 91.6%). The freedom of major adverse events and angina was 89.5% (95% CI, 87.4% to 91.5%) after 5 years and 75.3% (95% CI, 68.2% to 82.4%) after 15 years.

Conclusions: MIDCAB in both isolated and multivessel disease is safely performed with low postoperative mortality and morbidity. The excellent short-term and long-term survival as well as freedom from major adverse cardiac and cerebral events and angina compare favorably with stenting and conventional surgery, achieving a reduced surgical invasiveness.

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47. Short and Long-Term Outcomes of Hybrid Coronary Revascularization for Double-Vessel Disease: Is There a Difference When Compared with Traditional CABG?

Nirav C. Patel, Jonathan M. Hemli, Karthik Seetharam, Luigi Pirelli, Derek R. Brinster, S. Jacob Scheinerman

Lenox Hill Hospital, New York, NY

Invited Discussant: *Zhe Zheng

Objective: To evaluate in-hospital resource utilization and short and long-term survival data for patients who underwent hybrid myocardial revascularization for two-vessel coronary disease (robotic-assisted minimally-invasive left internal mammary artery graft to the left anterior descending coronary artery (MIDCAB), coupled with an interval drug-eluting stent to either the circumflex or right coronary artery), as compared with a concurrent cohort who had traditional coronary artery bypass grafting (CABG) for the same distribution of atheromatous disease.

Methods: A comprehensive retrospective review was undertaken of our prospectively collected database from January 2009 to December 2016. Of those patients who underwent hybrid revascularization for double-vessel coronary disease, we propensity-matched 207 cases with patients who underwent CABG via sternotomy during the same time period. Patients who received any form of revascularization for single-vessel or triple-vessel disease were excluded. Longer-term survival data was obtained from the National Death Index. Follow-up was 100% complete.

Results: Thirty-day mortality was 0.5% (1 death) in both the hybrid and CABG groups. Eight-year survival for the hybrid group was 90.3% (20 deaths), as compared with 87.9% for the CABG cohort (25 deaths). End-stage renal disease was identified as an independent predictor of late mortality for those patients who had CABG, as compared with those who had hybrid therapy (OR 8.69, $p < 0.0001$). Age over 70 years was also

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independently associated with poorer long-term survival for the CABG group as compared to the hybrid group (OR 1.23, $p = 0.03$), as was age over 80 years (OR 2.16, $p < 0.0001$). Female patients who underwent hybrid revascularization actually had a higher incidence of late death than did those who had traditional CABG (OR 2.19, $p = 0.04$). Postoperative intensive care and hospital length of stay, duration of postoperative ventilation, and perioperative requirements for transfusion were all significantly lower in the hybrid group than in the CABG cohort ($p < 0.0001$ for all variables).

Conclusions: Hybrid revascularization for two-vessel coronary disease is associated with similar short and long-term survival as is traditional CABG, but offers a significant survival advantage to patients with advanced age and to those with end-stage renal disease. A hybrid revascularization strategy is also associated with the use of significantly less hospital resources in the perioperative period than is CABG.

48. Advanced Hybrid Coronary Revascularization: Mid-Term Outcomes with Robotic Beating Heart Totally Endoscopic Multi-Vessel Grafting and PCI

Hiroto Kitahara, Taishi Hirai, Mackenzie McCrorey, Brooke Patel, Sarah Nisivaco, Sandeep Nathan, Husam Balkh
University of Chicago, Chicago, IL

Invited Discussant: *Joseph J. Deroose

Objective: The purpose of this study was to investigate the outcomes of patients undergoing advanced hybrid coronary revascularization (AHR), defined as *multi vessel* robotic beating heart totally endoscopic coronary artery bypass (TECAB) with PCI.

Methods: From July 2013 to September 2017, 53 patients underwent AHR (Mean age 66 ± 8.9 years old, 41 male) at our institution and were retrospectively assessed. PCI for non-left anterior descending (LAD) lesions was performed before, after, or simultaneously with multi vessel TECAB. The perioperative and mid-term outcomes were reviewed.

Results: Surgical procedures were successfully performed in all patients without conversion to a more extensive incision. Bilateral internal mammary artery grafting was used in 46 patients (86.8%). Sequential grafting of the left internal mammary artery (LIMA) was applied in 7 patients (13.2%) and right internal mammary artery (RIMA) in 2 (3.8%). The mean operative time was 319 ± 53 minutes. Cardiopulmonary bypass was required in 1 patient (1.9%) because of intolerance of one lung ventilation. The mean length of intensive care unit and hospital stay was 1.4 ± 0.6 days and 2.9 ± 0.9 days, respectively. There was no in-hospital or 30-day mortality. PCI was performed before TECAB in 3 patients, and simultaneously in 2. PCI target lesions were the right coronary artery only in 73.6% (39/53), the left circumflex artery only in 7.5% (4/53), and multiple lesions in 11.3% (6/53). PCI was unsuccessful in 2 patients and not applied in 2 patients because of a change in management plan. At postoperative angiogram (mean interval from the surgery 90 days), graft patency was 96.2% (51/53) in LIMA grafts, and 95.7% (44/46) in RIMA grafts. At a mean clinical follow-up interval from surgery of 396 days, Kaplan-Meier analysis showed a 1-year cumulative survival rate of 96.7%. Simple regression analysis identified that PCI failure is a risk factor of mid-term mortality ($R^2 = 0.281$, $P < 0.001$).

Conclusions: AHR (Multi vessel TECAB with PCI), is a safe approach with short hospital stay, and excellent mid-term outcomes. Our results suggest that this strategy may be considered as an option in the less invasive treatment of coronary artery disease however further studies are necessary to evaluate long term results.

49. Intensive Versus Moderate Statin Therapy and Early Graft Occlusion After Coronary Bypass Surgery: The ACTIVE Randomized Clinical Trial

*[Alexander Kulik](#)¹, Amy M. Abreu¹, Viviana Boronat¹, *Marc Ruel²

¹Boca Raton Regional Hospital, Boca Raton, FL; ²University of Ottawa Heart Institute, Ottawa, ON, Canada

Invited Discussant: *David M. Shahian

Objective: Statins prevent saphenous vein graft (SVG) disease and improve clinical outcomes after coronary artery bypass graft surgery (CABG). However, the optimal postoperative statin dose remains unclear. The Aggressive Cholesterol Therapy to Inhibit Vein Graft Events (ACTIVE) trial was undertaken to evaluate whether early postoperative high-dose statin therapy reduces SVG occlusion compared to conventional moderate-dose therapy.

Methods: In this multi-center double-blind randomized controlled trial, 173 patients who had CABG with SVG were randomized to receive atorvastatin 10 mg daily or atorvastatin 80 mg daily for 1 year starting within 5 days after surgery. The primary outcome was SVG occlusion as evaluated by computed tomography (CT) coronary angiography at 1 year. Secondary outcomes were SVG stenosis and major adverse cardiovascular events (MACE).

Results: During trial enrollment, subjects randomized to atorvastatin 80 mg achieved significantly lower low-density lipoprotein (LDL) levels (mean LDL level: 79.2 ± 19.7 mg/dL versus 58.5 ± 20.4 mg/dL, atorvastatin 10 mg versus atorvastatin 80 mg, $P < 0.00001$). One-year graft assessment was performed in 145 patients (83.8%). The primary outcome, SVG occlusion at 1 year, did not significantly differ between the 2 groups. Vein graft occlusion 1 year after surgery was 12.9% in the atorvastatin 10 mg group, and 11.4% in the atorvastatin 80 mg group ($P = 0.85$). The incidence of vein graft stenosis also did not significantly differ between the groups (5.6% versus 3.2%, atorvastatin 10 mg versus atorvastatin 80 mg, $P = 0.54$). However, there was a trend towards fewer patients developing vein graft disease (either occlusion or stenosis) in the atorvastatin 80 mg group (29.2% versus 19.2%, atorvastatin 10 mg versus atorvastatin 80 mg, $P = 0.18$). Freedom from MACE at 1 year was similar between the groups ($P = 0.27$). Exclusion of patients who prematurely discontinued the allocated therapy (per-protocol analysis) yielded similar results.

Conclusions: Compared to atorvastatin 10 mg daily, early postoperatively high-dose statin therapy with atorvastatin 80 mg daily did not significantly reduce vein graft occlusion 1 year after CABG.

5:30 pm **Adjourn**

5:35 pm – **Executive Session, AATS Members Only**

6:15 pm

Ballroom 20A, SDCC

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MONDAY AFTERNOON, APRIL 30, 2018

2:00 pm

Congenital Heart Disease Simultaneous Scientific Session

Room 24ABC, SDCC

8 minute presentation, 10 minute discussion

Moderators: *Vaughn A. Starnes and *Luca A. Vricella

50. The Hidden Side of Shone Syndrome

Stephanie L. Perrier, Mangesh Jadhav, *Yves D'Udekem, Johann Brink,

*Igor E. Konstantinov, Michael M. Cheung, *Christian P. Brizard

Royal Children's Hospital, Parkville, Australia

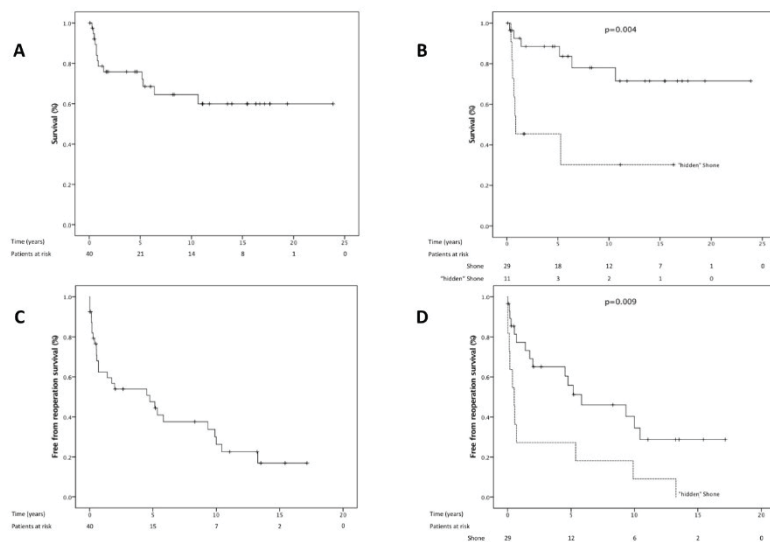
Invited Discussant: *Christian Pizarro

Objective: Shone syndrome comprises a range of left ventricular inflow and outflow tract lesions with apparently homogenous hemodynamic features, heterogeneous developmental origins and no precise clinical definition yet. The purpose of this study is to characterise patients with Shone syndrome and review long-term outcomes of mitral valve surgery.

Methods: Forty patients with left ventricular outflow obstruction, at any level, who underwent mitral valve surgery between 1990 and 2016 were included in the study. Patients characteristics, long-term survival, freedom from reoperation, risk factors for death and reoperation were analyzed retrospectively.

Results: The left ventricular outflow obstruction was an aortic valve stenosis in 20 patients (50%), bicuspid aortic valve in 26 (65%), subaortic stenosis in 19 (47.5%), coarctation in 23 (57.5%) and hypoplastic aortic arch in 16 (40%). Nineteen patients (47.5%) had a supravalvar mitral ring and 15 (37.5%) had a parachute mitral valve. Twenty-two patients (55%) had a primary surgery involving the aortic arch and/or aortic valve and/or left ventricular outflow tract 6.2 months [7 days–10.4 years] before the mitral valve procedure; of these, 11 patients (27.5%) underwent mitral valve surgery before 6 months of age. This subgroup of patients was defined as “hidden” Shone syndrome. Thirty-five patients (87.5%) had a mitral valve repair. Age at first mitral surgery was 7.7 [0.03–169] months. The mitral valve surgery was combined to a procedure on the left ventricular outflow tract in 30 patients (75%). In-hospital mortality was 17.5% (7 patients). Survival at 1 year, 5, 10 and 15 years was $78.6 \pm 6.7\%$, $75.8 \pm 7\%$, $64.6 \pm 8.5\%$ and $59.9 \pm 9.1\%$, respectively. Overall mortality was 32.5% (13 patients) with a mean follow-up of 15.6 ± 1.8 years. Twenty-three patients (59%) required a reoperation on the mitral valve 8.4 [0.21–159] months after the initial surgery. Freedom from reoperation at 1, 5, 10 and 15 years were $62.4 \pm 8\%$, $47.5 \pm 8.4\%$, $26.3 \pm 8\%$ and $16.9 \pm 7.6\%$, respectively. Mean survival, 6.1 ± 2.2 years vs. 18.5 ± 1.9 years ($p = 0.004$), and mean freedom from reoperation, 2.8 ± 1.4 years vs. 7.9 ± 1.4 years ($p = 0.009$), were significantly lower for patients with a “hidden” Shone syndrome (Figure 1).

Figure 1. A) Survival. B) Survival among clinical presentation groups. C) Free from reoperation survival. D) Free from reoperation survival curve among clinical presentation groups.



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Conclusions: Dismal outcomes after mitral surgery were found in the subgroup of infants with “hidden” Shone syndrome. Long term survival was dramatically superior in the remainder of the cohort. We advocate abandoning the term ‘Shone syndrome’ as a homogeneous group and revising the taxonomy of multiple left heart obstruction with mitral valve anomalies. Early detection of patients with hidden Shone syndrome would allow appropriate and timely orientation towards a univentricular pathway.

51. Post-Operative Heart Block Following Congenital Heart Surgery: Analysis from the Pediatric Cardiac Critical Care Consortium.

Amy Romer¹, Sarah Tabbutt¹, Susan Etheridge², Peter Fischbach³, Nancy Ghanayem⁴, *V. Mohan Reddy¹, Raj Sahulee⁵, Ronn Tanel¹, *James Tweddell⁶, Michael Gaies⁷, Lauren Retzlaff⁷, Wenying Zhang⁷, Akash Patel¹

¹University of California, San Francisco, CA; ²University of Utah, Salt Lake City, UT;

³Emory University, Atlanta, GA; ⁴Texas Children's Hospital, Baylor College of Medicine,

Houston, TX; ⁵New York University, New York, NY; ⁶University of Cincinnati, Cincinnati,

OH; ⁷University of Michigan, Ann Arbor, MI

Invited Discussant: *Tain-Yen Hsia

Objective: High-grade atrioventricular block (AVB) complicates congenital heart surgery (CHS) resulting in prolonged Cardiac Intensive Care Unit (CICU) and hospital length of stay. We aimed to describe the contemporary epidemiology of high-grade AVB following CHS and to determine predictors for AVB and recovery from AVB to help guide timing of permanent pacemaker placement (PPP).

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Methods: Patients who underwent CHS and recovered in the CICU from August 1, 2014 to June 1, 2017 were analyzed for post-operative AVB (2nd degree or complete) using the Pediatric Cardiac Critical Care Consortium registry that includes patients from 25 dedicated CICUs. Candidate predictors of AVB included demographics, diagnoses, pre-operative, and intraoperative risk factors, in addition to high-risk surgical procedures chosen by consensus of the study investigators. Three outcome groups were identified: no AVB, AVB with resolution, and AVB with PPP. Predictors of AVB with or without PPP were identified through multinomial logistic regression.

Results: Of the 15,901 cases analyzed, 422 (2.7%) were complicated by AVB, of which 162 (38.4%) underwent PPP during the same hospital admission. Across all institutions, the unadjusted incidence of AVB ranged from 0 to 6.3% and the need for PPP ranged from 0 to 3.1%. In patients with transient AVB the median time between onset and resolution was 47 hours (IQR 19.9–114.2) and 90% had resolution within 8 days (Figure 1). For those with AVB who had PPP during the hospital admission, the median time from onset of AVB to PPP was 7.9 days (IQR 6.1–14.2) (Figure 1). The risk factors independently associated with need for PPP compared to those cases with resolution of AVB included longer duration of cardiopulmonary bypass time (RRR 1.04, $p = 0.024$) and receiving a high-risk surgical procedure (RRR 2.59, $p = 0.001$).

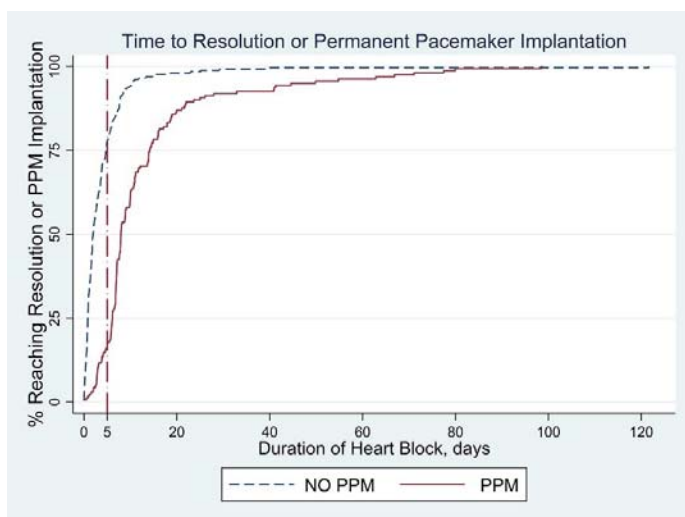


Figure 1. Time from onset of atrioventricular block (AVB) to permanent pacemaker placement (solid line) and time from onset of AVB to resolution in those who did not require pacemaker placement (dashed line).

Conclusions: This is the first multicenter study evaluating incidence, duration, and risk factors for AVB following CHS. We found a 2.7% incidence of AVB, and for those with transient AVB, 90% resolved within 8 days. Of those who required PPP, half had placement within 8 days. Patients who had high risk surgical procedures and longer cardiopulmonary bypass times were less likely to recover and more likely to undergo PPP. Further analysis of the association between individual high risk surgical procedures and need for PPP may help identify those patients who would benefit from earlier PPP, thus shortening hospital length of stay.



52. The Third Decade of Surgical Palliation in Hypoplastic Left Heart Syndrome: Restricted Usage of the Right Ventricle to Pulmonary Artery Conduit

Thomas Kelly¹, Diana Zannino², Johann Brink³, *Yves d'Udekem³, *Igor E. Konstantinov³, Michael Cheung³, *Christian Brizard³

¹University of Melbourne, Melbourne, Australia; ²Murdoch Children's Research Institute, Melbourne, Australia; ³Royal Children's Hospital, Melbourne, Australia

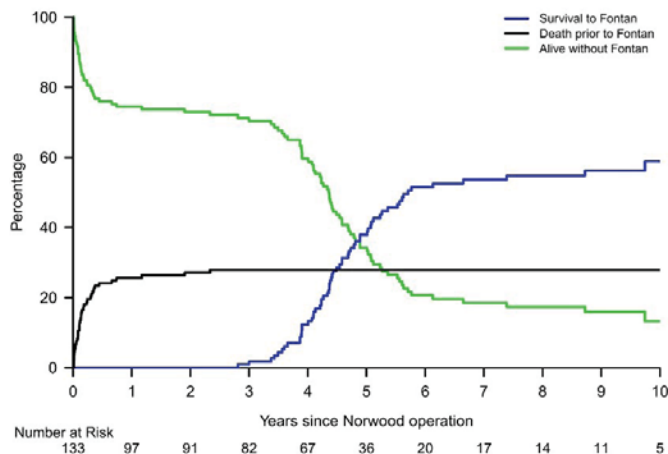
Invited Discussant: Shunnji Sano

Objective: To evaluate the impact of shunt type in the Norwood procedure for Hypoplastic Left Heart Syndrome (HLHS). Our retrospective cohort extends from 2004 to 2016 and includes HLHS patients exclusively. Prior to 2008, there was no institutional protocol for the choice of Norwood shunt. In 2008, a standard protocol was implemented, by which the Right Ventricle to Pulmonary Artery Conduit (RVPAC) was utilised for low birth weight patients (<2.5 kg), in whom the RBTS diameter to weight ratio is suboptimal, or those with precluding anatomy (e.g., aberrant subclavian artery). The Right Modified Blalock-Taussig Shunt (RBTS) was constructed for lower risk patients. Since 2001, the Bidirectional Cavo-Pulmonary Shunt (BCPS) is constructed at precisely 90 days Post-Norwood for all patients. This study explores the impact of a strict protocol in shunt decision making.

Methods: The records of 133 consecutive patients with strict HLHS anatomy operated between 2004 and 2016 were retrospectively reviewed. Survival risk factors were analysed using the Cox Proportional Hazards Risk Model.

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Competitive Risk Analysis for Death and Fontan Completion



Results: The Norwood procedure was performed at a mean age of 2.9 days and mean weight of 3.3 kg. BCPS was performed at a mean age of 99.8 days and a mean weight of 5.2 kg. Pre-2008, 38.6% patients received the RBTS (22/57) and 61.4% patients (35/57) the RVPAC. Post-2008, 75.0% received the RBTS (66/88) and 25.0% (22/88) the RVPAC. The actuarial 1-year survival for this period was 75.9% (101/133). For the whole cohort, 30-day mortality was significantly higher for the RVPAC patients, HR = 5.49, compared

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to RBTS, HR = 0.182, $p = 0.012$. However, there was no significant mortality difference between shunts within the eras at both 30-days and BCPS endpoints. Pre-2008, 74.1% (43/58) reached BCPS compared with 84.0% (63/75), post-2008. Patients managed Pre-2008 were more likely to die within the 1st year, HR = 2.437, $p = 0.021$ with no significant difference between shunts. Figure 1 shows the competitive risk analysis for death and Fontan completion.

Conclusions: The number of patients surviving to BCPS increased by 13.4% after the implementation of our protocol. In our hands, the RVPAC generates higher mortality over the whole cohort. Our protocol reduced the RVPAC use, hence the improved 1-year survival. Being electively used in our high-risk patients it may have improved the underlying risk in that group. However, no difference between shunt was found within each era suggesting other underlying factors contributing to the improved survival demonstrated in the post-2008 era. This strategy compares favourably with others for 1-year actuarial survival.

53. Aortic Translocation, Anatomic Repair with Expanded Indications

Vincent K. Tam, Eldad Erez, Lisa Roten, Hisashi Nikaidoh, Vinod A. Sebastian, Katy Wilson, Johnbosco Umejiego

Cook Childrens Medical Center, Fort Worth, TX

Invited Discussant: *Vaughn A. Starnes

Introduction: Aortic translocation (AT), introduced by Nikaido in 1984, for repair of TGA VSD with LVOTO has become increasingly popular the last few years. We reviewed our entire experience with expanded indications for aortic translocation for repair of defects where the native aorta is connected to the right ventricle.

Materials and Methods: From October 1996 to December 2016, 30 consecutive patients underwent AT, with mean age of 28.9 months (1.6–152.7), and mean weight of 11.8 Kg (4.8–45.3). Diagnoses were TGA VSD LVOTO (14), congenitally corrected TGA VSD with LVOTO (8), heterotaxy syndrome (4), neo-aortic regurgitation after arterial switch (4). Additional defects included multiple VSD's, pulmonary atresia with MAPCA's and hypoplastic branch pa's, anomalous pulmonary venous connection. Previous procedures included modified BT shunt (16), transcatheter stenting of LPA (1), Fontan (1), repair of TAPVC (1) and bilateral unifocalization of MAPCA's (1). Additional confounding factors include situs inversus (5), dextrocardia (8), and single coronary (3). 6 patients had aortic and pulmonary root translocation. Other simultaneous procedures included modified Senning atrial switch, repair of anomalous pulmonary veins, pa reconstruction and shunt takedown.

Results: Three of 30 patients died in hospital (10%) Four patients were supported with ECMO, including the three hospital mortalities. Transient supraventricular tachycardia was the most common complication and occurred frequently in patients with ccTGA

and heterotaxy syndrome. 1 pt (DORV VSD LVOTO, multiple VSD's) had postoperative pacemaker implant for complete AV conduction block, while a second with ccTGA had pacemaker for first degree heart block. Median LOS was 19 days (4–115). Mean follow up was 52.4 months (12–147). There were 2 late mortalities, including an earlier patient who had repeat repair for aortic regurgitation 6 years after initial surgery. No other patient has more than mild AI, with the majority having none to trace.

Conclusion: AT provides excellent anatomic repair of TGA VSD LVOTO, without an extra anatomic conduit. Additionally, AT is a useful technique for reconstruction of complex heart defects including ccTGA with LVOTO, and complex heterotaxy syndrome. Despite technical complexities, AT may be achieved with acceptable morbidity and mortality and thus far low re-operative rate.

3:15 pm – Coffee Break in the Exhibit Hall

3:55 pm

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54. Trachea Morphology Inpatients with Pulmonary Sling Before and After Slide Tracheoplasty

Shu-chien Huang, En-Ting Wu, Ching-Chia Wang, Yih-Sharnng Chen, Shyh-Jye Chen
National Taiwan University Hospital, Taipei, Taiwan

Invited Discussant: *Carl L. Backer

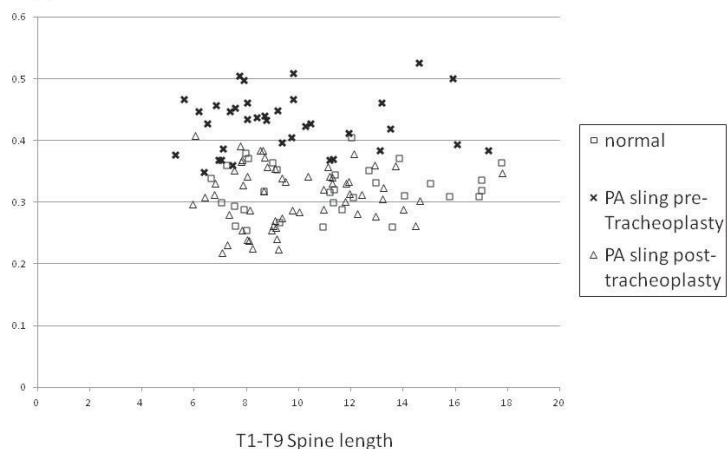
Objective: Pulmonary artery sling (PA sling) is frequently associated with congenital tracheal stenosis (CTS) and slide tracheoplasty is the most preferred approach for CTS. However, the morphology of trachea beyond CTS was not well reported.

Methods: We measured the intra-thoracic tracheal length and the carina angle between right and left bronchus from CT images in patients (n = 27) with PA sling before and after surgery, and compared to the normal subjects. For body status adjustment, the patients' intra-thoracic trachea length divided by the spine length from T1 to T9 (trachea/spine ratio) was used for comparison.

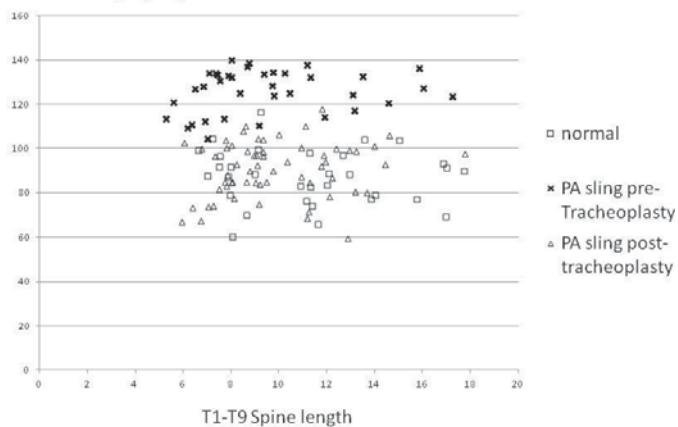
Results: The trachea/spine ratio in patients with PA sling without slide tracheoplasty was 0.43 ± 0.05 , which was significant longer than 0.32 ± 0.04 in normal control. ($p < 0.0001$) In the patients who had received slide tracheoplasty (n = 17), the trachea/spine ration was 0.31 ± 0.05 , which was similar to normal. The carina angle was wider in patient with PA sling than normal (126.0 ± 10 vs. 86.4 ± 13.1 degree, $p < 0.0001$). After slide tracheoplasty (n = 17), the carina angle was significant narrower and near normal (90.7 ± 12.4 degree). Longer trachea and wider carina angle persisted in patients who received left PA reimplantation without tracheoplasty.

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Intrathoracic
trachea/spine ratio



Carina angle between right
and left bronchus (degree)



Conclusions: In PA sling, the trachea is longer and the carina angle is wider than normal. The excessive trachea length is favorable for tracheoplasty. Slide tracheoplasty not only correct the CTS, but also the trachea length and carina angle toward normal.



55. Long-Term Results of Transposition of the Great Arteries with Left Ventricular Outflow Tract Obstruction: Comparison of Three Types Operation and Risk Analysis

Akihisa Furuta, Hiroshi Niinami, Goki Matsumura

Tokyo Women's Medical University, Tokyo, Japan

Invited Discussant: Hisashi Nikaidoh

Objective: Left ventricular outflow tract obstruction (LVOTO) accompanied with transposition of the great arteries (TGA) has a considerable impact on a selection of surgical procedure and surgical results. The purpose of this study is to compare the results of three different surgical procedure and to evaluate the risk factor of mortality and reoperation in TGA with LVOTO.

Methods: We conducted a retrospective study on 108 patients with TGA and LVOTO who underwent biventricular repair between 1980 and 2014. The total cohort was divided into three groups based on the surgical procedure as follows: Group 1, repair on the arterial level (n = 15) (Arterial switch operation, Nikaidoh operation, and truncal switch operation); Group 2, atrial switch operation (n = 22) (Senning operation and Mustard operation); Group 3, intraventricular rerouting operation (n = 71) (Rastelli operation and REV operation). We compared the results of three procedures in regard to the survival, the freedom from the reoperation and evaluated the risk factor of mortality and reoperation.

Results: There were significant differences in age, body weight, subvalvular obstruction, pulmonary atresia, intact ventricular septum, and peak gradient (PG) in left ventricular (LV) outflow tract in patient characteristics (Table). Median follow-up was 15.0 years. The overall survival at 20 years was $65 \pm 12.7\%$ in group 1, $79.6 \pm 9.1\%$ in group 2, and $75.9 \pm 5.6\%$ in group 3 ($p = 0.4$). Early survival was 87% in group 1, 95% in group 2 and 96% in group 3. Freedom from reoperation at 20 years was $53.3 \pm 23.6\%$ in group 1, $74.6 \pm 11.7\%$ in group 2 and $53.0 \pm 7.6\%$ in group 3 ($p = 0.23$). The latest angiography demonstrated significant differences in LV EF (ejection fraction) (group 1 vs. group 2 vs. group 3: 60 vs. 62 vs. 57%, $p = 0.02$), cardiac index (4.4 vs. 3.9 vs. 3.3 L/min/m², $p = 0.01$), PG in LVOT (0 vs. 4.5 vs. 0 mmHg, $p = 0.0004$) and PG in right ventricular (RV) outflow tract (8 vs. 0 vs. 8.5 mmHg, $p < 0.0001$). Univariate analysis indicated that the risk factors for mortality were age >8 years ($p = 0.04$), and body weight >18 kg ($p = 0.03$). Multivariate analysis by multiple logistic regression analysis revealed that the risk factor for mortality was body weight >18 kg ($p = 0.04$). Univariate analysis indicated that the risk factors for reoperation was Rastelli operation ($p = 0.01$), postoperative arrhythmia ($p = 0.005$), and RV EF $<60\%$ in angiography ($p = 0.07$). Multivariate analysis by multiple logistic regression analysis revealed that the risk factor for reoperation was Rastelli operation ($p = 0.01$), postoperative arrhythmia ($p = 0.03$), and RV EF $<60\%$ in angiography ($p = 0.008$).

Conclusions: The long-term results of TGA with LVOTO were favorable and there were no significant differences in survival and freedom from reoperation between groups. The risk factor of mortality was body weight. The risk factor of reoperation was Rastelli operation, postoperative arrhythmia and low RV EF.

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56. Mid-Term Outcomes Following Repair of Double Outlet Right Ventricle

Olubunmi Oladunjoye, Breanna Piekarski, Christopher Baird, Puja Banka, Gerald Marx,

*Pedro del Nido, *Sitaram Emani

Boston Children's Hospital, Boston, MA

Invited Discussant:

Objective: Double outlet right ventricle (DORV) is a complex cardiac malformation with many anatomic variations and various approaches for surgical repair. This study aimed to determine the clinical outcomes of left ventricular outflow tract obstruction (LVOTO) and mortality following biventricular (BiV) repair in DORV patients.

Methods: Patients with diagnosis of DORV, who underwent BiV repair between January, 2000 and September, 2017 were retrospectively reviewed. The patients were divided into two groups. Group A included patients who underwent primary BiV repair without previous palliative operations and Group B included patients who underwent palliative procedures (shunt, pulmonary artery band, bidirectional Glenn, Fontan) followed by ultimate BiV conversion. LVOTO was defined as outflow tract gradient of ≥ 30 mmHg. Time-dependent development of LVOTO and mortality were evaluated using Kaplan-Meier survival analysis.

Results: A total of 222 patients with diagnosis of DORV underwent BiV repair at a median age of 5.9 months (range 0.1 month–39.5 years). The median follow-up time from BiV repair was 20.5 months (range 0.1 month–16.4 years). Characteristics of patients in groups A and B are in Table 1. The overall and early (thirty-day mortality) mortality rates were 9.5% and 4.1% respectively. Survival at 1, 5 and 10 years were 89.8%, 88.0% and 85.4%. The overall rate of LVOTO was 10.8% and the reoperation rate was 8.6%. The median time from BiV repair to LVOTO was 30 months (range 0–14.3 years). Freedom from LVOTO development at 1, 5 and 10 years were 96.7%, 79.2% and 69.8% respectively. Freedom from re-intervention for LVOTO at 1, 5 and 10 years were 98.4%, 83.7% and 81.9% respectively. Age of surgery, and group type were not significantly associated with risk LVOTO.

Table 1: Patient Characteristics by Type of BiV Surgery

	Primary Repair (N = 124)	Palliative Repair (N = 98)	p Value
Median age at BiV repair (months), median (IQR)	1.9 (0.3,4.5)	22.0 (10.1,47.4)	<0.01
Median weight at BiV repair (kg), median (IQR)	4.0 (3.2,5.8)	10.4 (7.9,14.5)	<0.01
Anatomic type			
Doubly Committed VSD	10 (8.1)	6 (6.1)	
Noncommitted VSD	22 (17.9)	53 (54.1)	<0.01
SubAortic VSD	54 (43.9)	22 (22.5)	
Subpulmonary VSD	37 (30.1)	17 (17.5)	
CAVC	42 (42.9)	13 (10.6)	<0.01
Heterotaxy	13 (10.5)	41 (41.8)	<0.01
L-loop Ventricle	6 (4.8)	18 (18.4)	<0.01
Subpulmonary Obstruction			
Pulmonary stenosis	63 (50.8)	51 (52.0)	
Pulmonary atresia	8 (6.5)	18 (18.4)	0.01
None	53 (42.7)	29 (29.6)	

	Primary Repair (N = 124)	Palliative Repair (N = 98)	p Value
Dextrocardia	8 (6.5)	19 (19.4)	<0.01
Pulmonary venous connection anomalies	3 (2.4)	20 (20.6)	<0.01
Cardiopulmonary bypass time (minutes), median (IQR)	164 (123,230)	228 (196,294)	<0.01
Cross clamp time (minutes), median (IQR)	103 (75,153)	138 (110,204)	<0.01
Duration of Ventilation (days), median (IQR)	4 (2,7)	4 (2,6)	0.83
ICU length of stay (days), median (IQR)	6 (3,12)	7 (5,10)	0.19
Hospital length of stay (days), median (IQR)	12 (7,21)	13 (10,19)	0.15
Mortality			
Survival at	11 (8.9)	10 (10.2)	
1 year	91.3%	87.4%	0.82
5 years	89.9%	85.1%	0.53
10 years	86.3%	85.1%	
LVOTO			
Freedom from LVOTO at	15 (12.1)	9 (9.2)	
1 year	96.4%	97.1%	0.49
5 years	81.3%	75.1%	0.73
10 years	71.7%	75.1%	
Re-intervention for LVOTO			
Freedom from re-intervention for LVOTO at	12 (9.7)	7 (7.1)	
1 year	97.1%	100.0%	0.50
5 years	84.7%	80.6%	0.81
10 years	82.2%	80.6%	

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Conclusion: Patients with DORV undergo either a primary BiV repair or BiV conversion from a single ventricle in those with complex anatomy and these procedures are associated with good outcomes. However, LVOTO remains an ongoing problem but this does not differ by the type of BiV surgery.

57. Pulmonary Arterioplasty at Stage Two Palliation Does Not Adversely Impact Outcomes to Fontan

W. Hampton Gray, John D. Cleveland, *Winfield J. Wells, *Vaughn A. Starnes, S. Ram Kumar

Children's Hospital of Los Angeles, Los Angeles, CA

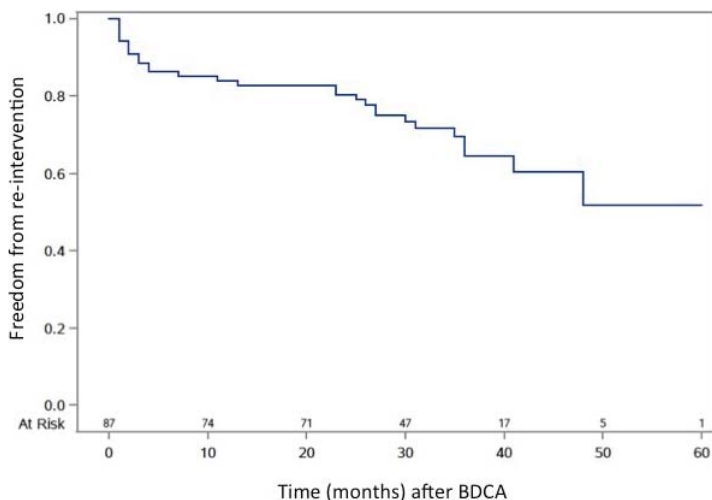
Invited Discussant: *Jennifer C. Romano

Objective: We have previously shown that need for pulmonary arterioplasty (PA plasty) at the time of bidirectional cavopulmonary anastomosis (BDCA) is associated with increased hospital morbidity and mortality. The impact of need for PA plasty on post-discharge outcomes to completion Fontan is not known. We sought to determine whether PA plasty at the time of BDCA adversely impacts survival or PA growth following discharge.

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Methods: We retrospectively reviewed the records of patients who underwent BDCA at our institution between 2007 and 2016. PA plasty at the time of BDCA was categorized by extent (Type 1–4) as previously described. Outcome measures included PA re-intervention, and mortality up to completion of final stage palliation. Patient demographics, clinical variables and outcome data were collected and analyzed using SAS 9.2 software. Data are presented as median and interquartile ranges.

Results: 424 patients (193 girls) underwent BDCA at 7 (5.5–8.9) months of age and a weight of 6.5 (5.7–7.7) kg. 111 patients (26%) required concomitant PA plasty. 411 patients (105 of those with PA plasty) survived to discharge following BDCA. A total of 47 patients (11%) required 54 PA re-interventions prior to final stage palliation. Amongst the 105 BDCA survivors who required PA plasty, 22 (21%) required 28 PA re-interventions (7 surgical). PA re-interventions were analyzed by extent of PA plasty – Type 1 (0/15, 0%), Type 2 (9/42, 21%), Type 3 (6/28, 21%), Type 4 (7/20, 35%), $p = 0.002$. Amongst 306 survivors who did not require PA plasty, 25 (8%, $p = 0.012$ compared to PA plasty) required 26 PA re-interventions (16 surgical). Freedom from re-intervention at 12, 24 and 36 months following PA plasty were $83.9 \pm 3.9\%$, $80.3 \pm 4.3\%$ and $69.4 \pm 5.4\%$, respectively. The Nakata Index at pre-Fontan catheterization was 197 (163.5–227.75) mm^2/m^2 in the PA plasty group and 237 (200–275) mm^2/m^2 in the non-PA plasty group, $p = \text{NS}$. 18 patients (4.4%, 4/105 in PA plasty and 14/306 in non-PA plasty groups, $p = \text{NS}$) died during follow-up. 346 (85 PA plasty and 261 non-PA plasty) patients have reached final stage palliation at 3 (3–3.5) years of age and 14 (13–15) kg. 320 underwent Fontan, 25 one-and-a-half ventricle repair, and 1 orthotopic heart transplant. 31 (8 PA plasty and 23 non-PA plasty) patients are alive awaiting Fontan. There was no difference in hospital mortality, length of stay, or morbidity between the PA plasty and non-PA plasty groups at completion Fontan.



Conclusion: Amongst hospital survivors, the need for PA plasty at the time of Glenn does not confer an additional mortality risk leading up to completion of final stage palliation. Despite an increased need for re-intervention, sustained growth of the pulmonary arteries to completion Fontan can be reliably expected.



58. The Prevalence and Impact of Congenital Diaphragmatic Hernia Among Patients Undergoing Surgery for Congenital Heart Disease

Charles D. Fraser, III¹, Kevin D. Hill², Amelia S. Wallace², Karen Chiswell², Xun Zhou¹, Eric B. Jelin¹, David Kays³, *Jeffrey P. Jacobs³, Narutoshi Hibino¹, *Marshall L. Jacobs¹, *Luca A. Vricella¹

¹Johns Hopkins Hospital, Baltimore, MD; ²Duke University, Durham, NC; ³Johns Hopkins All Children's Hospital, St. Petersburg, FL

Invited Discussant: *Scott M. Bradley

Objective: Previous studies have evaluated the impact of congenital cardiac anomalies on morbidity and mortality in children with congenital diaphragmatic hernia (CDH). However, there has yet to be a multicenter investigation to elucidate the prevalence and impact of CDH on pediatric patients undergoing cardiac surgery. We investigated the prevalence of CDH across the most common congenital cardiac diagnostic and procedural groups and its impact on outcomes following cardiac surgery.

Methods: The STS Congenital Heart Surgery Database was queried to identify all children (<18 years) undergoing cardiac surgery who also had CDH. Patients were grouped by fundamental cardiac diagnosis and primary cardiac surgical procedure. Prevalence of CDH was stratified by age. Baseline demographics, perioperative characteristics and postoperative outcomes were compared between CDH and non-CDH groups. Further subgroup analyses were performed based on case complexity as determined by STAT Categories.

Results: From 2010 to 2016, 426 of 157,419 (0.27%) pediatric patients undergoing cardiac surgery had a diagnosis of CDH. Prevalence of CDH among these patients was higher for infants (0.39%) and neonates (0.25%) compared to children (0.18%). The CDH group was comprised of 89 (21%) neonates, 217 (51%) infants and 120 (28%) children. Prevalence of CDH varied across diagnostic groups and in neonates and infants was highest for tetralogy of Fallot (0.45%), coarctation (0.39%) and complete atrioventricular septal defects (0.31%). Operative mortality, postoperative length of stay (PLOS) and major complication rates were all significantly higher in CDH vs. no-CDH patients across each of the most common diagnostic and procedural groups (Table). Among neonates undergoing STAT 1–2 procedures, no difference in operative mortality was observed between groups (11.8% vs. 5.7%, $p = 0.252$). For STAT 3–5 procedures on neonates, operative mortality was significantly higher in CDH patients (34.4% vs. 10.3%, $p < 0.0001$). Among infants, operative mortality was significantly higher for CDH group irrespective of STAT category. In neonates and infants, PLOS and major complications were significantly higher in the CDH group regardless of STAT mortality category. However, in children older than 1 year, no significant differences exist in mortality, PLOS or major complications between groups in high complexity cases, but significant differences in PLOS and major complications were observed in low complexity cases.

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	Operative Mortality, % (n)			Postoperative Length of Stay, Median (IQR)			Major Postoperative Complications, % (n)		
	No CDH	CDH	p-value	No CDH	CDH	p-value	No CDH	CDH	p-value
Fundamental Cardiac Diagnosis									
<i>Coarctation</i>	2.1% (140)	15.4% (4)	0.002	8.0 (5-16)	55 (21-99)	<0.0001	10.6% (696)	42.3% (111)	<0.0001
<i>Coarctation with VSD</i>	4.2% (127)	20% (2)	0.0655	15 (8-31)	59 (57-86)	0.0001	20.9% (608)	33.3% (3)	0.4068
<i>Tetralogy of Fallot</i>	1.9% (165)	14.6% (6)	0.0001	7 (5-12)	25 (8-57)	<0.0001	10.1% (859)	23.7% (9)	0.0122
<i>Complete AVSD</i>	4.5% (267)	21.1% (4)	0.0098	9 (6-20)	40 (9-97)	0.0001	15.1% (868)	36.8% (7)	0.0173
<i>Single Ventricle</i>	6.3% (349)	27.3% (3)	0.0291	11 (6-27)	37 (9-126)	0.061	23.3% (1226)	27.3% (3)	0.7252
<i>Hypoplastic Left Heart Syndrome</i>	13.3% (1021)	25% (2)	0.2886	21 (9-43)	84 (6-140)	0.1498	32.4% (2396)	44.4% (4)	0.4837
<i>Transposition of the Great Arteries</i>	4.3% (283)	0	1.00	12 (8-21)	28.5 (10-46)	0.0845	20.4% (1297)	16.7% (1)	1.00
Primary Cardiac Procedure									
<i>Aortic Arch Repair</i>	4.1% (137)	21.4% (3)	0.0182	13 (8-26)	56.5 (30-107)	<0.0001	18.8% (613)	40% (6)	0.0473
<i>Complete AVSD Repair</i>	2.9% (141)	15.4% (2)	0.0536	8 (6-16)	16 (9-44)	0.0073	12.6% (597)	23.1% (3)	0.2191
<i>Coarctation Repair</i>	1.4% (74)	10.5% (2)	0.0292	6 (4-12)	28 (6-83)	0.0029	7.3% (378)	33.3% (6)	0.0014
<i>Tetralogy of Fallot Repair</i>	2% (170)	13.3% (4)	0.0031	7 (5-12)	24.5 (8-62)	<0.0001	10.4% (846)	25.9% (7)	0.0181
<i>Norwood</i>	15.9% (766)	41.7% (5)	0.0304	29 (18-51)	85.5 (20.5-132.5)	0.0491	42.6% (1984)	63.6% (7)	0.2225
<i>Glenn</i>	2.3% (146)	0	1.00	7 (5-12)	9 (7-14)	0.2519	14.3% (880)	11.1% (1)	1.00
<i>Pulmonary Artery Banding</i>	9.8% (309)	41.2% (7)	0.0007	19 (8-44)	55 (19-140)	0.0144	23.2% (710)	23.5% (4)	1.00
<i>PDA Ligation</i>	6.3% (609)	15.6% (5)	0.0478	56 (6-99)	46.5 (11-119.5)	0.4015	8% (773)	25% (8)	0.0032
<i>VSD Repair</i>	0.9% (80)	8.2% (4)	0.0009	5 (4-8)	20.5 (7-52.5)	<0.0001	5.3% (481)	8.9% (4)	0.302

Conclusions: CDH is a rare malformation and occurs in a small percentage of patients born with congenital heart disease. Concomitant diagnosis of diaphragmatic hernia portends increased morbidity and mortality in infants and neonates undergoing surgery for congenital heart disease. For children undergoing cardiac surgery beyond infancy, a diagnosis of CDH is not consistently predictive of worse outcomes.

5:30 pm **Adjourn**

5:35 pm – **Executive Session, AATS Members Only** Ballroom 20A, SDCC
6:15 pm

MONDAY AFTERNOON, APRIL 30, 2018

2:00 pm **General Thoracic Surgery** Room 25ABC, SDCC
 Simultaneous Scientific Session
8 minute presentation, 10 minute discussion

Moderators: *Thomas A. D'Amico and *Stephen C. Yang

59. First Series of Minimally Invasive, Robot-Assisted Tracheobronchoplasty with Mesh for Severe Tracheobronchomalacia

Richard Lazzaro¹, Byron Patton¹, *Paul Lee¹, Jason Karp², Efstathia Mihelis¹, Sohrab Vatsia¹, S. Jacob Scheinerman¹

¹Lenox Hill Hospital, New York, NY; ²North Shore University Hospital, Manhasset, NY

Invited Discussant: *Abbas E. Abbas

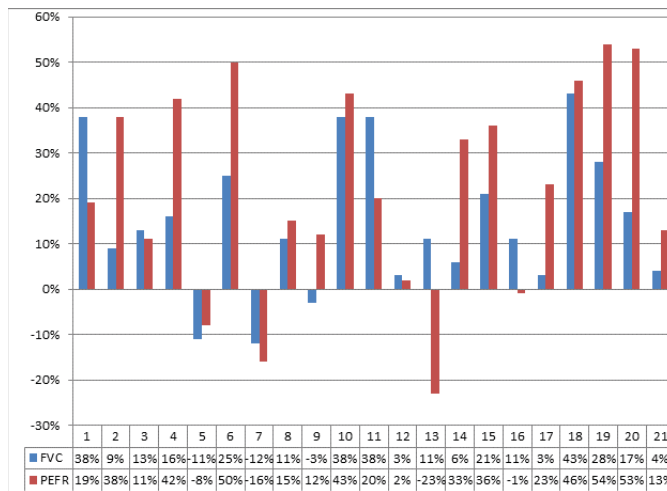
Objective: Tracheobronchomalacia (TBM) is a progressive, debilitating disease with limited treatment options. Open tracheobronchoplasty (O-TBP) is an accepted surgical option for relief of TBM symptoms, but its application is restricted to highly selected patients due to its significant morbidity and mortality. The purpose of this study was to examine the safety and outcomes of the first reported series of robot-assisted tracheobronchoplasty (R-TBP).



Methods: From May 2016 to April 2017, 260 patients were evaluated for TBM by dynamic CT scan. Of this group, 121 had greater than 50% collapse of the trachea by CT, 42 had bronchoscopic evaluation and ultimately 23 consecutive patients underwent R-TBP. R-TBP was performed at a single institution utilizing a portal, 4-arm robotic platform. The posterior membrane of the trachea and bilateral mainstem bronchi were plicated and stabilized with a polypropylene mesh. Pulmonary function testing was performed preoperatively and approximately 3 months postoperatively for 21 of the patients.

Results: The mean age of the surgical patients was 65.8 ± 10.3 years (range; 47 to 87). Twenty patients (87%) had asthma, twenty (87%) had GERD, sixteen (70%) had COPD, five (22%) had a history of cardiovascular disease, and four (17%) had prior chest surgery. The mean BMI was 28.8 ± 4.5 kg/m² (range; 20.4 to 40.4). Mean operative time was 244 ± 33 minutes, no blood transfusions were necessary, and no operations were converted to O-TBP. Median length of ICU stay was 1 day and median LOS was 3 days. No patients required immediate postoperative bronchoscopies and no patients were reintubated. Postoperative complications were minimal: 1 patient (5%) with pneumonia and 2 patients with (9%) pneumothorax. There was no mortality and all patients were discharged home. There was a significant increase in the mean percent forced vital capacity (FVC) from 70.6% to 85.6% after R-TBP ($p = 0.001$). Correspondingly, the mean percent peak expiratory flow rate (PEFR) increased from 62.7% to 85.1% after surgical repair ($p = 0.001$). The graph shows percent change in FVC and PEFR from preoperative to postoperative testing for each patient.

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Conclusions: In this series, we report the first experience with R-TBP in the world and its short-term outcomes with low morbidity, no mortality, and significant improvement in FVC and PEFR. Early data demonstrate operative time, LOS and discharge status were all favorable as compared to previous reports of the open approach. R-TBP can be safely performed and expands the treatment options for this complex, high-risk population.

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60. Single-Institution Results of Near-Infrared Intraoperative Imaging During Minimally Invasive Pulmonary Metastasectomy for Sarcomas

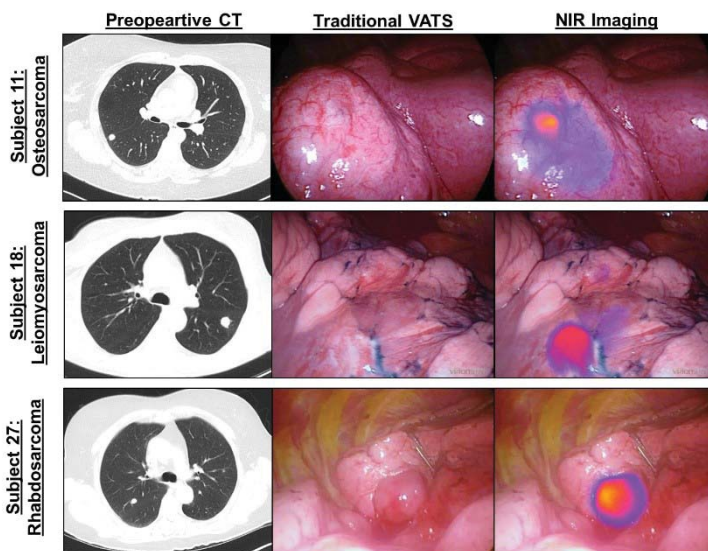
Jarrold D. Predina, Andrew Newton, Colleen Gaughan, Doraid Jarrar, Taine Pechet, John Kucharczuk, *[Sunil Singhal](#)

University of Pennsylvania, Philadelphia, PA

Invited Discussant:

Background: Complete pulmonary metastasectomy for isolated sarcoma metastases provides patients an opportunity for long-term survivorship. Identification of small metastases and occult nodules may be challenging, particularly during VATS. In this trial we evaluate the ability of near-infrared (NIR) intraoperative imaging using indocyanine-green (ICG) to improve: (i) localization of known metastases and (ii) detection of occult nodules.

Methods: Thirty subjects with pulmonary nodules suspicious for sarcoma metastases were enrolled in a human clinical trial (NCT02280954). All subjects received intravenous ICG (5 mg/kg) one day prior to metastasectomy. Subjects 1–10 (Cohort 1) underwent metastasectomy via thoracotomy to assess fluorescence patterns of nodules detected by traditional methods (preoperative imaging and intraoperative visualization/palpation). After confirming reliability in Cohort 1, Subjects 11–30 (Cohort 2) underwent VATS metastasectomy with NIR imaging. All resected nodules underwent histopathologic analysis and microscopic fluorescent tomographic evaluation.



Results: Systemic ICG infusion was well tolerated with no toxicity observed. NIR imaging added a mean of 9 minutes (range, 5–12 minutes) to case duration. Within Cohort 1, 14/16 (87.5%) of preoperatively identified pulmonary metastases displayed tumor fluorescence with a mean tumor-to-background fluorescent ratio (TBR) of 3.1



(SD 2.7–4.2). Non-fluorescent metastases were deeper than fluorescent metastases (2.1 cm vs. 1.3 cm; $p = 0.03$). 7/7 (100%) metastases identified during thoracotomy only by palpation/visualization also displayed fluorescence with a mean TBR of 3.3 (SD 2.8–4.1). NIR imaging identified 3 additional occult metastases (size range, 3 mm–5 mm). Within Cohort 2, 33/37 (89.1%) of preoperatively identified pulmonary metastases displayed high fluorescence (mean TBR, 2.9). Again, all non-fluorescent tumors were deeper than 2.0 cm ($p = 0.007$). NIR imaging identified 24 additional fluorescent lesions during VATS, with a mean TBR of 2.8 (SD 2.6–3.0) and a mean size of 4 mm (range, 2 mm–6 mm). Of the 24 occult lesions, 21 (87.5%) were confirmed metastases and 3 were benign lymphoid aggregates. Histopathologic and fluorescent evaluation confirmed ICG accumulated within tumors via the enhanced permeability and retention effect.

Conclusions: NIR intraoperative imaging with ICG for sarcoma pulmonary metastases localizes known nodules. This approach also identifies additional occult lesions by drawing the surgeons' attention to smaller nodules. Based on our molecular imaging experience involving over 600 subjects, we believe that this is the most promising application of molecular imaging to date.

MONDAY, APRIL 30

61. Effect of Virtual-Assisted Lung Mapping (VAL-MAP) in Acquisition of Surgical Margins in Sublobar Lung Resection: A Multicenter, Prospective Study in Japan

◆Masaaki Sato¹, Masashi Kobayashi², Fumitsugu Kojima³, Fumihiro Tanaka⁴, Masahiro Yanagiya⁵, Shinji Kosaka⁶, Ryuta Fukai⁷, Yoshiaki Furuhashi⁸, Kenji Misawa⁹, Masaki Ikeda¹⁰, Hideaki Miyamoto¹¹, Ryotaro Kamohara¹², Yukihiro Yoshida¹³, Yukihiro Yoshida¹³, Hiroaki Sakai¹⁴, Yasuo Sekine¹⁵, Terumoto Koike¹⁶, Yosuke Otake¹⁷

¹University of Tokyo, Tokyo, Japan; ²Tokyo Medical and Dental University, Tokyo, Japan; ³St. Luke's International Hospital, Tokyo, Japan; ⁴University of Occupational and Environmental Health, Kitakyushu, Japan; ⁵NTT Medical Center Tokyo, Tokyo, Japan; ⁶Shimane Prefectural Central Hospital, Izumo, Japan; ⁷Shonan Kamakura General Hospital, Kamakura, Japan; ⁸Japanese Red Cross Medical Center, Tokyo, Japan; ⁹Aizawa Hospital, Matsumoto, Japan; ¹⁰Nagara Medical Center, Gifu, Japan; ¹¹Matsue Red Cross Hospital, Matsue, Japan; ¹²Nagasaki University, Nagasaki, Japan; ¹³Asahi Central Hospital, Asahi, Japan; ¹⁴Hyogo Prefectural Amagasaki General Medical Center, Amagasaki, Japan; ¹⁵Tokyo Women's Medical University Yachiyo Medical Center, Yachiyo, Japan; ¹⁶Niigata University Graduate School of Medical and Dental Sciences, Niigata, Japan; ¹⁷Kitano Hospital, Osaka, Japan

Invited Discussant: *Yolonda L. Colson

Objective: Virtual-assisted lung mapping (VAL-MAP) is a preoperative bronchoscopic multi-spot dye-marking technique using virtual images. The present study aimed to examine the efficacy of VAL-MAP for obtaining sufficient surgical margins in sublobar lung resection of small nodules.

Methods: A multicenter, prospective, single-arm study was conducted from September 2016 to July 2017 under the supervision of the Japanese Ministry of Health, Labour and Welfare, to evaluate the safety and efficacy of VAL-MAP (clinical trial registration ID: UMIN000022991). In 18 registered centers, patients who required sublobar lung resection and careful determination of resection margins underwent VAL-MAP followed by

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thoracoscopic surgery after appropriate informed consent. All of the data were prospectively collected. Successful resection was defined as resection of the target lesion with resection margins greater than the diameter of the lesion or 2 cm (macroscopic measurement) using planned sublobar resection (i.e., wedge resection or segmentectomy) without additional resection. Considering the historical control of CT-guided marking (successful resection, 67%; estimated maximum success, 85%), we defined the primary goal of the study as achieving successful resection of 95% (lower limit of confidence interval (CI), 90%).

Results: Among 203 lesions of 153 patients who were eventually evaluated, 178 lesions met the criteria of successful resection (87.8%; 95% CI, 82.4–91.9%). Among 559 marks made, 521 (93.2%; 95% CI, 90.8–95.1%) were identifiable during the operation. VAL-MAP markings successfully aided identification of 190 lesions (93.6%; 95% CI, 89.3–96.5%). Selected operation types included wedge resection (117, 63.6%), segmentectomy (50, 27.2%), and others (17, 9.2%). No major adverse event was directly associated with VAL-MAP. The most frequent minor complication was pneumothorax (10.3%) and 94% patients required no further treatment. Multivariate analysis showed that the most significant factor affecting successful resection was the depth of the necessary resection margin ($P = 0.0048$; Table 1).

Table 1: Multi-Variate Analysis of Risk Factors Affecting Resection Failure

Factor	Reference	Risk Ratio	95% CI		p Value
Required resection depth*: \geq median	<Median	4.30	1.49	12.39	0.007
Planned operation: segmentectomy	Wedge resection	0.72	0.34	1.54	0.396
Brinckman index: ≥ 500	<500	1.27	0.6	2.69	0.532
Measurement of resection margin on regular basis in the center: occasional or no routine measurement	Regular measurement	2.51	1.05	5.97	0.038
Surgeons' average experience: per 5-year increase		1.05	0.62	1.76	0.867
Lesion characteristics: GGO with solid component	Nodule/solid or cavity	2.68	1.02	6.99	0.045
Lesion characteristics: pure GGO	Nodule/solid or cavity	1.65	0.65	4.18	0.29

* Resection depth (cm) = distance from the closest pleura + {[diameter x 2 (tumor <2 cm)] or 4 (tumor ≥ 2 cm)}

Conclusions: This study shows the safety and reasonable efficacy of VAL-MAP, although the successful resection rate did not reach the primary goal. The depth of the required resection margin is the most significant factor leading to resection failure. Further investigation is necessary to obtain sufficient resection margins, particularly in deeply located lesions.



62. Prospective Feasibility Study of Sealing with Energy Vessel Sealing System for Pulmonary Vessels in Lung Surgery

Yoshihiro Miyata¹, *Morihiro Okada¹, Yasuhiro Tsutani¹, Kazuya Takamochi², Shiaki Oh², ♦Kenji Suzuki²

¹Hiroshima University, Hiroshima, Japan; ²Juntendo University, Tokyo, Japan

Invited Discussant: *Scott J. Swanson

Objective: Vascular sealing with energy devices during lung resection might provide the surgeons to simply and safely treat small vessels with minimal dissection, and possibly lower injury. We examined the feasibility of energy sealing for branches of pulmonary arteries and veins.

Methods: We started a prospective pre-operative registration study in two institutions to evaluate the significance of energy sealing with no additional reinforcing material such as suture ligation for pulmonary vessels up to 7 mm during anatomical lung resection (Cohort-1 study). Since a post-operative hemorrhage had occurred in 128th case, Cohort-2 study was re-conducted after the inclusion criteria were changed to pulmonary artery up to 5 mm.

Results: In Cohort-1 (n = 128), energy sealing was done for 216 pulmonary arteries and 189 pulmonary veins, while for 250 pulmonary arteries and 213 pulmonary veins in Cohort-2 (n = 200). Totally post-operative hemorrhage was recognized in one patient (1/328, 0.3%), although there were no serious post-operative complications associated with energy sealing in following 200 cases of Cohort-2. According to the following inspection of the torn artery stump, the point of bleeding was not at sealing zone but at the adjacent portion.

Conclusions: The use of energy sealing without any reinforcement allows us to easily and securely treat pulmonary artery up to 5 mm in diameter and pulmonary vein up to 7 mm. It is important for the surgeon to understand the mechanism of the bleeding after the usage of energy device.

3:15 pm – Coffee Break in the Exhibit Hall
3:55 pm

3:25 pm – 3:50 pm

Deep Dive: Disentangling Trade-Offs Between Different Forms of Resource Utilization in Regionalized Esophagectomy Care: Analysis of Healthcare Costs

5 minute presentation, 20 minute discussion

See page 52 for details.

AATS CT Theater I
Booth #134, Exhibit Hall
Not for Credit

MONDAY, APRIL 30

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63. Assessment of Competence in Video Assisted Thoracoscopic Surgery Lobectomy — A Nationwide Study

Rene Horsleben Petersen¹, Kirsten Gjæraa¹, Katrine Jensen¹, Lars B. Møller²,
Henrik Jessen Hansen¹, Lars Konge¹

¹Copenhagen University Hospital, Rigshospitalet, Copenhagen, Denmark; ²Aalborg University Hospital, Aalborg, Denmark

Invited Discussant: ♦Paul H. Schipper

Objective: Assessment of competence in VATS lobectomy has previously been established based on numbers of procedures performed, but this approach does not ensure competence. Specific assessment tools like the newly developed VATSAT (Video-Assisted Thoracoscopic Surgery Assessment Tool) allow for structured and objective assessment of technical skills in VATS lobectomy. Our aim was to provide validity evidence for VATSAT.

Methods: Video recordings of 60 VATS lobectomies performed by 18 thoracic surgeons were rated using the VATSAT. Two ratings were deducted from analysis because of conversion to thoracotomy. All four national centres of cardio-thoracic surgery participated in the study. The surgeons had different skill levels (beginner <50 cases, intermediate 50–499 cases, experts >500 cases). The two raters were blinded to surgeon and centre.

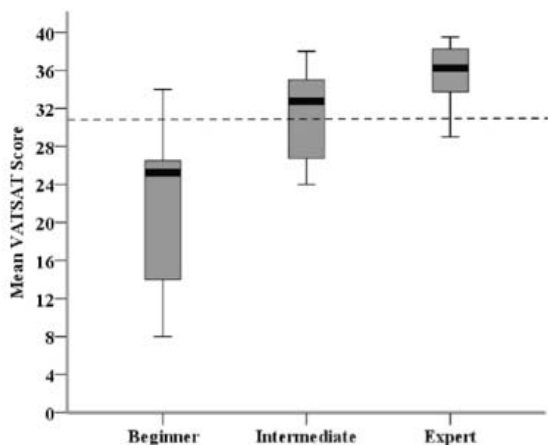


Figure 1: Relation between the experience level of the thoracic surgeons and the mean VATSAT score. Box plot shows: (black: median, grey: 25%-75% quartile, thin lines: minimum, maximum, dotted line: pass/fail ratio 31 points).

Results: The total internal consistency reliability, Cronbach's Alpha, was 0.93. Inter-rater reliability between the two raters was Pearson's $r = 0.71$ ($p < 0.001$). The mean VATSAT score for the 10 procedures performed by beginners were 22.1 (SD 8.6; range 8.0–34.0),



for the 28 procedures performed by the intermediate surgeons 31.2 (SD 4.4; range 24.0–38.0) and for the 20 procedures performed by experts 35.9 (SD 2.9; range 29.0–39.5); $p < 0.001$. Bonferroni post-hoc tests showed that experts were significant better than intermediates ($p < 0.008$) and beginners ($p < 0.001$). Intermediates' mean scores were significant better than beginners ($p < 0.001$). The Pearson's correlation between the logarithmic number of VATS lobectomies performed and the mean VATSAT score was $r = 0.68$ ($p < 0.001$). The pass/fail standard calculated using the contrasting group's method was 31 points. One of the beginners passed and two experts failed the test.

Conclusion: Validity evidence was provided for a newly developed assessment tool for VATS lobectomy (VATSAT) in a clinical setting. Internal consistency reliability was high and inter-rater reliability acceptable. The discriminatory ability between expert surgeons, intermediate surgeons, and beginners proved highly significant. The pass/fail standard was 31 points. VATSAT could be an important aid in the future training and certification of residents in thoracic surgery.

MONDAY, APRIL 30

64. The Role of Thoracoscopic Pneumonectomy in the Management of Non-Small Cell Lung Cancer: A Multicenter Study of 434 Patients

Chi-Fu Jeffrey Yang¹, *Sai Yendamuri², Nicholas Mayne¹, Athar Battoo², Hanghang Wang¹, Ryan Meyerhoff¹, Sameer Hirji³, *Mark Berry⁴, *Robert McKenna⁵, *Todd Demmy², *Thomas D'Amico¹

¹Duke University, Durham, NC; ²Roswell Park Cancer Institute, Buffalo, NY; ³Brigham and Women's Hospital, Boston, MA; ⁴Stanford University, Stanford, CA; ⁵Cedars-Sinai Medical Center, Los Angeles, CA

Invited Discussant: *James D. Luketich

Objective: The role of thoracoscopic lobectomy is well supported by numerous clinical series and meta-analyses, but the potential benefits of thoracoscopic pneumonectomy have only been inferred. The objective of this study was to evaluate the impact of a video-assisted thoracoscopic (VATS) approach on outcomes of patients who received pneumonectomy in a multicenter study setting.

Methods: The impact of surgical approach (VATS versus thoracotomy) on perioperative complications and survival of patients with non-small-cell lung cancer (NSCLC) who underwent pneumonectomy from 1993–2016 across three institutions was assessed using Kaplan-Meier, multivariable logistic regression, multivariable Cox proportional hazard analysis and propensity-score matching. An intent-to-treat analysis was performed.

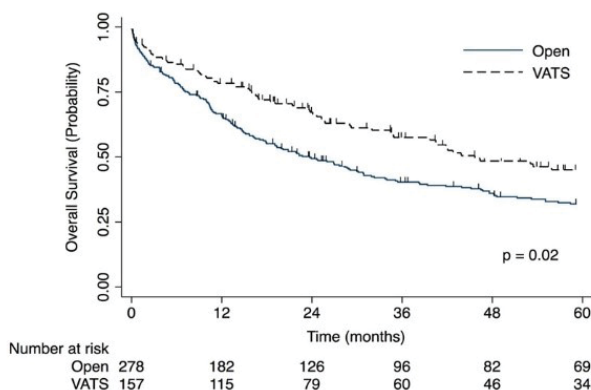
Results: During the study period, 434 patients met inclusion criteria and underwent pneumonectomy for NSCLC: 154 (35%) VATS and 280 (65%) thoracotomy. Compared to thoracotomy patients, VATS patients were older and were more likely to have COPD. A VATS approach was associated with shorter chest tube duration ($p = 0.001$) and a higher number of N2 stations dissected ($p < 0.001$). Of the VATS cases, 26 (17%) were converted to thoracotomy. Perioperative mortality (VATS 6% [$n = 10$] vs. open 9% [$n = 26$]; $p = 0.29$) and morbidity (VATS 29% [$n = 44$] vs. open 28% [$n = 79$], $p = 0.93$) were similar between the groups, even after multivariable adjustment. VATS was associated with improved overall survival when compared with thoracotomy (5-year survival 46%

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[95% CI: 36–55] vs. 32% [95% CI: 26–37]; log-rank $p = 0.02$; Figure), but there was no significant difference in survival between the two groups after multivariable adjustment ($p = 0.23$). A propensity-score matched analysis balancing patient characteristics—including pulmonary function, tumor size and stage—was also performed, and found no significant difference in overall survival between the two groups ($p = 0.69$).

Figure. Overall Survival for Patients Undergoing VATS vs Open Pneumonectomy for Non-small-cell Lung Cancer



Conclusion: Although the role of VATS pneumonectomy will likely become clearer as more surgeons report their results, this multicenter study suggests that introducing a VATS approach for pneumonectomy into clinical practice can be done safely and without compromising oncologic outcomes.

65. Extent of Lymphadenectomy Is Associated with Oncological Efficacy of Sublobar Resection for Lung Cancer Less Than or Equal to 2 cm

*[Brendon M. Stiles](#), Jialin Mao, Sebron Harrison, Benjamin Lee, Andrew Nguyen,

*Jeffrey L. Port, Art Sedrakyan, *Nasser K. Altorki

New York Presbyterian Hospital Weill Cornell Medical College, New York, NY

Invited Discussant: *Sai Yendamuri

Objective: Sublobar resection (SLR), either wedge or segmentectomy, is under evaluation as an alternative to lobectomy for NSCLC in randomized surgical trials. Comparative effectiveness of the two approaches may be modified by the extent of lymph node (LN) dissection, viewed as a quality indicator for NSCLC surgery. We sought to determine whether extent of lymphadenectomy influenced survival in node negative patients with NSCLC ≤ 2 cm in size.

Methods: We utilized SEER-Medicare (registry data linked to in- and outpatient Medicare claims) to identify non-small cell lung cancer (NSCLC) patients with primary lung cancer ≥ 66 years old, with pstage I disease, and tumor size ≤ 2 cm. Propensity score matching for demographic, comorbidity, tumor, and surgeon/facility variables was performed using a one-to-one nearest neighbor matching algorithm for analysis of balanced cohorts. We compared patient characteristics with t tests for continuous



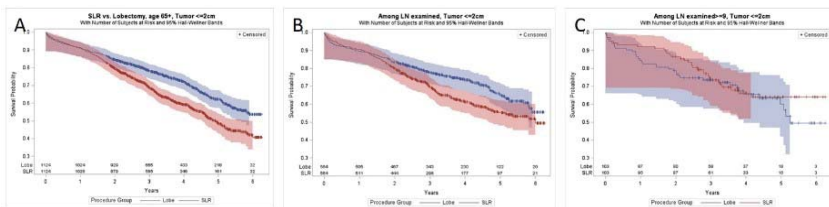
variables and χ^2 tests for categorical variables. Kaplan-Meier curves were constructed (95% Hall-Wellner confidence bands) to determine overall survival (OS) and cancer specific survival (CSS). We evaluated OS and CSS among cohorts undergoing lobectomy versus SLR, particularly as it related to extent of lymphadenectomy (one or more LN or 10 or more LN).

Results: For the time period studied (2007–2012), there were 2,757 lobectomies and 1,229 SLR performed for stage I tumors ≤ 2 cm. There were demographic and comorbidity differences between patients undergoing lobectomy vs. SLR (Table). We propensity matched 1,124 patients from each group. Propensity matched patients undergoing SLR were more likely to have no lymph nodes sampled (46.9% vs. 6.4%, $p < 0.001$) and were less likely to have >10 LN sampled (5.8% vs. 27.3%, $p < 0.001$). All-cause (HR 1.48, CI 1.29–1.69) and cancer-specific (HR 2.06, CI 1.41–3.02) mortality were higher in the matched cohort following SLR (A). When propensity matched cohorts of patients with at least one LN removed ($n = 564$ each group) were examined, the HR for SLR decreased (all-cause HR 1.38, CI 1.12–1.69 and cancer specific HR 1.58, CI 0.97–2.57, B). Finally, when cohorts were propensity matched for >10 LN removed ($n = 103$ each group), there was no difference in all-cause (HR 0.84, CI 0.50–1.39) or cancer-specific (HR 1.10, CI 0.35–3.41) mortality when comparing SLR to lobectomy (C).

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Table: Groups Matched for Pre-Surgical Variables But Not Lymph Nodes

		Unmatched Cohort			Matched Cohort*		
		Lobectomy (N = 2757)	SLR (N = 1229)	p Value	Lobectomy (n = 1124)	SLR (n = 1124)	p Value
Demographic	Age	74.3	75.6	<0.001	75.1	75.3	0.55
	Male	43.4%	40.5%	0.09	39.6%	40.7%	0.58
	White race	90.2%	92.0%	0.07	92.4%	91.8%	0.58
Comorbidities	0–2	618 (22.4%)	238 (19.4%)	0.004	220 (19.6%)	224 (19.9%)	0.95
	3–5	1384 (50.2%)	595 (48.4%)		546 (48.6%)	549 (48.8%)	
	6+	755 (27.4%)	396 (32.2%)		358 (31.9%)	351 (31.2%)	
Tumor	T1	85.7%	83.1%	0.03	83.4%	83.2%	0.91
	Mean size	1.5 (0.4)	1.5 (1.4)	<0.001	1.4 (0.4)	1.4 (0.4)	0.88



Conclusions: In pathologically staged NSCLC patients with tumors ≤ 2 cm, SLR leads to fewer resected LN and is associated with inferior survival compared to lobectomy. A more extensive lymphadenectomy appears to provide a protective effect and is associated with equivalent survival between matched patients undergoing SLR and lobectomy. We hypothesize that this effect may be due to stage purification, but it is also possible that there may be an oncologic benefit of a more extensive lymphadenectomy.

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66. Close Surgical Margins and Risks of Local Treatment Failure After Wedge Resection of Colorectal Pulmonary Metastases

David B. Nelson, Nabihah Tayob, Kyle G. Mitchell, Arlene M. Correa,

*Wayne L. Hofstetter, Boris Sepesi, *Garrett L. Walsh, *Ara A. Vaporciyan,

*Stephen G. Swisher, Mara B. Antonoff, *Jack A. Roth, *David C. Rice, *Reza J. Mehran

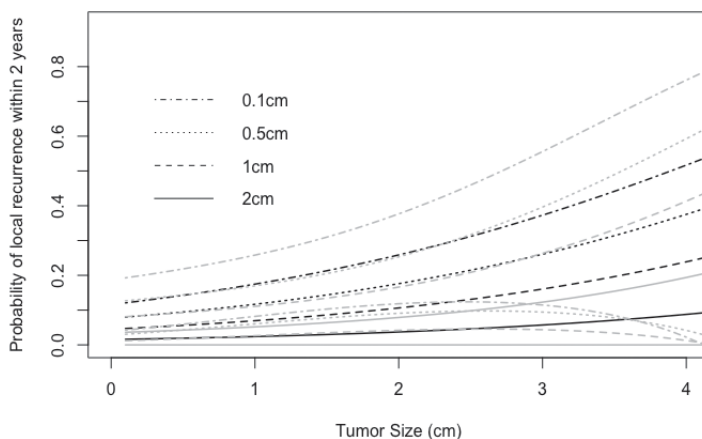
MD Anderson Cancer Center, Houston, TX

Invited Discussant: *Thomas K. Waddell

Purpose: During resection of pulmonary metastases, the need to spare lung parenchyma is often weighed against the increased risks of local recurrence if an inadequate surgical margin is obtained. We sought to identify risk factors for local failure after wedge resection of pulmonary metastases of a colorectal origin.

Methods: A retrospective review of patients who underwent a wedge resection for colorectal pulmonary metastases from 2006–2016 was performed. Patients with a positive surgical margin were excluded. We defined local recurrence as an enlarging nodule adjacent to the staple line. Margin length was measured from the cut staple line. Hierarchical Cox regression with robust variance was used to estimate risk of local failure per nodule treated. The multivariate Cox regression model was used to estimate risk of local recurrence with varying degrees of tumor size or margin length, with other variables set their respective median or mode.

Results: 345 patients who underwent 771 wedge resections were identified. Local recurrence within 2-years for each nodule was 12.0% (95% CI 9.3%–14.6%), and within 5-years was 20.6% (95% CI 16.5%–24.5%). Longer margin length decreased the hazard of local recurrence (HR 0.33 per additional cm of length, $p = 0.002$), whereas larger tumor size increased the odds of local recurrence (HR 1.56 per additional cm of size, $p = 0.004$). However, other factors tested, including tumor grade, KRAS status and response to pre-procedure chemotherapy, were not risk factors for local treatment failure. Tumors up to 4 cm were associated with a local recurrence rate less than 10% provided a 2 cm margin was obtained (Figure), however, 2 cm tumors were associated with a local recurrence rate less than 10% with a 1 cm margin, and 1 cm tumors were associated with a local recurrence rate less than 10% with a 0.5 cm margin.



Conclusions: Among surgically resected colorectal pulmonary metastases, technical factors related to margin length and tumor size were associated with the risk of local recurrence. Tumor grade and KRAS mutational status were not associated with the risk of local recurrence in our population. Increased risk of local recurrence with larger tumors was found to be diminished with a sufficient margin length.

67. Effects of Time from Completed Clinical Staging to Surgery: Does It Make a Difference in Stage 1 Non-Small Cell Lung Cancer?

Derek Ray Serna-Gallegos, Fernando Espinoza-Mercado, Taryne Imai, David Berz, Harmik J. Soukiasian

Cedars-Sinai Medical Center, Los Angeles, CA

Invited Discussant: *Felix G. Fernandez

Objective: The National Cancer Comprehensive Network (NCCN) guidelines recommend surgical therapy within 8 weeks of completed clinical staging for NSCLC. We investigate upstaging over time, ranging from week 1 to week 12 after the completion of clinical staging for overall stage 1 NSCLC. Our goal being to evaluate if a delay past the 8-week mark has a significant effect on upstaging.

Methods: Treatment data of clinical stage 1 NSCLC patients undergoing surgical resection were obtained from the National Cancer Data Base (NCDB). Patients who underwent anatomic lobar resection and lymphadenectomy or lymph node sampling who did not receive chemotherapy for clinical stage 1 NSCLC were analyzed and compared to their eventual pathologic staging. The rates of upstaging for stage 1 tumors were evaluated based on the time from completed clinical staging to surgery for the first 12 weeks, using the Cochran-Armitage trend test. Fisher-exact test was used to compare upstaging of week 1 versus each subsequent week for 12 weeks from the time of completed clinical staging. In addition, subgroup analyses were performed for 1a and 1b adenocarcinoma and squamous cell carcinoma.

Results: A total of 52,406 patients with clinical stage 1 NSCLC were analyzed. The percentage of operations performed within a given number of weeks from the completion of clinical staging is represented in Figure 1. Most resections (25.4%, 13325/52406) were performed within 1 week. By 8 weeks, 78.9% (41362/52406) of patients had undergone resection and by 12 weeks 91.2% (47844/52406) of patients had undergone resection.

Significant increase in upstaging is seen with increasing week from completion of clinical staging to resection. These significant trends are demonstrated in subgroup analysis of stage 1A and 1B adenocarcinoma as well as with 1A and 1B squamous cell carcinoma as represented in Figure 2. The data demonstrated a significant increase in upstaging for all clinical stage 1 NSCLC with 21.7% (2896/13325) of patients being upstaged after 1 week and 31.5% (961/3046) after 8 weeks ($p < 0.05$). The significant increase in upstaging was also demonstrated at the 12 week time period 32.6% (366/1027).

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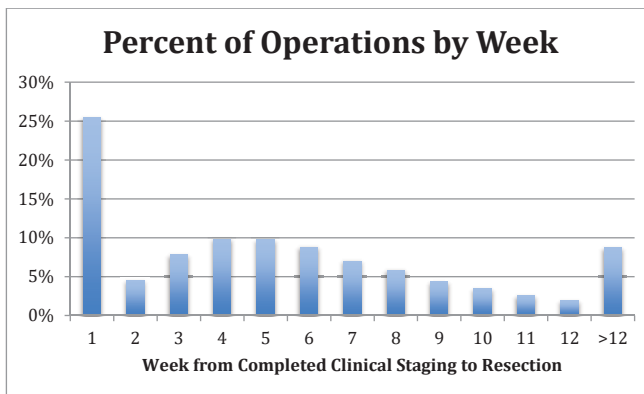


Figure 1

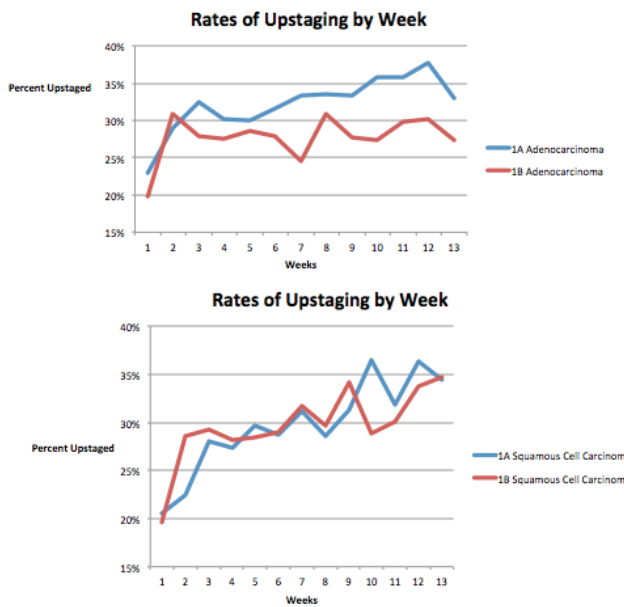


Figure 2

Conclusions: Significant trends demonstrate increased upstaging as time from clinical staging to resection increases in patients with stage 1 NCSLC who undergo lobar resection and lymph node staging. This data suggests that early intervention after the completion of clinical staging leads to decreased rates of upstaging and therefore achieves more consistent clinical staging.

5:30 pm Adjourn

5:35 pm – Executive Session, AATS Members Only

Ballroom 20A, SDCC

6:15 pm

MONDAY AFTERNOON, APRIL 30, 2018

2:00 pm

Perioperative Care

Room 28DE, SDCC

Simultaneous Scientific Session

6 minute presentation, 8 minute discussion

Moderators: Marci Damiano, Katherine J. Hoercher and

*Glenn J. Whitman

Late-Breaking Clinical Trial

68. One-Year Results from the First US-Based ERAS® Cardiac Program

Judson Blount Williams, Jr.¹, Gina McConnell², J. Erin Allender², Patricia Woltz², Peter K. Smith¹, *Daniel T. Engelman³, William T. Bradford²

¹Duke University, Raleigh, NC; ²WakeMed Health and Hospitals, Raleigh, NC; ³Baystate Medical Center, Springfield, MA

Invited Discussant: Subhasis Chatterjee

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69. Effects of Hemoglobin A1c Levels on Short-Term Outcomes and Mortality Rates In Patients Undergoing Transcatheter or Surgical Aortic Valve Replacement

Nnaemeka Ndubisi¹, Jessica Forcillo¹, Jonh Melvan¹, John Kelly¹, John Hunting¹, Jose Binongo¹, Vasilis Babaliaros¹, *Robert Guyton¹, Chandan Devireddy¹, Bradley Leshnower¹, James Stewart¹, Jeffrey Miller¹, *Edward Chen¹, *Michael Halkos¹, *Vinod Thourani²

¹Emory University, Atlanta, GA; ²Medstar Washington Hospital Center, Washington DC

Invited Discussant: *Harold L. Lazar

Objective: Diabetes mellitus has been shown to adversely affect outcomes in surgical aortic valve replacement (SAVR); however it remains a crude binary-marker for glucose control while HbA1c is a more precise determinant. Thus, we investigated the predictive role of HbA1c on outcomes in those undergoing transcatheter aortic-valve replacement (TAVR) or SAVR.

Methods: A single U.S. institution retrospective analysis of patients undergoing TAVR (n = 1,143) and SAVR (n = 2,147) was performed. Based on updated guidelines, HbA1c ≥ 6.5 was noted as a new diagnosis of diabetes or uncontrolled diabetes. Outcomes were then evaluated within TAVR and SAVR groups after adjusting for STS-PROM scores.

Results: An HbA1c of ≥ 6.5 was present in 23% (n = 260) of TAVR patients and 18% (n = 393) in SAVR. Mean TAVR group age was 80.1 ± 9.1 yrs, 44.3% were female (n = 506) and mean STS-PROM was $9.5 \pm 6.0\%$. The 30-day mortality in TAVR patients was 3.9% in the ≥ 6.5 HbA1c group and 3.4% in the < 6.5 group (p = 0.1). Other TAVR group outcomes showed no significant differences. Mean age in the SAVR group was 66.6 ± 13.9 yrs, 39.1% were female (n = 841) and mean STS-PROM was $4.4 \pm 5.3\%$. The 30-day mortality in SAVR patients was 3.8% in the ≥ 6.5 HbA1c group and 2.7% in the < 6.5 group (p = 0.6). Other outcomes within the SAVR group, again, showed no difference. In those

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patients with a HbA1c >6.5, adjustment for STS-PROM (Table) revealed no difference in 30-day mortality between TAVR and SAVR (O.R. 0.85, $p = 0.7$), but did reveal higher MACE in the SAVR group (O.R. 0.39, $p = 0.008$).

Variable	TAVR HbA1C <6.5 (n=907)	TAVR HbA1C ≥6.5 (n=260)	SAVR HbA1C <6.5 (n=1753)	SAVR HbA1C ≥6.5 (n=393)
STS PROM, mean (std)	10.53% (6.32)	9.22% (5.84)	4.05% (5.01)	5.98% (6.32)
Actual 30d mortality	31 (3.42%)	10 (3.85%)	47 (2.68%)	15 (3.82%)
Stroke	11 (1.21%)	3 (1.15%)	44 (2.51%)	15 (3.82%)
Myocardial Infarction	2 (0.22%)	0	0	0
New Dialysis	9 (0.99%)	3 (1.15%)	25 (1.43%)	10 (2.54%)
New Renal failure	10 (1.10%)	7 (2.69%)	48 (2.74%)	15 (3.82%)
Overall LOS (days), median (Q1, Q3)	5.0 (3.0, 8.0)	5.0 (3.0, 8.0)	7.0 (5.0, 11.0)	8.0 (6.0, 13.0)
ICU LOS (hours), (Q1, Q3)	29.0 (23.0, 55.3)	29.0 (22.9, 50.3)	45.4 (24.6, 78.2)	48.1 (25.2, 94.2)

Conclusions: HbA1c levels ≥6.5 did not adversely affect outcomes and short-term mortality in patients undergoing TAVR or SAVR, respectively. In those patients with a HbA1c ≥6.5, mortality rates when comparing SAVR and TAVR, but SAVR patients did have a significantly higher rate of MACE.

70. The Utility of Platelet Reactivity Assay in Patients on P2Y12 Receptor Antagonists Undergoing Coronary Artery Bypass Grafting

Jota Nakano, Erin St. Angelo, Bola Lawuyi, Nichole Melody, Menghan Liu, Duc Thinh Pham,

*Patrick M. McCarthy, Andrei Churyla, *S. Chris Malaisrie

Northwestern University, Chicago, IL

Invited Discussant: *J. Michael DiMaio

Objective: Exposure to P2Y12 inhibitors prior to coronary artery bypass grafting (CABG) has been associated with an increased risk of bleeding. Societal Guidelines recommend discontinuation of P2Y12 inhibitors; clopidogrel and ticagrelor 5 days prior to surgery (class I) and platelet function testing to individualize the time needed between CABG and discontinuation of P2Y12 inhibitors (class IIb). Several platelet function tests are available, but the validity of any particular assay remains elusive. The purpose of this study is to determine the utility of platelet function testing to individualize the timing of CABG after discontinuation of P2Y12 inhibitors.

Methods: A retrospective cohort study from January 2013 to December 2016 identified 82 patients who were previously on clopidogrel or ticagrelor, and underwent CABG at a tertiary academic hospital. Patients were divided into those that discontinued clopidogrel or ticagrelor 5 days prior to surgery ($n = 66$) and those that went to CABG based on platelet reactivity units (PRU >194) as determined by the Verify Now Assay ($n = 16$). The primary outcome was incidence of bleeding as measured by Bleeding Academic Research Consortium (BARC)-4, including perioperative intracranial bleeding within 48 hours, reoperation after closure of sternotomy, transfusion of ≥5 units of packed RBC's within 48 hours and 24-hour chest tube drainage ≥2000 mL. Secondary outcomes included timing to surgery (days from discontinuation).

Results: BARC-4 bleeding was similar between the PRU directed surgery group and the non-PRU directed group; 7 (12.5%) vs. 2 (10.6%), $p = 0.828$. The rate of perioperative

intracranial bleeding within 48 hours, reoperation after closure of sternotomy, transfusion ≥ 5 units of RBC's within 48 hours, and 24 hour chest tube drainage ≥ 2000 mL was 0 (0%) vs. 0 (0%), 3 (4.5%) vs. 2 (12.5%), 2 (3%) vs. 0 (0%), 5 (7.6%) vs. 1 (6.3%) in PRU vs. non-PRU groups, respectively. The time from P2Y12 inhibitor discontinuation to CABG was 3.6 days in the PRU group vs. 6.5 days in the non-PRU group, $p < 0.0001$.

Conclusions: Platelet function testing can identify patients who may safely proceed to CABG sooner than 5 days after discontinuation of P2Y12 inhibitors. The risk of bleeding in the PRU-directed patients was similar to that in patients who waited 5 days or more after discontinuation of P2Y12 inhibitors. These findings support guidelines recommendations to individualize time of CABG based on measurement of platelet reactivity.

71. Hyperlactemia During Cardiopulmonary Bypass Is Predictive of Postoperative Renal Failure, Ventilatory Failure and Mortality, Even in the Absence of Postoperative Shock

Xun Zhou, Alejandro Suarez-Pierre, Charles D. Fraser, III, Cecillia Lui, Jeffrey M. Dodd-O, Laeben C. Lester, Viachaslau Barodka, Marc Sussman, *Glenn J. Whitman

Johns Hopkins Hospital, Baltimore, MD

Invited Discussant: Rita Karianna Milewski

Objective: Postoperative renal failure is an extremely morbid complication following cardiac surgery. Inadequate renal perfusion during cardiopulmonary bypass (CPB) is a potentially identifiable and correctable etiology. We hypothesized that serum lactate during bypass may be a useful surrogate for inadequate oxygen delivery during CPB and predict postoperative renal failure, even in patients whose lactate clears rapidly after bypass.

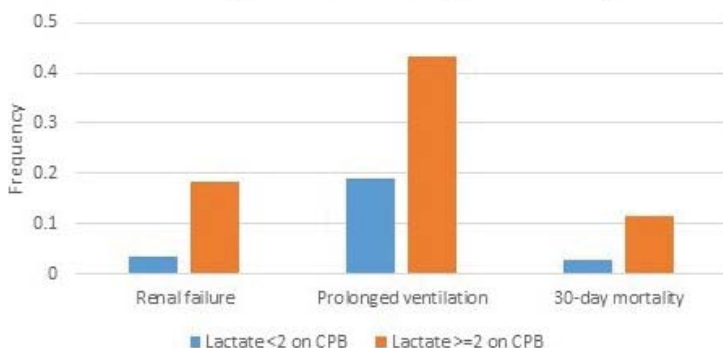
Methods: A single-institution retrospective analysis was performed of all adult patients undergoing cardiac surgery with cardiopulmonary bypass between 2016 and 2017. Serum lactate was measured before surgery, during CPB, and at 4 hour intervals following cessation of bypass until downtrending. Hyperlactemia was defined as serum lactate > 2 mg/dL. Patients were classified into two groups – those who developed hyperlactemia during CPB, and those who did not. Patients with a history of end stage renal disease or elevated preoperative lactate were excluded. Any patients with rising postoperative lactate, suggestive of shock physiology, were also excluded. The primary outcome investigated was the development of acute postoperative renal failure. Additional outcomes analyzed included change in creatinine from baseline to postoperative peak (ΔCr), prolonged ventilation, and 30-day mortality.

Results: A total of 235 patients were studied, of which 27.2% ($n = 64$) developed hyperlactemia on CPB, with an average lactate of 3.3 from an average preoperative baseline of 1.1. The frequency of renal failure for patients with hyperlactemia on CPB was 18.3%, as compared to 3.4% in patients with normal lactate on CPB, ($p = 0.00020$). Hyperlactemia on bypass was associated with an increased rate of prolonged ventilation (43.1 vs. 19.1%, $p = 1.6 \times 10^{-5}$) and 30-day mortality (11.7 vs. 2.8%, $p = 0.0025$). In multivariate linear regression including age, congestive heart failure, chronic lung disease, and bypass time as covariates, lactate while on CPB was a significant predictor of ΔCr ($p = 0.0075$).

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Outcomes Following Cardiac Surgery, Stratified by Hyperlactemia on Bypass



Conclusions: Postoperative renal failure is associated with elevated lactate while on CPB, despite its early resolution upon cessation of bypass. By excluding postoperative shock as a potential confounder and limiting the analysis to lactate while on bypass, the data suggests that inadequate perfusion and oxygen delivery during bypass may be uniquely contributing to a renal as well as systemic insult. This finding emphasizes the importance of optimizing tissue oxygen delivery while on bypass.

72. Impact of Public Reporting on Risk Aversion in Cardiac Surgery

Robert B. Hawkins¹, J. Hunter Mehaffey¹, Clifford Fonner², *Alan Speir³, Mohammed Quader⁴, *Irving L. Kron¹, *Jeffrey B. Rich⁵, *Gorav Ailawadi¹

¹University of Virginia, Charlottesville, VA; ²Virginia Cardiac Services Quality Initiative, Falls Church, VA; ³Inova Heart and Vascular Institute, Falls Church, VA; ⁴Virginia Commonwealth University, Richmond, VA; ⁵Cleveland Clinic, Cleveland, OH

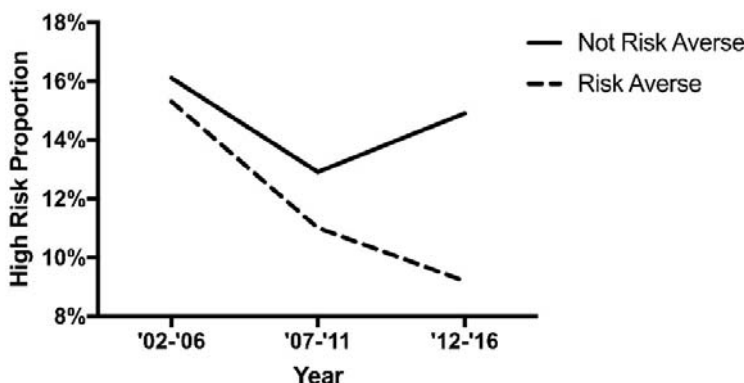
Invited Discussant:

Objective: With a greater emphasis on public reporting, there is a perception that some surgeons and hospitals are selecting only optimal surgical candidates to improve their statistics. We hypothesized that select hospitals are becoming increasingly risk averse by avoiding high-risk operations. Further, we sought to determine the association between risk-averse practices, outcomes and publicly reported quality measures.

Methods: Clinical data from 78,417 patients undergoing cardiac surgery (2002–2016) with an STS risk score available in a regional consortium were paired with publically available Medicare reimbursement and quality data. High-risk surgery was defined as STS predicted risk of mortality (PROM) ≥5% (n = 10,589, 13.5% of all operations). Hospital risk aversion was defined by regression modeling as a significant decrease in both high-risk volume and proportion of cases being high-risk. Cases were stratified by risk aversion for univariate analysis.

Results: Across the region, performance of high-risk operations decreased from 17.9% of cases in 2002 to 12.6% in 2016. Significant risk aversion was seen in 39% of hospitals with a 59% decrease in high-risk volume at those centers compared to only 16% at non-risk-averse hospitals (Figure). As expected, patients treated at risk-averse hospitals had lower median PROM compared to non-risk-averse hospitals (1.3% vs. 1.5%, $p < 0.0001$). In the last five years, risk-averse hospitals have treated a smaller proportion of high-risk cases (9.2% vs. 14.9%, $p < 0.0001$) in part by operating on fewer patients transferred from other hospitals (19.2% vs. 28.1%, $p < 0.0001$) and from the emergency department (17.6% vs. 19.2%, $p = 0.001$). Risk-averse hospitals had significantly lower rates of morbidity and mortality (15.0% vs. 16.2%, $p < 0.0001$). However after risk adjustment, only non-risk-averse hospitals had better than expected rates of morbidity and mortality (risk-averse: 1.01, $p = 0.23$ vs. non-risk-averse: 0.97, $p < 0.0001$). Despite having superior risk-adjusted outcomes, hospitals willing to operate on high risk patients do not see this translate into better STS or Medicare ratings (both $p > 0.05$).

High Risk Proportion By Risk Aversion Status



Conclusions: Over 60% of hospitals did not demonstrate risk-averse practices leading to inferior unadjusted results. After adjusting for case mix, hospitals that treat high-risk patients demonstrate superior risk-adjusted outcomes, but are not rewarded with higher publicly reported measures. This discrepancy may further incentivize risk-averse practices that have developed because of the public reporting system.

3:15 pm – Coffee Break in the Exhibit Hall
3:55 pm

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73. Adult Cardiovascular Surgical Intensive Care Unit Organization and Outcome: Does the 24-hour presence of an intensivist Lead to Better Clinical Outcomes?

Pascal Huard, Jed Lipes, Ying Tung Sia, Marc-Antoine Tardif, Mathieu Simon,
Steve Blackburn, Stephane Langevin, *Francois Dagenais, Dimitri Kalavrouziotis,
*Siamak Mohammadi

Quebec Heart & Lung University Institute, Quebec City, QC, Canada

Invited Discussant: *David A. Fullerton

Objective: To compare the post-cardiac surgery early clinical outcomes in a dedicated adult cardiac surgery intensive care unit (ICU) before and after the implementation of 24-hour coverage by ICU specialists.

Methods: A retrospective cohort study was performed among 16,454 consecutive adult patients admitted to the ICU following cardiac surgery between 2008 and 2016. During this period, postoperative patients in the ICU were managed by ICU specialists during the day. However, in July 2010, there was a major staffing change whereby night-time coverage was transferred from the hands of residents and fellows to ICU specialists, thus assuring 24-hour ICU specialist coverage. We compared the postoperative outcomes before (2008 to June 2010, group A: n = 4184) and after this change (July 2010 to 2016, group B: n = 12270) using 1-to-1 propensity score matching, generating two comparable groups of patients (n = 4,174 in each group). In-hospital outcomes were then compared between the two groups. Among matched patients, patients were further stratified into low (<5% predicted operative mortality) and high risk (≥5% predicted mortality) based on EuroSCORE II.

Results: Baseline clinical characteristics of the matched patients are shown in Table 1. Group B matched patients had significantly lower ICU-mortality (1.4% vs. 2.1%, p = 0.01) and in-hospital mortality (1.8% vs. 2.7%, p = 0.008), compared to group A patients, respectively. This mortality benefit was only observed for high-risk patients (5.9% vs. 9.8%, p = 0.04, and 7.9% vs. 12.3%, p = 0.03), such that no significant difference in ICU-mortality (0.4% vs. 0.6%, p = 0.38) and in-hospital mortality (0.6% vs. 0.7%, p = 0.58) was observed between group B vs. group A low risk patients, respectively. Intubation duration was significantly lower among group B vs. group A patients (11 h vs. 15.5 h, p = 0.0005). In post-hoc analysis, among matched patients with an ICU length of stay ≥5 days, there was a significantly lower rate of ICU mortality (7.3% vs. 16.9%, p = 0.04), in-hospital mortality (10.4% vs. 21.2%, p = 0.0004), intubation duration (74.6 h vs. 122.2 h, p = 0.007), re-intubation (24.5% vs. 36.2%, p = 0.002), and ICU length of stay (11.3 days vs. 14.8 days, p = 0.01), in group B patients vs. group A patients.

Conclusions: In this large cohort of postoperative patients admitted to a dedicated adult cardiac surgery ICU, 24-hour intensivist coverage was associated with a reduced mortality among patients with an expected operative mortality ≥5%, and patients with prolonged ICU stay. These data suggest that lower-risk patients and those not anticipated to have a prolonged ICU length of stay could be safely managed by “fast-track” protocols not involving 24-hour intensivist coverage although this hypothesis needs further investigation.

Table 1: Population Characteristics

Population	All Patients			Matched Patients		
	Fellow Resident n = 4184	Intensivist N = 12270	p Value	Fellow Resident n = 4174	Intensivist n = 4174	P Value
Age	65.1 ± 11.4	65.7 ± 11.5	0.01	65.1 ± 11.4	65.1 ± 11.3	0.90
75 years and older	926 (22.1%)	2834 (23.1%)	0.20	925 (22.2%)	887 (21.2%)	0.31
Women	1173 (28%)	3271 (26.7%)	0.08	1170 (28%)	1172 (28.1%)	0.96
Body mass index	27.9 ± 5	28.1 ± 5.1 (N = 12268)	0.02	27.9 ± 5.0	27.9 ± 5.1	0.97
BMI 30 and more	1223 (29.2%)	3820/12268 (31.1%)	0.02	1221 (29.2%)	1244 (29.8%)	0.58
Logestic Euroscore II	4.2 ± 6.4 (N = 4143)	4.4 ± 6.7 (N = 12139)	0.02	4.2 ± 6.4 (N = 4135)	4.4 ± 6.5 (N = 4132)	0.11
Euroscore greater than 5	924/4143 (22.3%)	2805/12139 (23.1%)	0.29	923/4135 (22.3%)	957/4132 (23.2%)	0.36
Diabetes	1136 (27.1%)	3601 (29.3%)	0.01	1134 (27.2%)	1125 (27%)	0.82
Diabetes with insulin	291/4147 (7%)	931/12229 (7.6%)	0.21	290/4137 (7%)	301/4158 (7.2%)	0.69
Arterial hypertension	2922 (69.8%)	9183 (74.8%)	<.01	2914 (69.8%)	2948 (70.6%)	0.34
Smoking	751 (18%)	1989 (16.2%)	0.01	750 (18%)	725 (17.4%)	0.46
Recent myocard infarctus	121 (2.9%)	303 (2.5%)	0.14	120 (2.9%)	116 (2.8%)	0.79
History of PTCA	583 (13.9%)	2108 (17.2%)	<.01	581 (13.9%)	572 (13.7%)	0.75
Redo sternotomy	323 (7.7%)	944 (7.7%)	0.96	323 (7.7%)	329 (7.9%)	0.81
Heart failure	307 (7.3%)	869 (7.1%)	0.58	307 (7.4%)	306 (7.3%)	0.97
LFEV <25%	125/4143 (3%)	356/12136 (2.9%)	0.78	125/4135 (3%)	125/4131 (3%)	0.99
Stroke	231 (5.5%)	801 (6.5%)	0.02	231 (5.5%)	223 (5.3%)	0.69
COPD	409 (9.8%)	1204 (9.8%)	0.94	409 (9.8%)	392 (9.4%)	0.53
History of AF	679 (16.2%)	2083 (17%)	0.26	679 (16.3%)	731 (17.5%)	0.13
Renal failure	172 (4.1%)	487 (4%)	0.69	172 (4.1%)	180 (4.3%)	0.66
Pre-op dialysis	32 (0.8%)	80 (0.6%)	0.44	32 (0.8%)	29 (0.7%)	0.70
Creatinin level	92.6 ± 52.6 (N = 4174)	91.5 ± 44.1 (N = 12254)	0.20	92.6 ± 52.6	92 ± 44.6	0.60
Clearance MDRD	79.2 ± 23.5 (N = 4174)	79.8 ± 24 (N = 12254)	0.13	79.2 ± 23.5	79.2 ± 24.0	0.97

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74. Is Routine Extubation Overnight Safe in Cardiac Surgery Patients?

Elizabeth D. Krebs¹, Robert B. Hawkins¹, J. Hunter Mehaffey¹, Clifford E. Fonner²,

*Alan M. Speir³, Mohammed A. Quader⁴, *Jeffrey B. Rich⁵, Leora T. Yarboro¹,
Nicholas R. Teman¹, *Gorav Ailawadi¹

¹University of Virginia, Charlottesville, VA; ²Virginia Cardiac Services Quality Initiative, Virginia Beach, VA; ³INOVA Heart and Vascular Institute, Falls Church, VA; ⁴Virginia Commonwealth University, Richmond, VA; ⁵Cleveland Clinic, Cleveland, OH

Invited Discussant: *Kevin W. Lobbell

Objectives: Extubation within 24 hours following cardiac surgery has become an important quality metric, driving early extubation, often during the night. Data from critical care studies has suggested overnight extubation leads to worse mortality with higher risk of reintubation due to fewer resources available at night. We hypothesized that cardiac surgery patients extubated overnight would be at increased risk for adverse outcomes.

Methods: Data from all patients undergoing coronary artery bypass grafting and/or cardiac valve operations (with an STS PROM) between 2008–2016 were evaluated from a multicenter, statewide Society of Thoracic Surgeons (STS) database. Patients were stratified by initial extubation during the day (6 am–6 pm), evening (6 pm–12 am) or overnight (12 am–6 am). Patients were excluded if intubated >72 hours or extubated in the operating room. Primary outcomes included reintubation, morbidity, mortality, and duration of intubation. Multivariable regression models analyzed the impact of extubation times, adjusting for baseline STS predictive risk scores.

Results: A total of 41,993 patients were included, with 20,825 (49.6%) extubated during the day, 14,964 (35.6%) in evening, and 6,204 (14.8%) overnight. Expectedly, the groups exhibited differing mean duration of mechanical ventilation (10.8 hrs vs. 6.9 hrs vs. 11.0 hrs, $p < .0001$), with patients extubated overnight having the longest ventilation time. Furthermore, overnight patients demonstrated the highest STS PROM (2.42% vs. 2.15% vs. 2.86%, $p < .0001$). The day, evening, and night groups had incrementally different rates of reintubation, (4.40% vs. 3.34% vs. 3.98%, $p < .0001$), operative mortality (2.23% vs. 1.82% vs. 2.26%, $p = 0.015$) and composite morbidity and mortality (15.87% vs. 8.70% vs. 12.11%, $p < .0001$).

Importantly, after risk adjustment, neither evening nor night extubation was associated with operative mortality or reintubation (Table 1). However, evening and night extubation were both associated with decreased composite morbidity and mortality as well as decreased rate of prolonged mechanical ventilation (>24 H). To exclude confounding patients intubated >24H, a secondary analysis in patients extubated within 24 hours postoperatively demonstrated that overnight extubation was still associated with less reintubation (OR 0.67, $p < .0001$), operative mortality (OR 0.65, $p < .0001$), and composite morbidity and mortality (OR 0.66, $p < .0001$).





Table 1: Risk- Adjusted Odds Ratios for Evening and Night Extubation Compared to Daytime Extubation

Outcome	Evening (6 pm–12 am)			Night (12 am–6 am)		
	Risk-Adjusted Odds Ratio	95% Confidence Interval	p Value	Risk-Adjusted Odds Ratio	95% Confidence Interval	p Value
Need for Reintubation ¹	0.81	0.72–0.91	<0.01	0.86	0.74–0.99	0.04
Operative Mortality ²	0.88	0.75–1.03	0.11	0.93	0.77–1.14	0.50
Composite morbidity-mortality ³	0.52	0.49–0.56	<0.01	0.65	0.59–0.71	<0.01
Prolonged Mechanical Ventilation (>24H) ¹	0.38	0.35–0.42	<0.01	0.37	0.33–0.42	<0.01

1. Risk-adjusted using STS Predicted Prolonged Ventilation

2. Risk-adjusted using STS Predicted Risk of Mortality

3. Risk-adjusted using STS Predicted Risk of Composite Morbidity or Mortality (Composite of mortality, stroke, surgical re-exploration, deep sternal wound infection, postoperative renal failure, prolonged intubation)

Conclusions: Patients extubated overnight tended to be sicker at baseline with higher STS risk and longer ventilator times compared to those extubated in the day. Contrary to our hypothesis, overnight extubation was not associated with higher risk of reintubation or worse morbidity/ mortality. These results suggest that, in the appropriate clinical setting, it is safe to extubate cardiac surgery patients overnight.

MONDAY, APRIL 30

75. Advances in Management of Post Cardiotomy Open Chest: Use of Negative Pressure Dressing in 588 Adults

*Gosta B. Pettersson, *Faisal G. Bakaeen, Osama Haddad, Mudathir Ibrahim, Salviar Mok, *Douglas R. Johnston, *Edward G. Soltesz, *Nicholas G. Smedira, *Kenneth R. McCurry, Stephanie L. Mick, *Jose L. Navia, Per Wierup, Michael Z. Tong, Penny Houghtaling, *Eric E. Roselli, *A Marc Gillinov, *Eugene H. Blackstone, *Lars G. Svensson

Cleveland Clinic, Cleveland, OH

Invited Discussant:

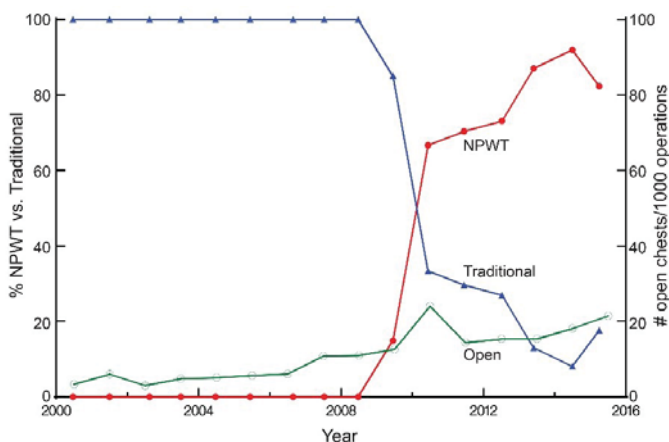
Objective: Little is known about use of negative pressure wound therapy (NPWT) in the management of postcardiotomy open chest.

Methods: A single center review of all postcardiotomy open chests from 2000–2015. Trend in using a commercially available NPWT system over time relative to “traditional” (T) open chest was evaluated. Primary efficacy outcomes were hospital mortality, mediastinitis, and sepsis; safety endpoints were cardiovascular injury and hemodynamic intolerance. Other outcome measures included time to definitive sternal closure, bleeding, and blood transfusions. Comparisons were made using chi-squared and Wilcoxon rank sum (non-parametric) tests as appropriate.

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Results: Occurrence of open chests was 1.07% (n = 588) and increased over time. A few months after introducing NPWT (first case March, 2009), it became the management of choice for open chests (Figure). NPWT and T patients had few differences in preoperative risk profiles. Primary operations accounted for 43% (119 of 279) of NPWT cases and 47% (146 of 309) of T cases; reoperations (up to 9th sternotomy) accounted for the remaining cases (p = 0.6). Cardiopulmonary bypass and myocardial ischemia times were longer in NPWT patients, but use of mechanical cardiac support and ECMO was similar. Number of dressing changes required before definitive closure was similar between groups, but emergency bedside re-explorations, including re-explorations for bleeding, were more common in the T group. More platelets, and fresh frozen plasma were administered in the T group. Median duration of open chest to definitive sternal closure was 3.3 days for NPWT patients vs. 2.6 days for T patients (p < .0001). Ten (3.2%) cases were converted from T to NPWT and 10 (3.6%) from NPWT to T because of hemodynamic intolerance. There were no NPWT-related cardiovascular injuries. NPWT was associated with lower in-hospital mortality (39% vs. 51%, p = 0.006) and less mediastinitis (1.4% vs. 5.2%, p = 0.012) and sepsis (12% vs. 24%, p = 0.0002).



Conclusions: NPWT was rapidly adopted to manage open chests, and this study supports its safety and efficacy. By facilitating open chest management and potentially improving outcomes, it emerged as the therapy of choice and may have lowered the threshold for open chest management after cardiac surgery.



76. Prevalence and Burden of Opioid-Induced Respiratory Depression and Postoperative Nausea/Vomiting Associated with Acute Postoperative Pain Treatment After Cardiothoracic/Vascular Surgery

Gary M. Oderda¹, Anthony J. Senagore², Kellie Morland³, Sheikh Usman Iqbal⁴, Marla Kugel³, Sizhu Liu³, Nestor Villamizar⁵, Ashraf S. Habib⁶

¹University of Utah, Salt Lake City, UT; ²University of Texas, Galveston, TX; ³Xcenda LLC, Palm Harbor, FL; ⁴Trevena, Inc., Chesterbrook, PA; ⁵University of Miami, Miami, FL;

⁶Duke University, Durham, NC

Invited Discussant: ♦Daniel T. Engelman

Objective: Parenteral opioids are highly effective analgesics commonly used to manage moderate to severe pain after surgery, but the therapeutic window of these agents is often limited by adverse events (AEs). Of these AEs, opioid-induced respiratory depression (OIRD) and postoperative nausea and vomiting (PONV) can be the most challenging to manage. However, comprehensive evaluation of patient characteristics, treatment patterns of acute pain management, and the prevalence and burden of OIRD and PONV in major surgical specialties is lacking. The objective of this study was to examine these aspects in patients undergoing cardiothoracic (CT)/vascular (VASC) surgical procedures with high rates of postoperative opioid use.

Methods: In a retrospective inception cohort study, the Premier Perspective® database was used to identify hospital stays (July 2015–June 2016) for patients >18 years old who had undergone ≥1 CT/VASC surgical procedure and received ≥1 dose of parenteral morphine, hydromorphone, or fentanyl for acute postoperative pain (APP). For CT/VASC stays overall, patient characteristics and treatment patterns were compared between subgroups with and without OIRD or PONV using *t*, Mann-Whitney U, and chi-square tests; length of stay (LOS) and costs were compared using Poisson and generalized linear regression models. As a case representation, patients in the CT/VASC group who had undergone coronary artery bypass grafting (CABG) were also assessed.

Results: During stays for CT/VASC procedures, rates of OIRD and PONV were 17% and 53%, respectively. Increased odds of OIRD were associated with obesity (odds ratio [OR], 1.1), respiratory disease (1.4), sleep apnea (1.3), older age (>85 years, 1.3), average total daily morphine milligram equivalence ([MME] (45–≤90 mg, 1.7), and sedative use (Day >1, 1.8) (*P* < 0.05, all). Increased odds of PONV were associated with younger age (19–24 y: OR, 2.7), female gender (1.6), major disease severity (3.4), and MME (45–≤90 mg, 1.3) (*P* < 0.05). When OIRD was present vs. absent, mean total LOS was longer (12.7 vs. 5.6 days; *P* < 0.0001) and total hospital costs were higher (\$46,951 vs. \$23,108). When PONV was present, significant differences were also observed in LOS (9.2 vs. 4.1; *P* < 0.0001) and costs (\$33,984 vs. \$19,825). During stays for CABG, rates of OIRD and PONV were 25% and 92%, respectively. Similarities and differences were observed between CABG and overall CT/VASC groups in comorbidities, treatment patterns, and LOS/costs (Table).

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Table: Summary of Patient Characteristics, Treatment Patterns, Opioid-Related AEs, and Utilization/Cost Burden During Inpatient Stays for CT/VASc and CABG Procedures

	Overall CT/VASc Procedures (N = 173,312)	CABG Procedures (n = 30,866)
Patient Demographic Characteristics		
Age, y (SD)	65.1 (13.2)	65.8 (10.3)
Female, % (no.)	38 (65,843)	27 (8,280)
Patient Clinical Characteristics		
Obesity, % (no.)	13 (22,864)	20 (6,239)
Renal failure, % (no.)	14 (24,846)	21 (6,595)
Respiratory disorder, % (no.)	21 (35,479)	21 (6,398)
Sleep apnea, % (no.)	7 (12,325)	10 (3,076)
Treatment Pattern		
Total daily MME, mg (SD)	26.8 (218.5)	32.3 (51.0)
Combination therapy*, % (no.)	53 (92,229)	78 (24,122)
Parenteral Opioid, % Days[†] (SD)		
Morphine	24 (0.4)	22 (0.2)
Hydromorphone	11 (0.3)	9 (0.2)
Fentanyl	35 (0.3)	21 (0.2)
Non-opioid prescription analgesic, % (no.)	92 (158,853)	99 (30,499)
NSAIDs	13 (22,367)	30 (9,109)
Acetaminophen	48 (83,258)	71 (21,818)
Calcium channel blocker	14 (23,635)	12 (3,577)
Local anesthetic	80 (139,108)	90 (27,711)
NMDA receptor antagonist	3 (4,864)	5 (1,634)
α ₂ adrenergic receptor agonist	17 (28,924)	44 (13,526)
Sedative, % (no.)	56 (96,748)	62 (19,121)
Naloxone, % (no.)	2 (2,677)	2 (469)
Antiemetic, % (no.)	69 (118,986)	85 (26,228)
Opioid-Related AEs		
OIRD [‡] , % (no.)	17 (28,799)	25 (7,761)
PONV [§] , % (no.)	53 (91,248)	92 (24,069)
Utilization/Cost Burden		
LOS, no. of days (SD)	6.8 (7.9)	10.1 (7.4)
Readmission, <30 days, % (no.)	11 (17,896)	9 (2,774)
Total costs, US\$ (SD)	27,280 (33,028)	44,837 (36,324)

Mean values are presented, unless otherwise specified. *≥2 parenteral opioids; †days of inpatient therapy; ‡defined by diagnosis code for respiratory depression or ≥1 naloxone dose received during inpatient stay; §defined by diagnosis code for nausea or vomiting or antiemetic use after Day 1 of inpatient stay in CT/VASc group; defined by antiemetic use after Day 1 of inpatient stay in CABG subgroup. AEs, adverse events; CABG, coronary artery bypass grafting; CT/VASc, cardiothoracic/vascular; LOS, length of stay; MME, morphine milligram equivalence (for all parenteral opioids); NSAIDs, nonsteroidal anti-inflammatory drugs; NMDA, N-methyl-D-aspartate; OIRD, opioid-induced respiratory depression; PONV, postoperative nausea and vomiting.

Conclusions: Among patients undergoing CT/VASc procedures, including CABG, OIRD and PONV were more prevalent than previously reported in inpatient settings and associated with substantial clinical and economic burden. Preoperative patient risk assessment and therapeutic options for APP with better tolerability profiles may reduce the clinical and cost burden of these opioid-related AEs. (Sponsored by Trevena Inc.)

Late-Breaking Clinical Trial

LB4. Postoperative Atrial Fibrillation Is Reduced by Transcutaneous Electrical Stimulation of the Auricular Vagal Nerve

Martin Andreas, Philipp Arzl, Andreas Mitterbauer, Alfred Kocher, Guenther Laufer, Michael Wolzt

Medical University of Vienna, Vienna, Austria

Invited Discussant: Kaushik Mandal

Late-Breaking Clinical Trial

LB5. Fresh Frozen Plasma Is More Expensive and Carries Greater Risk Than Human Antithrombin Concentrate in Treating Heparin Resistance for Cardiac Surgery

Abigail Whateley Driscoll, Michelle Taylor

Apri Health, Rochester, MN

Invited Discussant: *Robert S. Kramer

5:30 pm Adjourn

5:35 pm – Executive Session, AATS Members Only
6:15 pm

Ballroom 20A, SDCC

MONDAY, APRIL 30

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TUESDAY MORNING, MAY 1, 2018

7:00 am

Cardiac Surgery Forum

Room 28DE, SDCC

5 minute presentation, 5 minute discussion

Moderators: *Todd K. Rosengart and *Tomasz A. Timek

F1. Patient Specific iPSC Disease Model Identified Dysfunction of Vascular Smooth Muscle Cells As a Cause of Loeys-Dietz Syndrome

Kui Hu^{1,2}, Yun Wan², Jinmiao Chen¹, Jun Li¹, *Chunsheng Wang¹

¹Zhongshan Hospital of Fudan University, Shanghai, China; ²People's Hospital of Guizhou Province, Guiyang, China

Invited Discussant: *Y. Joseph Woo

Objective: To develop a patient specific induced pluripotent stem cells (iPSCs) disease model of Loeys-Dietz syndrome (LDS) and to identify how *TGFBR* mutation result in dysfunction of vascular smooth muscle cell (VSMC) and implicated in LDS vascular pathogenic course.

Methods: Peripheral blood mononuclear cells (PBMCs) were isolated from three LDS patients carrying *TGFBR2*^{R193W}, *TGFBR1*^{R487W} and *TGFBR1*^{R487Q} mutations and one healthy volunteer. PBMCs were reprogrammed into induced pluripotent stem cells (iPSCs) by electroporation with episomal plasmids. The generated iPSCs were induced into contractile VSMC. Patient specific iPSC derived VSMC were then used to study how *TGFBR* mutation result in structural and functional abnormalities of the derived VSMC and cause LDS vascular pathogenic course.

Results: The generated iPSCs retained the same mutation with PBMCs, presented normal karyotype, expressed pluripotent markers and differentiated into tree germ layers *in vivo*. iPSCs were induced into VSMC. Immunofluorescence staining, Q-PCR and western-blot analysis showed that iPSC-derived-VSMC highly expressed specific markers including α -SMA, CNN1 and SM22 α . The expression of those specific markers were decreased in LDS-iPSC-VSMC compared with control both on gene and protein levels. Transmission electron microscope showed decreased and abnormal organized myoneme in LDS-iPSC-VSMC. Consistent with reduced expression of VSMC markers and abnormal organized myoneme, VSMC from LDS iPSC showed reduced contractility in response to carbachol stimulation. Furthermore, increased deposition of collagens was confirmed by Q-PCR and western-blot analysis. In addition, Flow cytometry measurement showed more cell apoptosis both in early and late state of culture in LDS-iPSC derived VSMC. Then we detect the activity of canonical TGF- β signaling under normal culture conditions and found defective activation of this pathway in the early stage of culture, but enhanced activation in the late stage. We also found a higher level of TGF- β 1 in LDS-iPSC-VSMC medium compared with control medium. Moreover, we examined the activation of non-canonical TGF- β signaling, and western-blot showed that phosphorylation of p38 was persistently enhanced in early and late culture stages while ERK1/2 was decreased in LDS cells compared with control.

Conclusions: Mutations in *TGFBR* result in abnormal activation of TGF- β signaling pathway and cause structural and functional abnormalities of VSMC which could be a cause of LDS. This *in vitro* cellular model of LDS may provide a promising platform to investigate disease mechanisms and explore new therapeutic targets.

F2. Fibrosis and Disruption of Trilayered Structure Are Evident in Mitral Valve Leaflets Explanted from Swine That Underwent Undersizing Mitral Annuloplasty for Repair of Ischemic Mitral Regurgitation

Alicja Sielicka, [Muralidhar Padala](#)

Emory University, Atlanta, GA

Invited Discussant: Spencer Melby

Objective: Frequent recurrence of regurgitation after undersizing mitral annuloplasty (UMA) for ischemic mitral regurgitation (IMR), is often blamed on continued left ventricular remodeling despite the repair. The randomized CTSNet trial negates this mechanism, as patients with good repair had reverse ventricular remodeling. We hypothesized that failure of UMA may occur due to gradual fibrosis and stiffening of the mitral leaflets, from the unphysiological tethering imposed on the mitral leaflets by the annuloplasty ring (Figure 1A).

Methods: Twelve ($n = 12$) swine were induced with a myocardial infarction by percutaneous occlusion of the left circumflex artery, and allowed 2 months to develop moderate IMR. After confirming IMR, seven swine ($n = 7$) underwent undersizing mitral annuloplasty and five swine ($n = 5$) did not undergo any repair. Animals that survived the surgery were followed to 2.5–3 months post repair and terminated. Echocardiography was performed before and after the repair to confirm anterior leaflet hyperextension and posterior leaflet immobility after UMA. After termination, leaflets from both groups of swine were explanted and molecular assays and immunohistochemistry was performed. Histopathology was performed to assess the morphology of the leaflets, and pro-collagen biosynthesis was measured with immunoblotting of the leaflets.

Results: Anterior leaflet hyperextension and posterior leaflet immobility were prominent after UMA, but not in the sham group. Hematoxylin and eosin staining depicted significant thickening of the anterior and posterior leaflets in the UMA group, compared to the sham (Figure 1B). Masson's trichrome staining depicted loss of the trilayered structure of the mitral leaflets from the UMA group, but not from the sham (Figure 1C). Normalized procollagen I C-end levels were elevated in the anterior (1.7 ± 0.2 times the sham, $p < 0.05$) and posterior mitral leaflets (1.4 ± 0.2 times the sham, $p < 0.05$). Pro-collagen I N-end were elevated in the anterior leaflet by 1.3 ± 0.3 times the sham ($p < 0.05$), but not in the posterior leaflet.

TUESDAY, MAY 1

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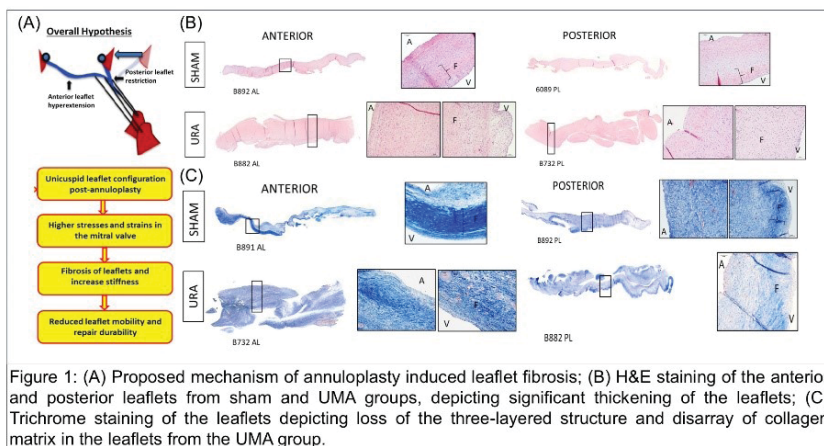


Figure 1: (A) Proposed mechanism of annuloplasty induced leaflet fibrosis; (B) H&E staining of the anterior and posterior leaflets from sham and UMA groups, depicting significant thickening of the leaflets; (C) Trichrome staining of the leaflets depicting loss of the three-layered structure and disarray of collagen matrix in the leaflets from the UMA group.

Conclusion: Data from these experiments indicates significant thickening and fibrosis of the mitral valve leaflets after undersizing mitral annuloplasty, compared to the sham group of animals. Since thicker and fibrotic leaflets cannot deform sufficiently in systole, poor leaflet coaptation and recurrence of mitral regurgitation are possible, indicating a biological mechanisms for failure of annuloplasty.

F3. Injectable Supraphysiologic PEG Hydrogels Reduce Infarct Strain and Improve Remote Myocardial Function Following Ischemic Injury

Ravi K. Ghanta¹, Yunge Zhao², Aarthi Pugazenthi¹, Lauren N. Russell², Kyle J. Lampe²

¹Baylor College of Medicine, Houston, TX; ²University of Virginia, Charlottesville, VA

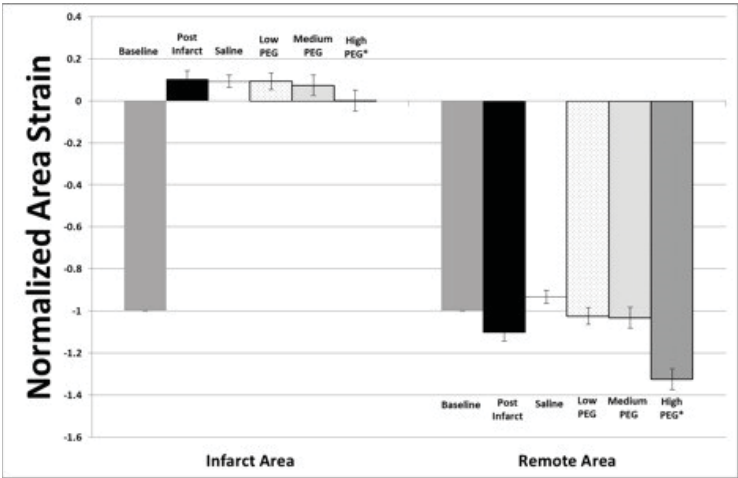
Invited Discussant: *Takashi Nitta

Objective: Injectable acellular biomaterials may limit adverse ventricular remodeling by thickening or stiffening the infarct region. The relationship of biomaterial mechanical properties on regional ventricular mechanics remains undefined. Consequently, rational biomaterial mechanical design criteria have not been determined. In this study, we hypothesized that a supraphysiologic stiffness material would reduce infarct strain and improve remote ventricular function in an acute and chronic rat infarction model.

Methods: Injectable methacrylated poly (ethylene glycol) (PEG) hydrogels were fabricated using reduction/oxidation polymerization at 3 different mechanical stiffnesses as determined by storage moduli: 4.9 ± 0.3 kPa (Low stiffness; similar to most prior injectable materials), 24.6 ± 1.0 kPa (Normal stiffness; similar to normal rat myocardium), and 249 ± 74 kPa (Supraphysiologic stiffness). All PEG conditions gelled within three minutes of initiation. We evaluated the mechanical effects of intramyocardial injection of the 3 PEG mechanical doses or saline control into the anterior LV wall after LAD ligation in a rat model (n = 20 total; 5 per group). Regional mechanics, LV volume, and

cardiac output were measured using sonomicrometry at baseline, 30 minutes after LAD ligation, and 30 minutes after PEG injection. We then utilized Cardiac MRI and DENSE imaging to measure chronic regional strain 1 week post injection of saline or supra-physiologic stiffness PEG. (n = 4; 2 per group).

Results: Following infarction, all subjects demonstrated increased LV EDP, decreased cardiac output, and rightward shift of the end-systolic pressure-volume relationship (ESPVR). Infarct areas demonstrated passive stretch instead of contraction during systole. PEG hydrogel injection reduced infarct strain and increased remote myocardial strain dependent on the mechanical dose administered. The figure below demonstrates change in infarct area and remote area strain (*p < 0.05 for change from post-infarct). Only supraphysiologic PEG reduced infarct area stretch ($+0.15 \pm 0.01$ control vs. 0.00 ± 0.001 PEG; p < 0.05) and improved remote area strain (-0.93 ± 0.02 control vs. -1.31 ± 0.01 PEG; p < 0.05). Furthermore high stiffness PEG gel shifted the ESPVR leftward, indicating improved pump function. After 1 week, high stiffness PEG sustained prevention of infarct stretch ($+0.10 \pm 0.02$ control vs. 0.00 ± 0.01 PEG; p < 0.05) and improvement in remote myocardial function (-0.12 ± 0.01 vs. 0.20 ± 0.02 ; p < 0.05).



Conclusions: Low stiffness injectable biomaterials do not affect post-infarct regional mechanics. High supra-physiologic stiff materials eliminate infarct strain and improve remote myocardial mechanics. Injectable biomaterials with mechanical properties that exceed the stiffness of native myocardium may maximize efficacy of therapy.

TUESDAY, MAY 1

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F4. Left Ventricular Dysfunction After Two Hours of Polarizing or Depolarizing Cardioplegic Arrest in a Porcine Model of Cardiopulmonary Bypass

Terje Aass¹, Lodve Stangeland², Christian Arvei Moen¹, Atle Solholm¹, Geir Olav Dahle², David J. Chambers³, Malte Urban¹, Knut Nesheim¹, *Rune Haaverstad¹, Knut Matre², Ketil Grong²

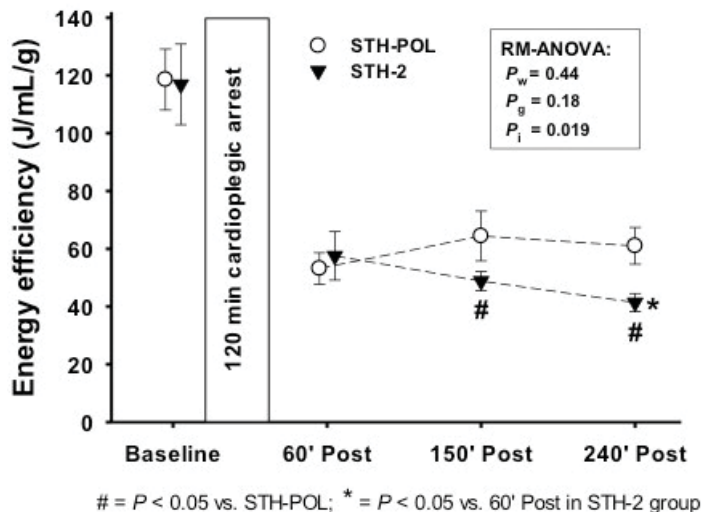
¹Haukeland University Hospital, Bergen, Norway; ²University of Bergen, Bergen, Norway; ³St Thomas' Hospital, London, United Kingdom

Invited Discussant: *Jennifer S. Lawton

Objective: Depolarizing potassium-based cardioplegic solutions have been used worldwide for decades. The alternative, polarizing arrest, has demonstrated several potential advantages both in clinical and experimental studies. However, the use of non-depolarized cardioplegia is not an established clinical routine. This study evaluates myocardial function after prolonged cardioplegic arrest with the novel St. Thomas' Hospital polarizing cardioplegia (STH-POL) containing esmolol, adenosine and Mg²⁺, and the standard potassium-based St. Thomas' Hospital No 2 cardioplegia (STH-2), both administered as cold, repeated, oxygenated blood solutions.

Methods: Twenty anaesthetized pigs on tepid cardiopulmonary bypass (CPB) were randomized to cardiac arrest for 120 min with antegrade freshly mixed, repeated, cold, oxygenated STH-POL or STH-2 blood cardioplegia every 20 min. Cardiac function was evaluated at Baseline and 60, 150 and 240 min after weaning from CPB using pressure-conductance catheter and epicardial echocardiography with Tissue Doppler Imaging. Regional tissue blood flow, cleaved caspase-3 activity and levels of malondialdehyde were evaluated in myocardial tissue samples.

Results: Preload recruitable stroke work (PRSW) was increased in the STH-POL compared to the STH-2 group 150 min after declamping (73.0 ± 3.2 vs. 64.3 ± 2.4 mmHg, $P = 0.047$), with no difference between groups after 240 min. Left ventricular Cardiac Index and other functional and hemodynamic variables did not differ. Compared to Baseline myocardial tissue blood flow rates (0.89 ± 0.06 and 0.92 ± 0.04 mL/min/g for STH-POL and STH-2 groups), the corresponding blood flow rate was high (1.54 ± 0.20 and 1.38 ± 0.13 mL/min/g) in both groups 60 min after declamping. In the STH-POL group, blood flow rate decreased significantly to 1.11 ± 0.13 mL/min/g at 150 min after declamping ($P < 0.005$). At 240 min myocardial blood flow rate was significantly reduced in the STH-POL compared to the STH-2 group; 1.11 ± 0.11 vs. 1.41 ± 0.16 mL/min/g ($P < 0.05$). Energy efficiency, the sum of potential and mechanical energy yield per ml of perfusion, gradually decreased in the STH-2 group only, and was significantly lower than in the STH-POL group after 150 and 240 min (Figure). At declamping, defibrillation was needed in 2 out of 10 animals in the STH-POL vs. 8 out of 10 in the STH-2 group ($P = 0.025$). Neither troponin-T release, tissue levels of malondialdehyde nor myocardial cleaved caspase-3 activity differed between groups.



Conclusions: Two hours of cardioplegic arrest with STH-POL in oxygenated blood alleviates mismatch between myocardial perfusion and function after weaning from CPB compared to STH-2 blood cardioplegia.

F5. Cardiac Bioengineering with Human Induced Pluripotent Stem Cells Using Genome Editing and a Visual Evaluation System

Junya Aoyama¹, Kohei Homma², Sumiko Usui¹, Yasuo Miyagi¹, Nari Tanabe³, Takahiro Natori³, Makoto Kaneda¹, *Takashi Nitta¹

¹Nippon Medical School, Tokyo, Japan; ²Keio University, Tokyo, Japan; ³Tokyo University of Science, Suwa, Nagano, Japan

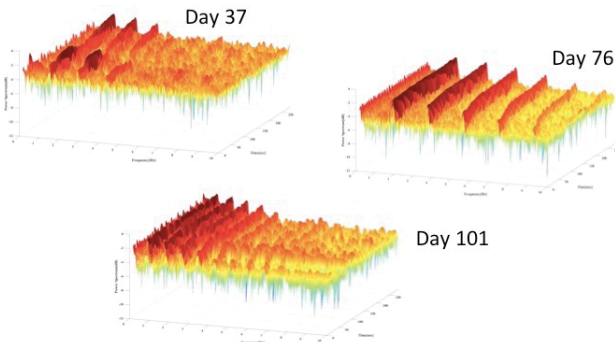
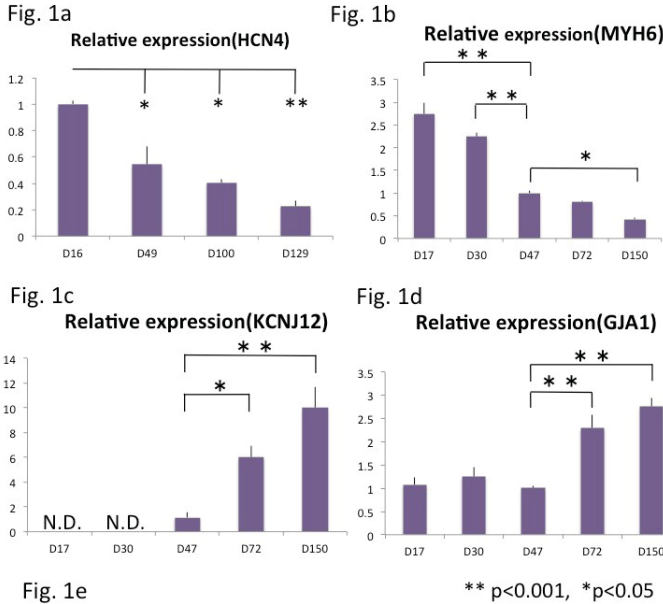
Invited Discussant: *Robert E. Michler

Objectives: Several studies have shown human induced pluripotent stem cells (hiPSCs) to be a valuable tool for regenerative therapy. Recently, highly efficient methods for the generation of cardiomyocytes from hiPSCs have been reported. However, it has also been reported that the differentiated cardiomyocytes give rise to not only ordinary cardiac muscle but also the conduction system. Thus it suggested that the differentiated cardiomyocytes on early stage were too immature for clinical applications. Moreover, there is not clear how long it takes to differentiate as mature cardiomyocyte. Therefore, in this study, we elucidated the timing of gene expression and evaluated the contractile function on each differentiation days.

TUESDAY, MAY 1

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Methods: In this study, knock-in cell lines were generated using clustered regularly interspaced short palindromic repeats (CRISPR), CRISPR-associated proteins 9 (Cas9) genetic editing technique, and electroporation. We successfully labeled HCN4 (pace-maker cell maker) and α MHC (cardio myocyte maker)-positive cells with the yellow/green fluorescent protein (YFP/GFP). The beating differentiated embryoid bodies (EBs) were analyzed using flowcytometry and quantitative reverse transcription-polymerase chain reaction (qRT-PCR) at several differentiation stages. For analyzing the beating function, images of the fluorescent-activated beating EBs were binarized in each differentiation days. Then, the association between gene expression levels and the beating function was evaluated.



Results: Each differentiated EBs expressed fluorescence protein and repeated a beat. Results of qRT-PCR analysis for the YFP-positive cells (derived from *HCN4* knock-in cell line) revealed that the expression of *HCN4* significantly decreased over time (Figure 1a,

$p < 0.001$). Furthermore, we analyzed the expression of *Tbx3*, *Tbx18*, and *Nkx2.5*, associated with pacemaker development and the relative expression changed significantly with time. Results of analysis for the GFP-positive cells (α MHC-GFP cell line) revealed that significant decrease in the expression of *MYH6* (encoding a myocardial myosin heavy chain, Figure 1b, $p < 0.001$) and calcium ion channel (*CACNA1D*, *CACND1C*) genes was observed. In contrast, significant increase after day 47 from differentiation started in the expression of potassium ion channel (*KCNJ12*, *KCND3*) genes (Figure 1c, $p < 0.001$) and *GJA1*, which regulates the development of gap junctions, was also observed (Figure 1d, $p < 0.001$). To analyze the beating function, we compared the frequency of EBs beat and changes in the power spectrum across different differentiation days. As differentiation progressed, the beating frequency and variation decreased (Figure 1e).

Conclusions: The differentiated cardiomyocyte from hiPSCs in less than 50 days were immature for clinical applications. These results yield valuable insights in the field of cardiac bioengineering.

F6. Effects of Central Pulmonary Artery Banding in Doxorubicin-Induced Toxic Left Ventricular Cardiomyopathy: An Experimental Ovine Model

Can Yerebakan¹, Johannes Boltze², Uygur Yörüker³, Hatem Elmontaser³, Heiner Latus³, Markus Khalil³, Stefan Ostermayer⁴, Gunter Kerst⁴, Blanka Steinbrenner³, Christa Tandl⁵, Matthias Schneider⁶, Dietmar Schranz³, Hakan Akinturk³

¹Children's National Heart Institute, Washington, DC; ²Fraunhofer Research Institution for Marine Biotechnology, Lubeck, Germany; ³Pediatric Heart Center Giessen, Giessen, Germany; ⁴University of Aachen, Aachen, Germany; ⁵J.W. Goethe University Frankfurt, Frankfurt, Germany; ⁶Veterinary Medicine Clinic for Small Animals, Giessen, Germany

Invited Discussant: Ram Kumar Subramanyan

Objective: Central pulmonary banding (cPAB) has been proposed as a novel alternative for the treatment left ventricular dilated cardiomyopathy in children. We sought to investigate the effects of cPAB in an experimental model of left ventricular dilated cardiomyopathy.

Methods: Four-month-old twenty-eight sheep were subjected to intermittent intracoronary injections of doxorubicin (0.75 mg/kg/dose) into the left main coronary artery every two to three weeks. A total mean dose 2.15 mg/kg of doxorubicin was applied until serial echocardiographic investigations revealed signs of left ventricular dilation and functional impairment. Surviving animals were treated either with surgical cPAB via left anterior thoracotomy or sham surgery. Transthoracic echocardiography and pressure-volume loop measurements were utilized to compare left ventricular function preoperatively (baseline = 100% for echocardiographic measurements) and after 3 months. Macroscopic and microscopic histological examinations were performed after study termination and heart harvesting.

Results: Nine animals from the cPAB group and eight animals from the sham group with similar weights survived and were included in the analysis. Both groups showed similar inflammation and fibrosis in the histological examination, being consistent with toxic myocardial effects of doxorubicin. There were no differences in the echocardiographic measurements before cPAB or sham operation. At 3 months, cPAB group had better left

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ventricular ejection fraction ($102.5 \pm 21.6\%$ vs. $76.7 \pm 11.7\%$, $p = 0.012$) with smaller left ventricular end-diastolic ($101.2 \pm 7.4\%$ vs. $107.9 \pm 10.8\%$, $p = 0.2612$) and end-systolic ($100.3 \pm 12.9\%$ vs. $116.5 \pm 9.6\%$, $p = 0.0326$) diameter of the left ventricle in comparison to the sham animals. The end-systolic volume ($101.4 \pm 31.6\%$ vs. $143.4 \pm 28.6\%$, $p = 0.0326$) and the end-diastolic volume ($80.1 \pm 13.9\%$ vs. $120.4 \pm 29.5\%$, $p = 0.0038$) were again significantly lower in the cPAB group 3 months postoperatively. Fractional shortening in the long ($118.5 \pm 21.5\%$ vs. $85.2 \pm 22.8\%$, $p = 0.0127$) and in the short axis ($122.5 \pm 18\%$ vs. $80.9 \pm 13.6\%$, $p = 0.0027$) revealed significantly higher values in the cPAB group. In the conductance catheter measurements end systolic and enddiastolic pressures were lower in the cPAB group as compared to the sham animals; however no significance level was reached.

Conclusions: This is the first study reporting that central pulmonary artery banding may improve left ventricular function and dimensions in the setting of an experimental left ventricular dilated cardiomyopathy. Potential further clinical applications of this technique for left ventricular dilated cardiomyopathy of different etiologies may be possible.

F7. Aberrant Biomechanical Properties and Stress Mapping Dissection Probability Models in Ascending Aortas of Patients Sustaining Acute Type A Aortic Dissection During Surveillance

Leonid Emerel¹, James Thunes¹, Spandan Maiti¹, Trevor Kickliter¹, Marie Billaud², Julie A. Phillippi², David A. Vorp¹, *Thomas G. Gleason¹

¹University of Pittsburgh, Pittsburgh, PA; ²McGowan Institute for Regenerative Medicine, Pittsburgh, PA

Invited Discussant: *Scott A. LeMaire

Objective: Our objective was to quantify aortic wall biomechanical properties in patients sustaining acute type A aortic dissection (TAAD) during imaging surveillance and to utilize these parameters to construct a model capable of forecasting overall and region-specific dissection potentials from pre-dissection computed tomography angiography (CTA) scans.

Methods: All patients undergoing surgical repair of TAAD within a single institution were reviewed retrospectively over the course of 2007–2016 ($n = 351$) and selected for a subset who had 2 or more pre-dissection event CTAs and echocardiograms ($n = 9$). Ascending aortic wall biomechanical properties (cardiac cycle aortic wall motion, distensibility, and stiffness) were quantified and compared to age-matched non-dissected control patients using transthoracic echocardiography. Pre-operative CTAs were computationally reconstructed and simulated using assessed wall biomechanical properties to obtain stress maps under aortic pressurization. Dissection potentials were generated for each patient by contrasting local wall stress to wall strength, and compared to the actual clinical dissection origins as determined at the time of surgery. Data is expressed as the mean \pm SEM.

Results: Mean age of the TAAD patient subset was 61.7 ± 2.85 years, with 7:2 M:F ratio and a mean ascending aortic maximal orthogonal diameter of 48.6 ± 2.04 mm. Compared to non-dissected controls, ascending aortas of patients sustaining TAAD demonstrated decreased cardiac cycle aortic wall motion ($14.7 \pm 1.17\%$ vs. $8.3 \pm 1.04\%$; $p < 0.003$), decreased distensibility (4.3 ± 0.43 vs. $2.5 \pm 0.50 \times 10^{-6} \text{ cm}^2 \cdot \text{dyne}^{-1}$; $p < 0.024$), and increased stiffness index (3.8 ± 0.25 vs. 7.7 ± 1.11); $p < 0.006$) (Figure 1 A-C). Stress mapping of reconstructed pre-operative CTA models revealed close association between surgeon-identified dissection origins and regions of increased dissection potential (Figure 1D). Additionally, based on the models, patients who sustained TAAD displayed a greater overall dissection potential than non-dissected controls (0.56 ± 0.09 vs. 0.45 ± 0.06 ; $p < 0.006$).

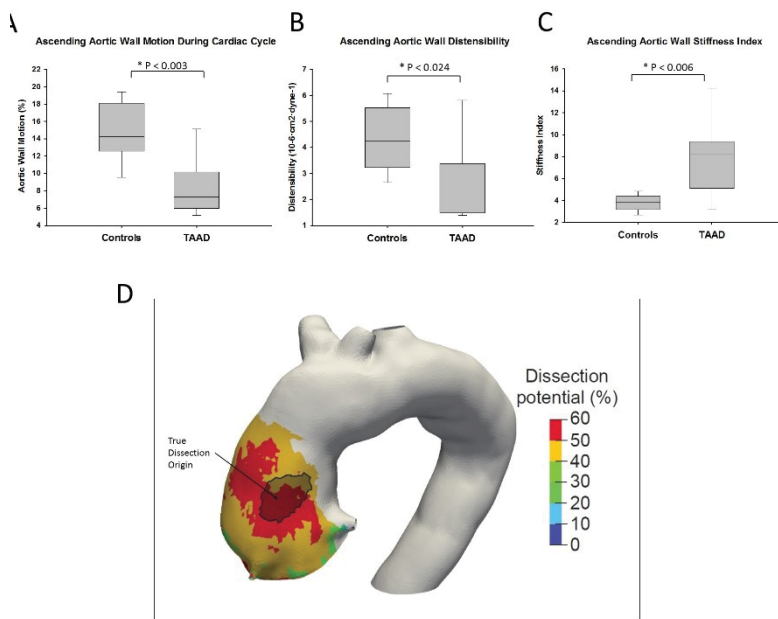


Figure 1. Cardiac cycle aortic motion, distensibility, and stiffness were quantified using transthoracic echocardiography. Dissection patients were found to have decreased aortic wall motion (A) and distensibility (B) and elevated stiffness (C). Box plots depict the median (middle line of the box), first quartile (lower line of the box) and third quartile (upper line of the box), with the whiskers representing 90th and 10th percentiles. * indicates p value comparing control vs TAAD patients as calculated using Mann-Whitney test. (D) Regions of elevated dissection potential (contours) correlated with the clinically noted location of dissection (outlined in black).

Conclusion: Our cohort of patients sustaining TAAD during clinical surveillance demonstrated abnormal aortic wall motion, distensibility, and stiffness, indicating a derangement in aortic wall load bearing properties that may pre-dispose to aortic dissection. These properties were able to be utilized as parameters to reveal increased dissection potentials using pressurization simulation models. Furthermore, these computational models correlated elevated dissection risk with true dissection origins with reasonable degree. Future investigations will include generation of patient-specific dissection potentials to risk stratify patients and help guide clinical care.

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F8. ASD Closure Device with Biodegradable Materials

Hirotsugu Kurobe¹, Tadahisa Sugiura², Hideki Miyachi², Mark W. Maxfield¹, Tetsuya Kitagawa¹, *Tohsihar Shinoka²

¹Tokushima University, Tokushima-Shi, Japan; ²Nationwide Cildrens Hospital, Columbus, OH

Invited Discussant: Richard W. Kim

Objective: Atrial septal defect (ASD) is one of the most common congenital heart diseases requiring surgical intervention. Over the past few years, a trans catheter ASD closure procedure has become more common. However, the procedure leaves behind a non-biodegradable device, typically nitinol, that remains in the heart for a lifetime without clear understanding of any possible long-term effect or risk. To help mitigate any such risk, we are developing a transcatheter atrial septal occluder system with biodegradable materials, which will bioresorb within a couple years after implanting. To assess the function and safety of biodegradable ASD closure devices.

Methods and Results: [Device] Biodegradable devices were made from both P (LA/CL) and PGA with a tiny nitinol spring in the central axis for accurate placement via X-ray fluoroscope. [*in vitro*] These biodegradable polymers undergo a hydrolytic degradation process with acidic byproducts, therefore changes of the *in vitro* pH scale and the mass loss of devices was monitored over 48 weeks. In results, the pH of PBS fell from 7.5 to 7.0 over the first 8 weeks and then remained until 48 weeks; the mass loss of the device was reduced to 50% of original at 48 weeks. [*in vivo*] Firstly, device evaluation experiments with right atrium were attempted in eight lambs with the biodegradable ASD closure devices. We made defects 3–5 cm in diameter on the right atrium as the surgical model, and implanted our devices for closing its hole. The placement was confirmed via X-ray and there were no acute deaths due to bleeding. Animals were sacrificed at 2, 4, 8 and 12 months, and both degrading implanted device and replacing by self-reorganization of implanted devices was confirmed by tissue analysis. Secondly, we made ASD models surgically under cardiopulmonary bypass in four lambs. After making ASD, our biodegradable devices were implanted as ASD occluder. There were no deaths in acute and chronic phase after surgery. Implanted lambs were sacrificed at 2, 4, 8 and 12 months after surgery. After 2 months following implantation, cells had migrated into implanted ASD devices and formed new tissue. After 12 months the P (LA/CL) and PGA almost disappeared fully and was replaced by native host tissue. There was no infarction of brain and lung by histological analysis. In addition, sequential evaluation by ultrasound through 12 months revealed no residual shunt of ASD, confirming proof of technology and device efficacy.

Conclusions: Large animal experiments with biodegradable ASD closure devices showed its safety and host tissue regeneration. There are few experimental reports using biodegradable ASD closure devices. For the patients' long-term benefit, it is better to restore native tissues after implanting. Our preliminary studies may appear promising and support testing the biodegradable ASD device in clinical in near future.

8:30 am Adjourn



7:00 am

General Thoracic Surgery Forum

Room 23BC, SDCC

5 minute presentation, 5 minute discussion

Moderators: *Prasad Adusumilli and *Sai Yendamuri

F9. RNA-Based Induction of p53 Activity in Malignant Pleural Mesothelioma

Anand Singh¹, Nisan Bhattacharyya¹, Abhishek Srivastava², R. Taylor Ripley¹,

*David S. Schrupp¹, Chuong D. Hoang¹

¹National Institutes of Health, Bethesda, MD; ²University of Pittsburgh, Pittsburgh, PA

Invited Discussant: *Marc de Perrot

Objective: Tumor suppressor p53 activation is an appealing treatment strategy in malignant pleural mesothelioma (MPM) because the gene is rarely mutated, but its activity is bypassed via frequent inactivation of p14ARF through promoter hypermethylation or deletion of the CDKN2A locus. We hypothesized that a novel microRNA (miR)-based approach may be therapeutically effective in MPM.

Methods: Prognostic miRs were identified by Kaplan-Meier analysis among 87 MPM public database specimens based on miR dichotomized (low or high) relative expression. In total, 41 MPM and 15 unmatched non-malignant pleura tissues were analyzed by q-PCR to validate miR public results. For functional assays of proliferation, foci formation, and apoptosis activity etc., several p53 wild-type MPM cell lines were used. MeT-5A and LP9 mesothelial cells were controls. miR overexpression was induced by lentiviral or mimic transfection. Protein levels were quantitated by Western blot. Cisplatin was used in chemoresponse assays. Immunodeficient (NSG) mice were used in xenograft studies. Human MPM cells (1×10^6) were subcutaneously injected and subsequent tumor xenografts were locally treated after reaching 100 mm³ with miR mimic or empty control, each solubilized in a RNA carrier.

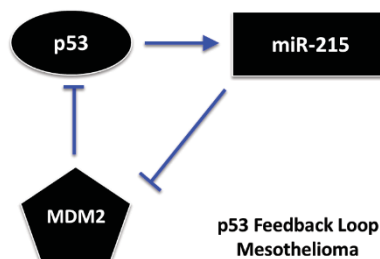
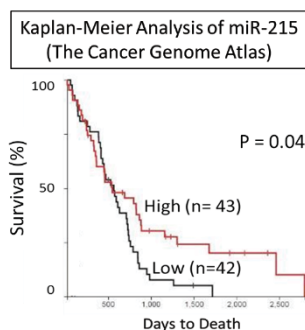
Results: Of the prognostic miRs, we identified a novel underexpressed miR-215 (Figure) and confirmed that MPM tissues lose expression of miR-215 by 5-fold ($p < 0.05$). Regulatory network analysis predicted that overexpression of miR-215 could induce a p53 positive feedback loop by inhibiting MDM2, the major regulator of p53, which, in turn, activates p53 that induces expression of more miR-215 (Figure). We validated this mechanism in MPM cells. miR-215 stable transfection reduced MDM2 transcript and protein levels leading to increases in p53 total protein amounts and activity. Using an activator of p53 (nutlin-3a), miR-215 transcript is increased. Annexin-V assay showed significant levels of early and late apoptosis in miR-215 transduced MPM cells. miR-215 retarded MPM cell viability severely; it stunted colony foci formation; and it prevented anchorage-independent cell growth in soft-agar and sphere assays. When Met-5A and LP9 cells were treated with miR-215, no biologic effects were seen. Inhibition experiments using transient miR-215 and pre-treatment with a p53 inhibitor (pifithrin- α) showed that miR-215 biologic effect is heavily dependent on p53 signaling. miR-215 synergized with cisplatin MPM cell killing in a dose-dependent manner. We observed tumor volume shrinkage by 80% ($p < 0.05$) compared to controls after peritumoral delivery of miR-215 in NSG mice flanks.

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Conclusions: Expression of miR-215 in MPM cells exerted tumor suppressive effects *in vitro* and *in vivo*. The underlying mechanism is dependent on activation of p53 apoptotic signaling. Our results further support miR modulation as a rational modality against MPM.

F10. 'Minority MOMP' May Induce Esophageal Carcinogenesis After Exposure to Bile Acids

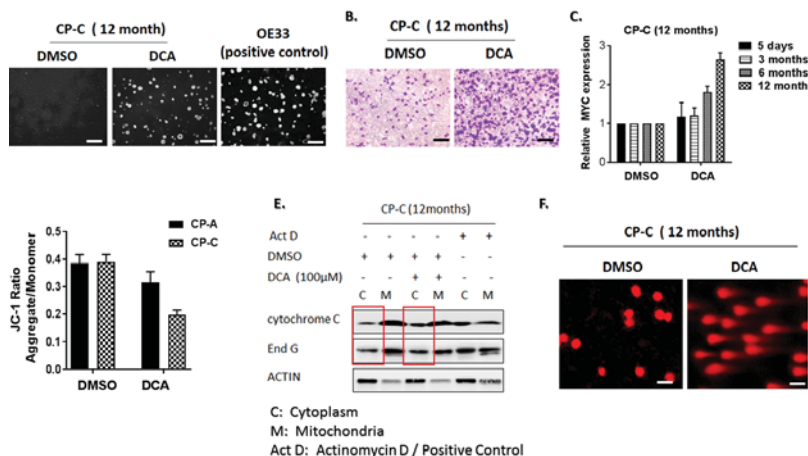
Yuan Xu, Deborah R. Surman, Kate Brown, Jonathan M. Hernandez, Choung D. Hoang, Jeremy L. Davis, *David S. Schrupp, [R. Taylor Ripley](#)
National Cancer Institute, NIH, Bethesda, MD

Invited Discussant: *Virginia R. Litle

Objective: Esophageal adenocarcinoma (EAC) often develops within Barrett's esophagus (BE) secondary to reflux disease. Resistance to apoptosis is a hallmark of cancer that is closely linked to mitochondrial energetics. During apoptosis, mitochondrial outer membrane permeabilization (MOMP) results in the release of toxic proteins such as cytochrome C (cytoC) and endonuclease G (EndoG) that activate the caspase cascade leading to DNA degradation, and normally, cell death. However, MOMP does not always result in cell death, but paradoxically promotes cancer – a phenomenon called 'Minority MOMP'; sublethal release of toxic proteins in response to carcinogen exposure results in DNA damage, chromosomal instability, and malignant transformation. In the present study, we utilized an in-vitro model to examine whether 'Minority MOMP' contributes to esophageal adenocarcinogenesis.

Methods: Immortalized Barrett's epithelial cell lines (CP-A and CP-C) were exposed to the oncogenic bile acid, deoxycholic acid (DCA), for 12 months to simulate chronic physiologic exposure conditions. Cell migration, invasion, and clonogenicity were examined using scratch, invasion, and soft agar assays. Myc, Bax, caspase-3, CytoC, EndoG, and were evaluated using qRT-PCR and immunoblot techniques. CytoC and EndoG subcellular localization was performed after mitochondrial/cytosol fractionation. Mitochondrial membrane potential was measured with the JC-1 assay. Caspase-3 activity was quantitated using a green fluorescence protein (GFP)-caspase-3 reporter assay. DNA damage was assessed using γH2AX levels and comet tail assay.

Results: DCA induced a time-dependent evolution of a malignant phenotype as noted by anchorage-independent clone formation (A) and enhanced cell migration and invasion (B). These phenotypic changes paralleled a time-dependent increase in oncogenic c-Myc expression (C). MOMP occurred in the transformed model as noted by significantly increased level of the pro-apoptotic protein, Bax, loss of mitochondrial membrane potential ($\Delta\psi_m$) (D), translocation of CytoC and EndoG to the cytoplasm (E), activation of caspase-3, and DNA damage (F) after 12 months of DCA exposure. Despite these alterations, no reduction in proliferation or viability was observed in DCA-treated cells.



Conclusion: Chronic DCA exposure induces pro-carcinogenic alterations in Barrett's epithelia that coincide with 'Minority MOMP'. Collectively these findings support further evaluation of 'Minority MOMP' in esophageal adenocarcinogenesis and the development of novel regimens that convert Minority MOMP to frank apoptosis for treatment and possible prevention of esophageal adenocarcinoma.

F11. Oncogenic Features of KDM4A Histone Demethylase in Mesothelioma

Lapidot Moshe, *Raphael Bueno

Brigham and Women's Hospital, Boston, MA

Invited Discussant: *Isabelle Schmitt-Opitz

Objectives: Malignant pleural mesothelioma (MPM) is a highly aggressive mesothelial derived cancer with a dismal median survival of 10.5 months. The lack of diagnostic markers for early detection and intrinsic drug resistance to standard therapy have contributed to the grim prognosis. Lysine-specific demethylase 4A (KDM4A) is a Jumoni C domain-containing histone demethylase that targets trimethylated lysine 9 and 36. KDM4A functions as an epigenetic regulator and plays a critical role in transcription control, chromatin architecture and cellular differentiation. KDM4A is aberrantly expressed in various solid tumors and is involved in the regulation of tumor progression, but the role of KDM4A in MPM tumorigenesis and its underlying mechanism are unclear. Herein, we examined the functional role of KDM4A for transformation in MPM.

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Methods: KDM4A protein and RNA expression (immunoblotting, qRT-PCR) and enzymatic activity (ELISA) were evaluated in human MPM cell lines (MSTO-211H, H2804, H2052) and compared to normal LP9 mesothelial cells. The effects of KDM4A on transformation using specific shRNA were analyzed, specifically on cell growth, invasion, apoptosis, and cell cycle progression. Finally, the KDM4A inhibitor PKF118–310 was examined for its ability to specifically inhibit mesothelioma cell growth.

Results: We found KDM4A to be highly expressed in mesothelioma cell lines (MSTO, H2804, H2052) and human mesothelioma tumors both at mRNA and protein level. Silencing of KDM4A by RNA interference reduced cell growth ($n = 3$, $p < 0.05$) in MSTO-211H (43.88-/± 9.39% of control), H2804 (21.78-/± 8.9% of control) and H2052 (46.25-/± 25.5% of control) cells, relative to control cells and led to G1 cell cycle arrest. Invasiveness of mesothelioma cells was reduced by 51.6-/± 10.1% of control ($n = 3$, $p < 0.05$). Finally, the genetic approach, was supported by pharmacological inhibition with the KDM4A inhibitor PKF118-310, which more efficiently inhibited cell growth ($n = 4$) in H28 (EC₅₀ = 0.18 μ M), MSTO-211H (EC₅₀ = 0.67 μ M), H2804 (EC₅₀ = 0.18 μ M) and H2052 (EC₅₀ = 0.33 μ M) cells, compared to LP9 cells (EC₅₀ = 0.91 μ M).

Conclusion: KDM4A overexpression is required for optimal cell growth and invasion in MPM thus encouraging further development of KDM4A inhibitors for clinical use to improve outcome in this devastating disease.

F12. The Protective Effect of Prone Positioning on Porcine Lungs During Ex Vivo Lung Perfusion

Hiromichi Niikawa, Toshihiro Okamoto, Kamal S. Ayyat, Yoshifumi Itoda,

*Kenneth R. McCurry

Cleveland Clinic, Cleveland, OH

Invited Discussant: Dan Kriesel

Objective: Prone positioning (PP) significantly improves oxygenation in patients who have severe lung injury due to alteration of ventilation/perfusion mismatching. The compressed dorsal side of the lungs in the supine position is expanded by position change and increases the functional residual capacity. We hypothesized that PP of lungs during *ex vivo* lung perfusion (EVLP) will improve not only oxygenation but also other pulmonary parameters by minimizing perfusion to the dorsal side of the lungs during the early period of EVLP, thus protecting this part of the lungs which may be more susceptible to edema due to previous prolonged dependency. The aim of our study was to evaluate the potential benefits of PP of lungs during EVLP.

Methods: Eleven Yorkshire pigs were utilized as lung donors. Following heparinization and cardiac arrest by injection of KCL, pigs were kept in supine position at room temperature for 2 hours. Lung procurement was then performed in a standard fashion with cold flush followed by 5 hours of cold storage with maintenance of lung orientation. Lungs were then subjected to 2 hours of cellular EVLP with either maintenance of

supine position (control group, n = 6) or prone positioning (prone group, n = 5). Lung function was evaluated using arterial blood gas analysis, airway and vascular parameters, and lung weight.

Results: Lung weight (LW) ratio (LW 2 hours of EVLP/ LW prior to EVLP) was significantly lower in the Prone group than Control group (1.28 ± 0.07 vs. 1.63 ± 0.39 , $p = 0.022$). The P/F ratio of left atrial blood was significantly higher in the Prone group than the Control group (297.6 ± 28.9 vs. 160.8 ± 60.2 mmHg, $p = 0.011$) as was the P/F ratio of inferior pulmonary vein blood (437.0 ± 35.0 vs. 81.3 ± 53.1 mmHg, $p < 0.001$). Shunt fraction and A-a gradient, were significantly better in the Prone group than Control group. Furthermore, dynamic compliance and static compliance were significantly higher in the Prone group than the Control group. Pulmonary vascular resistance was lower in the Prone group than Control group (but without statistical significance), while thermograph data, indicating perfusion flow rate, showed that the lower lobe temperature in Prone group was significantly lower than Control group (Table 1).

Table 1

Variables	Prone group N = 5 Mean \pm SD	Control group N = 6 Mean \pm SD	P value
EVLP parameters			
Lung weight ratio	1.28 ± 0.07	1.63 ± 0.39	0.022
ABG on left atrium			
P/F ratio, mmHg	297.6 ± 28.9	160.8 ± 60.2	0.011
Shunt fraction, %	37.5 ± 1.1	54.3 ± 7.8	0.012
A-a gradient, mmHg	367.6 ± 30.1	504.3 ± 57.3	0.040
ABG on inferior pulmonary vein			
P/F ratio, mmHg	437.0 ± 35.0	81.3 ± 53.1	<0.001
Shunt fraction, %	23.4 ± 6.3	85.2 ± 27.1	0.018
A-a gradient, mmHg	224.4 ± 34.7	586.0 ± 54.7	<0.001
Peak inspiratory pressure, cmH ₂ O	16.3 ± 2.0	22.0 ± 5.5	0.147
End tidal CO ₂ , mmHg	33.5 ± 2.1	32.5 ± 6.3	0.852
Dynamic compliance, ml/cmH ₂ O	29.4 ± 2.6	18.3 ± 7.8	0.031
Static compliance, ml/cmH ₂ O	37.3 ± 4.9	22.0 ± 8.0	0.026
Pulmonary vascular resistance, dyn·s/cm ⁵	502.2 ± 90.5	544.3 ± 70.0	0.485
Thermometer parameter			
Lung temperature at the lower lobe, °C	30.2 ± 6.5	33.2 ± 8.7	0.025

EVLP, ex vivo lung perfusion; Lung weight ratio, lung weight 2 hours of EVLP/ lung weight prior to EVLP; ABG, arterial blood gas analysis; P/F, PO₂/FiO₂

Conclusions: These results demonstrate that PP during 2 hours of EVLP leads to less lung weight gain, better P/F ratio and improved compliance compared to maintenance of supine positioning. We are currently evaluating the effect on inflammatory cytokines but these data suggest that prone positioning of lungs during EVLP may diminish IRI during EVLP.

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F13. Novel 3D-Printed Circumferential Tracheal Graft Enhances Graft Integration and Minimizes Granulation Tissue

Sadiq Rehmani, Wissam Raad, Landon Guntman, Farhan Jivraj, *Raja Flores, Robert Lebovics, Faiz Bhora

Icahn School of Medicine at Mount Sinai, New York, NY

Invited Discussant: *Christine L. Lau

Objective: Granulation tissue at the anastomotic site is the Achilles heel of a successful tracheal transplantation and remains a major limitation in developing a suitable tracheal replacement graft. Our lab previously demonstrated successful transplantation of 3D-printed circumferential tracheal grafts; however, clinical success was limited due to granulation tissue at the anastomotic sites. We hypothesized that incorporating small intestinal mucosal extracellular matrix (SIS-ECM) in our original design will minimize granulation tissue formation and enhance graft integration.

Methods: Size-matched poly-caprolactone (PCL) scaffolds were designed and 3D printed. For circumferential seamless application of SIS-ECM around PCL, we developed a novel design approach to fold ECM onto itself forming a tubular structure completely enveloping the PCL scaffold. A circumferential tracheal segment (30% of tracheal length) was replaced with the bioengineered graft in 2 Yorkshire pigs. Airway patency was evaluated using CT scan and grafts were explanted for further analysis.

Results: The novel design pattern produced a size-matched circumferential ECM shell around the 3D-printed PCL scaffold. The resulting bioengineered tracheal grafts (2.5 cm × 1.35 cm) showed high fidelity to the recipient anatomy. Both animals survived the pre-determined 2-week period. Gross examination of the explanted tracheas showed patent lumen with no graft malacia. Distal anastomosis appeared well-healed, showing mucosal continuity and minimal granulation tissue (Figure). Proximal anastomosis showed anterior dehiscence likely due to animal growth and neck extension, resulting in subcutaneous emphysema and airway narrowing. However, the animals did not show any signs of respiratory distress or pneumonia.



Figure: (A) Graft implantation; (B and C) On autopsy, distal anastomosis is patent and appears well-healed with minimal granulation at graft-native tissue interface (arrow)



Conclusions: Incorporating SIS-ECM into our original bioengineered tracheal graft design showed significantly decreased granulation tissue at the suture lines and better healing at graft-native tissue interface, especially at the distal anastomosis. The unique design allows for seamless integration of the ECM with PCL scaffold. Further innovations in design and materials will be required to produce suitable solutions for long-term successful outcomes.

F14. Strategies for Removal and Replacement of Pulmonary Epithelium in Extracorporeal Lungs on Cross-Circulation Support

John D. O'Neill, Brandon A. Guenthart, Ahmed Hozain, Gordana Vunjak-Novakovic,

*Matthew Bacchetta

Columbia University, New York, NY

Invited Discussant: *Marcelo Cypel

Objective: The administration of therapeutic agents in extracorporeal lungs (e.g., marginally unacceptable donor lungs) has been largely limited to the delivery of antibiotics, surfactant, and mesenchymal stem cells. Cell replacement is an emerging therapeutic approach where damaged or diseased cells are removed from the lung and replaced with healthy progenitor or differentiated cells, however, methods that enable the efficient regional removal of cells, e.g., pulmonary epithelium, without significantly compromising extracorporeal lung function have yet to be established. The objective of this study was to develop a method to efficiently remove pulmonary epithelium in distal regions of lungs on extracorporeal cross-circulation support without significant loss of lung structure or function.

Methods: Decellularization of target regions in lungs on cross-circulation support (Figure 1a) was achieved by bronchoscopic delivery of a mild detergent solution containing 8 mM CHAPS, 0.5 M NaCl, and 25 mM EDTA into bronchopulmonary segments with a custom catheter. Decellularization solution was allowed to dwell for 4 hours before repeated bronchoalveolar lavage with sterile normal saline. To assess the effectiveness of cell removal, lung wedge samples were collected following decellularization and fixed, stained, and imaged.

Results: Functional readouts (Figure 1b, c) before and after cell removal confirmed maintenance of extracorporeal lung gas exchange and compliance. Histologic (Figure 1d, e) and immunostaining (Figure 1f) analyses showed removal of lung epithelium with preservation of extracellular matrix (collagen, laminin) and microvascular structures, and cell replacement with lung epithelial cells.

Conclusions: A strategy cell replacement in extracorporeal lungs could enable significant recovery and regeneration of injured or damaged donor lungs prior to transplantation. Furthermore, the use of stem cells derived from the recipient could enable the creation of donor-recipient chimeric lungs, thereby potentially reducing or delaying the onset of chronic rejection.

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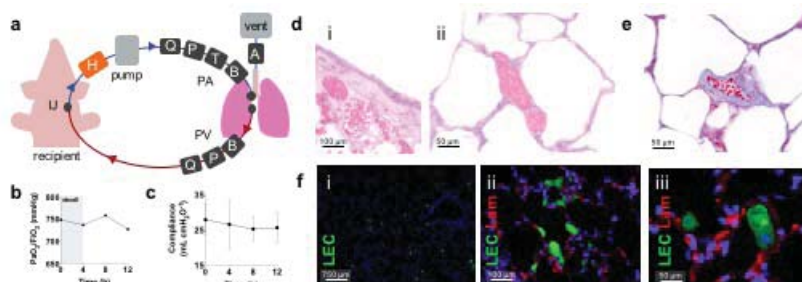


Figure 1 | Epithelial cell removal and replacement in extracorporeal lungs on cross-circulation support. (a) Schematic diagram of cross-circulation support circuit. A, air flow probe; B, blood-sample port; H, warm-water jacket; IJ, internal jugular vein; P, pressure sensor; PA, pulmonary artery; PV, pulmonary vein; Q, flow probe; T, temperature probe. (b) PaO₂/FiO₂ and (c) dynamic compliance during and after cell removal (decell). (d) H&E staining confirming epithelial cell removal from (i) large airways and (ii) alveoli, with vascular structures intact. (e) Trichrome staining showing preservation of collagenous lung extracellular matrix. (f) Immunohistochemical staining of laminin and lung epithelial cells (LEC) delivered into distal lung.

F15. Tumor Associated Macrophage Is Associated with Angiogenesis in Human Esophageal Squamous Cell Carcinoma

Haibo Ma¹, Jianjun Qin¹, Xintao Chen², Yin Li¹

¹Zhengzhou University, Zhengzhou, China; ²The People's Hospital of Jiaozuo City, Jiaozuo, China

Invited Discussant: *Sunil Singhal

Objective: This study aimed to clarify the mechanism that macrophages affect prognosis in esophageal squamous cell carcinoma and their association with tumor angiogenesis.

Methods: A total of surgical specimens were collected from 61 patients with thoracic esophageal squamous cell carcinoma who underwent surgery with lymph node dissection from January 2009 to May 2011. The expression of Tumor-Associated Macrophage was obtained by laser confocalization. Vascular endothelial growth factor, matrix metalloproteinase 9 and microvessels density were by HE staining.

Results: Including 56 men and 5 women with a mean age of 60.4 Years. CD68-positive macrophages were detected in varying concentrations in all 61 esophageal squamous carcinoma cases and in all adjacent normal lesion samples. The percentage of M2-polarized Tumor associated macrophage (M2) was $81.17 \pm 2.93\%$, and the percentage of M1-polarized Tumor associated macrophage (M1) was $18.13 \pm 2.93\%$. The low- Tumor associated macrophage group included 32 cases, and the high- Tumor associated macrophage group was comprised of 29 cases. There was a significant difference in Vascular endothelial growth factor, matrix metalloproteinase 9 and microvessels density expression between the two groups. M2 is also. No significant difference was observed in disease-free survival ($P = 0.052$) between the M2-low and M2-high.

Conclusion: In present study, M1 and M2 macrophages coexisted in tumor micro-environment, a larger number of M2-polarized Tumor associated macrophage is detected than that of M1-polarized Tumor associated macrophage, which showed the heterogeneity in esophageal squamous cell carcinoma. M2-polarized Tumor associated

macrophage is closely related to Vascular endothelial growth factor, matrix metalloproteinase 9 expression and microvessel density in esophageal squamous cell carcinoma, leading to tumor recurrence. However, M1-polarized Tumor associated macrophage is not related to these.

F16. Immunogenomic Determinants of Response to PD-1 Blockade in Non-Small Cell Lung Cancer (NSCLC)

Cynthia Y. Truong¹, Hyun-Sung Lee¹, Hee-Jin Jang¹, Masatsugu Hamaji², David A. Wheeler¹, Shawn S. Groth¹, *David J. Sugarbaker¹, ♦Bryan M. Burt¹

¹Baylor College of Medicine, Houston, TX; ²Kyoto University Hospital, Kyoto, Japan

Invited Discussant: Matthew J. Bott

Objective: PD-1 immune checkpoint inhibitors have revolutionized the treatment of patients with NSCLC. However, only a minority of patients will respond to these agents and the mechanisms underlying response to therapy are not fully understood. Our objective was to determine the immunogenomic determinants of response and resistance to αPD-1 therapy in NSCLC through comprehensive multi-platform analyses.

Methods: Among 35 metastatic NSCLC patients treated with αPD-1 therapy (GSE93157; Hospital Clinic of Barcelona), we utilized the nCounter PanCancer Immune Profiling Panel of 770 genes to derive an Immune Checkpoint Inhibitor Response (ICIR) signature. This signature was applied to 980 NSCLCs from The Cancer Genome Atlas (TCGA) to investigate correlation of high likelihood of response to αPD-1 blockade (i.e., high ICIR score) with a variety of immunogenomic factors including mutational burden, presence/absence of 75 common mutations, neoantigen burden, total somatic copy number alteration (SCNA), presence of SCNA in 63 commonly affected genes, T cell clonality, and immune cell composition deconvoluted by CIBERSORT. Significant findings were tested in an independent cohort of 29 NSCLC patients (GSE84797; Dana-Farber Cancer Institute) and in 2 lung adenocarcinoma patients in which we performed whole exome sequencing, protein profiling, and mass cytometry at our institution.

Results: An ICIR gene signature was developed by comparing objective responders (complete and partial response) and non-responders (progressive disease) to αPD-1 (Figure 1A). ICIR score, calculated as the average Z-values of 20 genes, outperformed previously published immune signatures such as cytolytic activity and IFN-γ signatures in predicting objective response and durable clinical benefit (Figure 1B). Application of this signature to NSCLC TCGA data demonstrated univariable correlation of numerous factors with ICIR score (Figure 1C, $P < 0.01$). Among them, multivariable binary logistic regression showed that tumors with no mutation in KEAP1, copy number gain of CDK4, no copy number loss of CDKN2A, decreased SCNA loss, higher T cell clonality, lower percentage of tumor cells, higher proportion of memory B cells or M1 macrophages (each deconvoluted from mRNA), and adenocarcinoma histology had significantly higher ICIR scores (Figure 1D). The factor with the strongest multivariable correlation with ICIR score was B cell infiltration ($P = 3.3 \times 10^{-12}$). This correlation was validated by flow cytometry in an independent cohort of 29 NSCLC patients (Figure 1E), and by mass cytometry in 2 patients who underwent multi-platform testing at our institution (Figure 1F).

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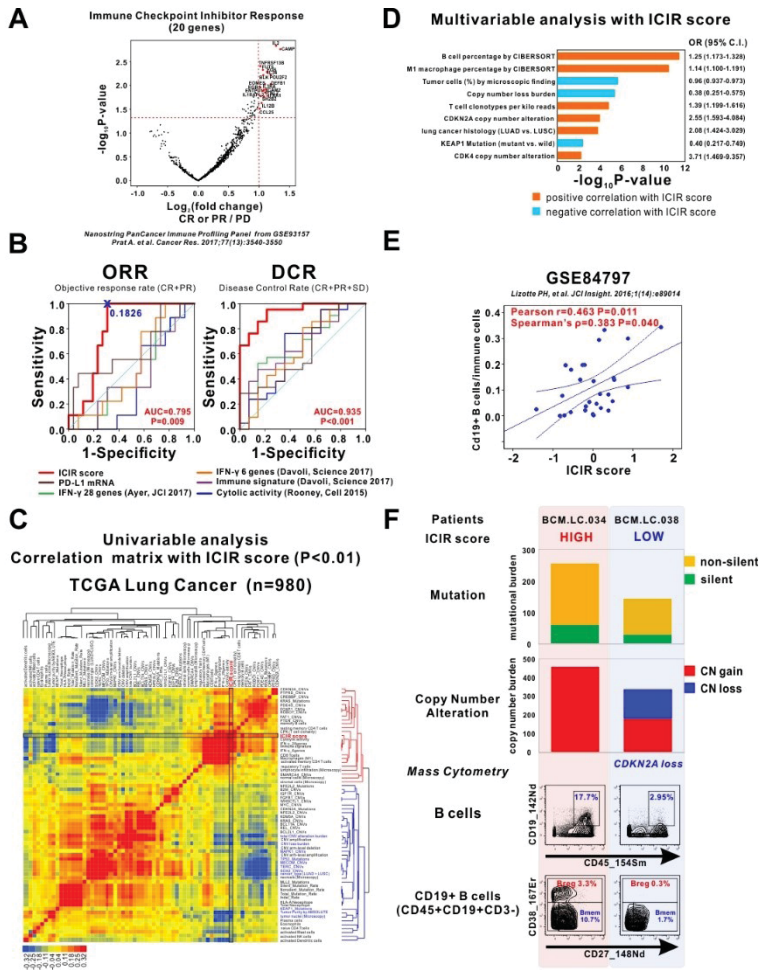


Figure 1. Immunogenomic determinants of response to PD-1 blockade in non-small cell lung cancer.

A. Development of a 20-gene immune checkpoint inhibitor response gene signature (ICIR) associated with response to α PD-1 blockade by comparing the immune profiling of objective responders (CR+PR) and non-responders (PD). **B.** Performance of ICIR score, the average of Z-values of 20 genes, compared with previously developed immune signatures such as cytolytic activity and IFN- γ signatures. **C.** Correlation matrix between ICIR score and significant determinants in NSCLC TCGA data (n=980). **D.** Multivariable binary logistic regression analysis. **E.** Independent validation of high correlation between ICIR score and B cell infiltration in the Dana Faber Cancer Institute cohort (n=29). **F.** Multi-platform testing with mass cytometry in 2 two female patients with solid adenocarcinoma. Percentages are calculated over total CD45+ immune cells.

Conclusions: A comprehensive multi-platform analysis demonstrates correlation of clinically relevant immune-based metrics with a simple gene signature that should be tested prospectively for prediction of response and resistance to α PD-1 therapy in NSCLC.

8:30 am Adjourn

TUESDAY MORNING, MAY 1, 2018

7:00 am

Adult Cardiac Emerging Technologies and Techniques/Case Video Forum

Room 28ABC, SDCC

5 minute presentation, 5 minute discussion

Moderators: Husam H. Balkhy and *Wilson Y. Szeto

T1. Minimalist Transcatheter Aortic Valve Replacement: Trends in 925 Patients with Severe Aortic Stenosis

*Vinod H. Thourani¹, John J. Kelly², Norihiko Kamioka², Jose N. Binongo², Tianyu Gao², Hope A. Caughron², Jessica Forcillo², Chandan Devireddy², Stamatios Lerakis², Kretan Mavromatis², Bradley G. Leshnower², *Robert A. Guyton², Patricia Keegan², Amy Simone², James P. Stewart², Vasilis Babaliaros²

¹Medstar Heart and Vascular Institute, Washington, DC; ²Emory University, Atlanta, GA

Objective: Most commonly, transfemoral transcatheter aortic valve replacement (TF-TAVR) is performed using general anesthesia, TEE, and invasive hemodynamic monitoring (Swan-Ganz and radial arterial catheter). In contrast, minimalist TF-TAVR (mTF-TAVR) is performed using IV sedation, TTE, and no invasive monitoring. Our objective was to analyze the early outcomes of patients who underwent mTF-TAVR.

Methods: All patients who underwent mTF-TAVR with a SAPIEN, SAPIEN XT, or SAPIEN 3 valve at a single U.S. academic institution from the introduction of this procedure in January 2012 through May 2017 were included. Other valve types were excluded. The patients were divided into groups based on the valve used. Demographics, procedural characteristics, and outcomes were reviewed. Routine statistical analysis was performed.

Results: A total of 925 patients were studied, which included 103 with a SAPIEN valve, 209 SAPIEN XT, and 613 SAPIEN 3. The mean STS Predicted Risk of Mortality (PROM) score differed significantly: 10.5%, 8.3%, and 6.5%, respectively ($p < 0.0001$). Mortality during the procedure was 2.9% ($n = 3$) for mTF-TAVR with SAPIEN, 1.9% ($n = 4$) for SAPIEN XT, and 0.3% ($n = 2$) for SAPIEN 3 ($p = 0.01$). Intubation and conversion to general anesthesia during the procedure has improved over time (SAPIEN: 4.9% [$n = 5$], SAPIEN XT: 2.9% [$n = 6$], and SAPIEN 3: 1.3% [$n = 8$; $p = 0.04$]), as has the median (interquartile range [IQR]) procedural room time (159 [132, 184], 156 [137, 177], and 146 [125, 168] minutes, respectively [$p < 0.0001$]). The percentage of patients requiring post-procedural ICU stay decreased over time (SAPIEN: 72.8% [$n = 75$], SAPIEN XT: 44.0% [$n = 92$], and SAPIEN 3: 20.8% [$n = 127$; $p < 0.0001$]). For those requiring time in the ICU, the duration of ICU stay also showed a decreasing trend (SAPIEN: 25.6, SAPIEN XT: 17.8, and SAPIEN 3: 10.0 hours; $p < 0.0001$). Median (IQR) length of postoperative hospital stay was 3 (2, 4), 2 (1, 3), and 2 (1, 2) days, respectively ($p < 0.0001$). The rate of new permanent pacemaker implantation was 8.7% ($n = 9$) for SAPIEN, 4.8% ($n = 10$) for SAPIEN XT, and 6.5% ($n = 40$) for SAPIEN 3 ($p = 0.39$). All-cause mortality at 30-days was 4.1% ($n = 4$; observed/expected [O/E] = 0.39) for the SAPIEN valve, 2.4% ($n = 5$; O/E = 0.29) for SAPIEN XT, and 0.8% ($n = 5$; O/E = 0.13) for SAPIEN 3 ($p = 0.02$). Moderate or severe paravalvular leak at 30-days was 0% ($n = 0$), 4.6% ($n = 9$), and 0.7% ($n = 4$), respectively ($p < 0.0001$).

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Table: Early Outcomes of mTF-TAVR

Outcome	All Patients (n = 925)	SAPIEN (n = 103)	SAPIEN XT (n = 209)	SAPIEN 3 (n = 613)	p Value
ICU stay, n (%)	294 (31.8%)	75 (72.8%)	92 (44.0%)	127 (20.8%)	<0.0001
Length of ICU stay (hrs), mean (std)	13.5 (35.7)	25.6 (43.0)	17.8 (39.9)	10.0 (32.1)	<0.0001
Length of post-op hospital stay (days), median (IQR)	2 (1,3)	3 (2,4)	2 (1,3)	2 (1,2)	<0.0001
In-hospital stroke, n (%)	15 (1.6%)	5 (4.9%)	4 (1.9%)	6 (1.0%)	0.02
New permanent pacemaker	59 (6.4%)	9 (8.7%)	10 (4.8%)	40 (6.5%)	0.39
STS PROM, mean (std)	7.4% (4.5%)	10.5% (4.6%)	8.3% (4.5%)	6.5% (4.3%)	<0.0001
30-day all-cause mortality, n (%)	14 (1.6%)	4 (4.1%)	5 (2.4%)	5 (0.8%)	0.02
30-day all-cause readmission, n (%)	91 (10.3%)	10 (10.0%)	16 (7.9%)	65 (11.2%)	0.42
30-day moderate/severe PVL, n (%)	13 (1.6%)	0 (0.0%)	9 (4.6%)	4 (0.7%)	<0.0001

Conclusions: Minimalist transfemoral TAVR with the 3rd generation balloon expandable valve can be performed safely with excellent early outcomes, minimal morbidity, and reduced resource utilization. Longer term follow-up is necessary to evaluate if these early findings continue to reflect improved outcomes over time.

T2. Early and Midterm Results of Frozen Elephant Trunk Operation with Evita Open Stent-Graftin Patients with Marfan Syndrome: Results of a Multicentre Study

Kazimierz Jan Jan Widenka¹, *Heinz Jakob², *Davide Pacini³, Wolfgang Hemmer⁴, Martin Grabenwoeger⁵, Thanos Sioris⁶, Anton Moritz⁷, Konstantinos Tsagakis²

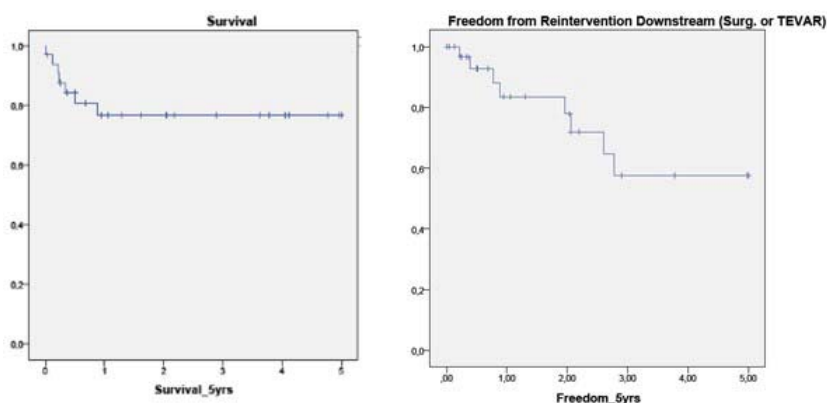
¹University of Rzeszów Poland, Rzeszów, Poland; ²University Hospital Essen, Essen, Germany; ³Sant'Orsola-Malpighi Hospital, Bologna, Italy; ⁴Sana Cardiac Surgery Stuttgart GmbH, Stuttgart, Germany; ⁵Hospital Hietzing, Vienna, Austria; ⁶Tampere University, Tampere, Finland; ⁷Johann Wolfgang Goethe University Hospital, Frankfurt am Main, Germany

Objective: Endovascular treatment of patients with Marfan syndrome (MS) is not recommended. The hybrid procedures such as frozen elephant trunk (FET) that combines the antegrade stent-graft deployment and the use of an integrated non-stented fabric graft for proximal grafting and suturing were not previously evaluated. To assess safety and feasibility of frozen elephant trunk (FET) operation in patients with MS, data from International Evita Open Registry (IEOR) was analyzed.

Methods: Between January 2005 and January 2017 out of 1049 1020 patients enrolled in IEO who underwent FET. 37 patients met Ghent criteria for Marfan syndrome, mean age was 38 ± 11 years; 24 were male and 13 female. Acute (AAD) or chronic (CAD) aortic dissection was present in 35 patients (14 and 21 respectively), 2 patients underwent FET operation for aortic aneurysm without dissection. Malperfusion syndrome

was present in 4 patients: renal in 2, cerebral in 1 and peripheral in 2. 29 patients had previous aortic surgical interventions. Early and midterm results were retrospectively analyzed. No standardized surgical protocol was applied. However the main surgical principles were similar.

Results: The mean cardiopulmonary bypass (CPB) was 254 ± 79 min, selective ante-grade cerebral perfusion (SACP) 73 ± 29 min, hypothermic circulatory arrest (HCA) 6 ± 8 min, crossclamp time (XCT) 154 ± 54 min and visceral ischemia time (VIT) 67 ± 26 min respectively. 30 day and hospital mortality was 8.1 and 13.5% respectively. Morbidity included: reexploration for bleeding 18.9%, prolonged ventilation (more than 72 hrs), 24.3%, renal failure requiring temporary dialysis 29.7%, minor stroke 5.4% with complete recovery), spinal cord injury 8.1% including permanent paraplegia 5.4% and transient paraparesis 2.7%. False lumen exclusion was present in 73% in stented segment (73% thrombosis, 16% partial thrombosis, 8% patent FL, 3% unknown). The overall 5 year survival was **71.3%** and freedom from reintervention downstream was 58.2% at 5 years. (TEVAR (**N = 3**) or surgery (**n = 6**)). In 9 patients that required reintervention for distal aortic disease 8 patients survived.



Conclusions: Frozen elephant trunk operation for patients with Marfan syndrome can be performed with acceptable mortality and morbidity. The 5 year survival of patients with Marfan syndrome undergoing FET is encouraging. During long term follow up no reinterventions on aortic arch were required. FET allows for easier second stage operations providing platform for both surgical and intervascular reinterventions. Further long term follow up is mandatory to assess long term results of FET in patients with Marfan syndrome.

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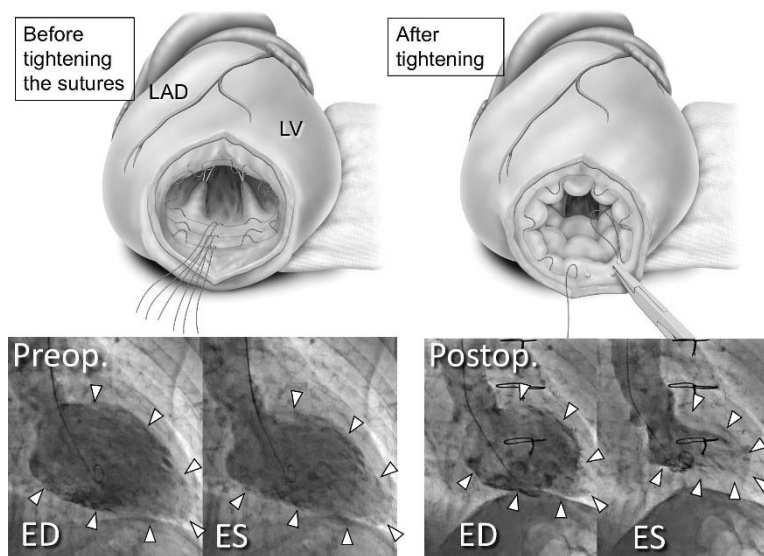
T3. “Frozen Apex” Restoration of the Left Ventricle for Dilated Cardiomyopathy in Non-Transplant Candidates — Toward Less Invasive and More Effective Surgery

*Masashi Komeda, Hirotomo Uchiyama, Takashi Kusunose, Shoji Fujiwara, Toshimi Ujiie

Iseikai Hospital, Osaka, Japan

Objective: Even after the STICH trial, surgical ventricular restoration (SVR) for dilated cardiomyopathy (DCM) has been yielding good results in experienced centers. Because the initial drop in survival rate after SVR was larger than that after common cardiac surgeries, we attempted to decrease the invasiveness of SVR by shortening the ischemic and pump time. Physiological investigations using radiopaque markers and anatomical studies reported that the left ventricular (LV) apex is important in its existence, especially for LV twist/recoil mechanics, but not so much in its own function for global LV one. Thus, we modified Kuinose’s endoventricular spiral plication for more physiologically and anatomically oriented surgery.

Methods: In the past 3 years, seven patients with DCM (four males; age, 65 ± 9 years; five with ischemia) underwent new SVR. Concomitant surgeries were: CABG in three patients and anterior relocation of papillary muscles in three. Two patients had undergone previous cardiac surgery. Indication for surgery included symptomatic DCM in patients in whom the main lesion was approximately apical half of LV, such as DiDonato type III. During surgery, we placed a few endocardial purse-string sutures on the short-axis plane to the LV apex from the papillary muscle base level to the tip of the apex via a small incision on the apex to make the apex conical (Frozen-apex SVR) and indirectly reduce the LV body diameter without touching it (Figure – ED, end-diastole; ES, end-systole). Postoperatively, all patients were administered Coumadin for a few months and beta-blocker and ARB to avoid long-term remodeling.





Results: Procedural time for the Frozen-apex SVR was less than 15 min in all patients. There was no hospital death, requirement for IABP, or late death with a follow-up of 17.9 ± 13.1 (range, 4.1–36.7) months. NYHA functional class changed from 3.3 ± 0.9 preoperatively to 2.0 ± 0.8 late postoperatively ($p = 0.001$ using paired t-test), LV diastolic diameter from 63 ± 17 mm to 60 ± 16 mm, LV systolic diameter from 59 ± 17 mm to 46 ± 18 mm ($p = 0.05$), ejection fraction from $27\% \pm 10\%$ to $41\% \pm 16\%$ ($p = 0.02$), right ventricular pressure from 31 ± 16 mmHg to 33 ± 14 mmHg, E/e' from 13.7 ± 2.6 to 11.6 ± 4.0 , and E/A from 0.8 ± 0.1 to 0.5 ± 0.2 .

Conclusions: Frozen-apex SVR, which is based on physiological and anatomical studies and is supported by postoperative aggressive medications by the heart team, improved short-term results and showed promising late results. It enhanced systolic function postoperatively without inducing diastolic dysfunction. Interestingly, systolic LV diameter improved more effectively than diastolic LV diameter partly because of the endocardial nature of the surgery. This type of compact SVR may benefit patients with DCM who are not eligible to undergo transplant, such as elderly patients who had multiple coronary interventions or those who had multiple/large myocardial infarction.

T4. Percutaneous Mitral Valve Repair As Salvage Therapy in Patients with Refractory Cardiogenic Shock

Vincent Chan, Marino Labinaz, Benjamin Hibbert, *Thierry Mesana
University of Ottawa Heart Institute, Ottawa, ON, Canada

Objective: Percutaneous mitral valve repair is a safe and effective treatment for mitral regurgitation (MR) due to degenerative and functional disease. However, few data are available describing the application of percutaneous mitral repair in patients in cardiogenic shock as a salvage procedure. We hypothesize that percutaneous mitral valve repair is a feasible salvage option in patients with MR and cardiogenic shock.

Methods: Between 2012 and 2017, 14 patients in cardiogenic shock underwent percutaneous mitral valve repair with the Mitraclip device (Abbott Vascular Devices, CA, USA). Of these, the etiology of MR was functional in 12 and organic in 2 patients. Cardiogenic shock was defined as the need for pre-procedure intra-aortic counterpulsation and/or intravenous inotrope/vasopressor therapy. Patient mean age was 66.6 ± 14.8 years with a Society of Thoracic Surgeons risk score of 19.7 ± 21.5 . Five (36%) were female. The mean number of clips implanted was 1.8.

Results: Over the course of follow-up that averaged 0.8 ± 1.0 years, 6 patients died at a mean of 73.7 ± 9.4 days following percutaneous mitral valve repair. In hospital death occurred in 3 (21%). Patients that died were more likely female ($p = 0.001$), but there were no differences between patients who died and those who survived in regards to preoperative hypertension, left ventricle (LV) function, or renal dysfunction (all $P < 0.05$). During the procedure, MR reduction to 2+ occurred in 6 and was lower in the remaining patients. At most recent follow-up, only 1 patient had MR >2+ and the mean LV ejection fraction was $27 \pm 14\%$ and not different between groups.

Conclusions: Percutaneous mitral valve repair is feasible and effective in the treatment of patients in cardiogenic shock. Early-term survival is favorable. However, longer term results remain unknown.

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Invited Speaker: Innovation in 2018

*James L. Cox, *Northwestern University Memorial Hospital*

T5. A Novel Beating-Heart Totally Endoscopic Tricuspid Valvuloplasty Technique with Patch Augmentation in Reoperative Cardiac Surgery

Huanlei Huang, Zerui Chen, Huiming Guo, Qingshi Zeng, Xiaohua Zhang, Cong Lu, Yingjie Ke, Ren Zhu

Guangdong General Hospital, Guangzhou, China

Objective: Endoscopic surgery is a valuable technique for primary valve operation. However, the application of this technique treating late severe tricuspid regurgitation (TR) following cardiac surgery still needs clinical evidence. This study aims to evaluate the feasibility and efficacy of a combination of beating-heart minimally invasive approach and leaflets augmentation technique treating TR after cardiac surgery.

Methods: From Jan 2015 to Aug 2017, patients undergoing re-operative tricuspid valve repair (TVP) with totally endoscopic approach and leaflets augmentation were enrolled. The indications of this study included: 1) tricuspid leaflet retraction with significant reduction of leaflet surface area; 2) isolated severe TR with symptoms failed to medication therapy and TR jet area $\geq 10 \text{ cm}^2$; 3) right pleural cavity intact at previous surgery. Cardiopulmonary bypass (CPB) was established via femoral vessels and the procedures were performed on beating heart with normothermic CPB. Technique of leaflets augmentation was as follows: pericardium and right atrium were opened at the same time, an extensive curvilinear incision was made along the base of anterior and posterior leaflets from antero-septal to poster-septal commissure; a bovine pericardial patch was sutured to leaflets and the annulus using 5/0 running interlocked sutures to convert the native leaflets into coaptation zone and partially the chordae. Other repair techniques were also applied as needed. The procedures were depicted in Figure 1.

Results: A total of 28 adults (mean age 55.6 ± 10.1 years; 5 male) were enrolled, the interval between prior surgery and current TVP was 16.6 ± 6.3 years. Previous cardiac surgery included MVR, AVR, VSD closure, Ebstein's anomaly correction in 14, 12, 1, and 1, respectively. Eight of them had previous TVP including Devega's procedure in 7 and ring implantation in 1. One patient was converted to median sternotomy due to pleural cavity adhesion; 27 underwent totally endoscopic TVP with leaflets augmentation, other techniques were applied including ring implantation, leaflet mobilization, artificial chordae implantation, cleft closure, and commissurotomy in 23, 5, 2, 1, and 1, respectively. No patient was converted to tricuspid valve replacement. 79% (22/27) patients had no compacted RBC transfusion. The duration of CPB, ventilation and post-operative hospital stay was 138.1 ± 52.3 min, 20.5 hours (range, 6–436) and 7 days (range, 4–56), respectively. The TR jet area was decreased from $20.7 \pm 10.1 \text{ cm}^2$ to $3.3 \pm 3.3 \text{ cm}^2$ after TVP according to the latest echocardiography ($p < 0.001$). All patients were followed-up for 7.4 ± 5.0 months and there were no late deaths and reoperation.

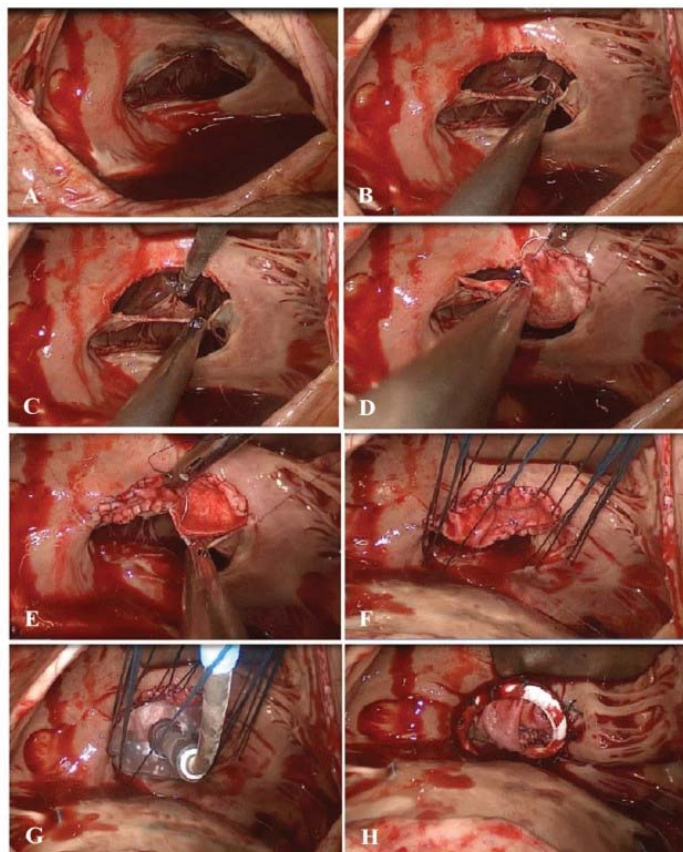


Fig 1. A, Thickening and rolling tricuspid valve; B, Incision of anterior and posterior leaflets base; C, papillary muscle release; D, Patch was sutured with leaflets base; E, Patch was sutured with anterior and posterior leaflets; F, Sutures were placed along annulus; G, Measured the size of valve annulus; H, Ring implantation.

Conclusion: Endoscopic TVP with leaflets augmentation is effective in treating severe TR after primary cardiac surgery; it can significantly decrease the surgical trauma, blood consumption, and mortality.

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T6. Impact of Hybrid Thoracoabdominal Aortic Repair on Visceral and Spinal Cord Perfusion: The New and Improved SPIDER-Graft

Sabine Wipper¹, Harleen K. Sandhu², Daniel Manzoni¹, Christoph Behem¹, Constantin Trepte¹, Charles C. Miller, III², *Anthony L. Estrera², *Hazim J. Safi², Tilo Kölbel¹, E. Sebastian Debus¹

¹University Heart Center Hamburg-Eppendorf, Hamburg, Germany; ²McGovern Medical School at UTHealth, Houston, TX

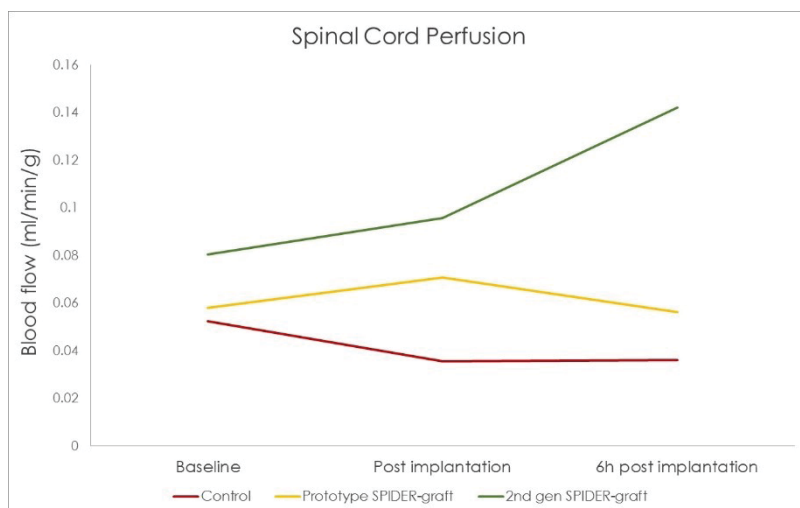
Objective: Visceral and spinal cord ischemia continues to challenge the conventional thoracoabdominal aortic (TAA) aneurysm repair. The novel hybrid TAA approach of SPIDER-graft, using a proximal stent graft and distal abdominal prosthesis, enables reduction in operative morbidity associated with the TAA exposure, extracorporeal circulation, and aortic clamp-time. However, the prototype did not address spinal cord perfusion. The 2nd generation design modification not only improves technical handling and reorientation of visceral branches but also enables reimplantation of lumbar arteries (Safi-loop). We evaluated the performance of the new SPIDER-graft in an experimental TAA-repair model.

Methods: A porcine experimental design was used for comparative evaluation of conventional TAA repair (control), prototype and 2nd-gen SPIDER-graft (group1 and 2). TAA exposure was performed via retroperitoneal access in all groups (7 pigs/group) with additional thoracic exposure in controls. Sequential crossclamping was performed in control group, while right iliac branch was first temporarily anastomosed end-to-side to the distal aorta maintaining periprocedural retrograde visceral and antegrade aortoiliac blood flow in the SPIDER-graft groups. This was followed by deployment of descending aortic stent-graft portion via the CT ostium and later visceral and renal arterial anastomoses. In group 2, lumbar arteries were reimplanted into the access branch via Safi-loop. Data were analyzed on baseline characteristics, operative times, hemodynamics, branch-vessel flow using transit-time flow measurement (TTFM) and quantitative tissue perfusion via fluorescent microspheres (FM) were evaluated before, after and 6-hours after implantation. Final angiography, post-procedural CT-angiography and histology were assessed for study endpoint evaluations.

Results: Technical success was 100% in all groups. There was no case of hemodynamic instability. Angiography and CT-scan confirmed successful graft implantation. Group 2 had longer total operative time (228 ± 79 min vs. 176 ± 17 controls vs. 169 ± 11 group 1) but had significantly shorter aortic clamp-time (3.3 ± 0.6 min vs. 88 ± 16 controls vs. 4.5 ± 0.6 group 1). There were no statistically significant differences in liver, mesenteric, or renal perfusion across all groups. TTFM and FM confirmed clinical findings. Although there was an additional time associated with Safi-loop implantation in group 2, there was an improvement in spinal cord perfusion (Figure).

Conclusions: Spinal cord perfusion significantly improved following reimplantation of lumbar arteries during hybrid TAA repair with 2nd-generation SPIDER-graft in an experimental pig model. Further modification to the Safi-loop reimplantation technique could improve operative times. Further studies and clinical validation is required to verify these experimental findings.





T7. Case Video: Suprasternal Transcatheter Aortic Valve Replacement: A Novel Simplified Approach

Kyle W. Eudailey¹, Susheel Kodali², *Isaac George²

¹Princeton Baptist Medical Center, Birmingham, AL; ²New York Presbyterian Hospital, Columbia University, New York, NY

Objective: Despite the continued advancement of transcatheter valve technology and delivery systems, there still remains a cohort of the transcatheter aortic valve replacement (TAVR) population who are not suitable for a transfemoral (TF) approach. Several options for alternative access for TAVR have been described in the literature, one of the most recent and novel approaches, has been the advent of the suprasternal TAVR (SS-TAVR) as described by Kiser et al using the Aegis Transit System (Aegis Surgical, Galway, Ireland). Herein we present a case of SS-TAVR, which requires no additional equipment and limited set-up, as a safe and effective alternate to TF-TAVR.

Case Video Summary: This is case of an 89-year-old man who was not suitable for TF access secondary to an infrarenal abdominal aortic aneurysm, with significant calcium and thrombus burden. All patients undergo general anesthesia, and they are positioned with a shoulder roll to allow to neck extension. We routinely place a right radial arterial line, a left internal jugular vein temporary pacer, and left radial access for a pigtail, so as to avoid the need for any femoral access and allow for early ambulation and mobilization post-operatively. A two centimeter curvilinear incision is made just above the sternal notch. The platysma muscle is divided, and further dissection is carried out in the avascular plane between sternocleidomastoid muscles, until the pretracheal fascial plane is identified. Blunt dissection is employed, and a sweeping motion is made from left to right in the avascular plane underneath the innominate vein and towards the innominate artery. The exposure is markedly improved with the division of the right sterno-thyroideus muscle. Two opposing pursestring sutures are placed. Under direct vision the innominate artery is punctured and using a soft wire a standard 7 French

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sheath is placed. The valve is then crossed in a standard manner, exchange for a stiffer wire is made, and the larger delivery sheath is placed. During the sheath exchanges the purse strings are used to minimize blood loss. Following the valve deployment, the sheath and wires are removed completely and the pursestrings are tied.

Conclusion: We believe that SS-TAVR is an extremely important tool to have in any valve team's alternative access armamentarium. This technique can be safely and reliably reproduced with any standard hybrid OR set up and no additional equipment. We have found minimal complications and comparable results when compared to TF-TAVR patients. We have adopted the suprasternal approach as our preferred alternative access route, and expect this technique to be adopted more broadly given its ease and simplicity.

8:30 am Adjourn

7:00 am Congenital Emerging Technologies and Room 24ABC, SDCC
Techniques/Case Video Forum
5 minute presentation, 5 minute discussion

Moderators: *Paul J. Chai and *Aditya K. Kaza

T8. Combined Ventricular Assist Device and Hybrid Stage 1 Procedure As Bridge to Transplantation in Hypoplastic Left Heart Syndrome with Severe Tricuspid Regurgitation or Right Ventricular Dysfunction

*Mark Bleiweis, Joseph Philip, Ahmed Mohsen, Alan Brock, Susan Cooke, James Curt Fudge, Himesh Vyas, Lisa Schnabel, Karl M. Reyes
University of Florida, Gainesville, FL

Objective: Patients with hypoplastic left heart syndrome (HLHS) and severe tricuspid regurgitation (TR) or severe right ventricular (RV) dysfunction are perhaps the most difficult subset of HLHS to manage because of the paucity of palliative therapies available. Invariably, heart transplantation has been the only recourse in these patients, and unfortunately due to extremely poor donor availability with prolonged wait times and a high wait list mortality, transplantation alone is limited in overall success as primary therapy. The following presentation demonstrates a novel approach to managing this subset of patients. By combining placement of ventricular assist device (VAD), atrial septectomy, pulmonary artery (PA) banding and ductal stent; the systemic ventricle is off loaded, balancing of the systemic and pulmonary circulations are managed with a baseline constant cardiac output, and regional cerebral perfusion or deep hypothermia for ascending and aortic arch reconstruction with Damus-Kaye-Stansel anastomosis is avoided in the early neonatal period.

Case Video Summary: After sternotomy and inspection of cardiac anatomy, the inflow and outflow VAD cannulas are prepared for implantation and VAD exit sites are marked. Innominate, SVC and IVC cannulation is done and cardiopulmonary bypass is initiated. The ductus is snared down with a vessel loop and the right and left PAs are banded with rings cut out of a 3.5 mm polytetrafluoroethylene graft. The outflow cannula is then connected to the MPA, followed by atrial septectomy and then connection of the inflow cannula to the right atrium. Heart is deaired and the VAD is connected to the cannulas.



Patient is then transitioned to the VAD from cardiopulmonary bypass. A ductal stent is then deployed through the right ventricle under fluoroscopic guidance and this completes the procedure.

Conclusion: VAD combined with Hybrid Stage 1 procedure for HLHS and severe RV dysfunction or TR is a novel approach as bridge to transplantation or transplant candidacy in patients who would have otherwise deteriorated due to poor cardiac function while waiting for heart transplantation. This procedure was conceptualized both as an attempt to stabilize the systemic circulation while waiting for a donor heart as well as for prevention of end organ damage which can in itself preclude transplant candidacy. While still in its initial stages, this procedure has great potential and we look forward to outcomes of using this strategy as primary palliative approach in this difficult to manage subset of HLHS prior to transplantation.

T9. A Novel, Patient-Specific, 3D Printed, Bioresorbable External Airway Splint for the Treatment of Life-Threatening Tracheobronchomalacia

Andrea S. Les¹, Colleen L. Flanagan¹, Ayishwariya Premanathan², Scott J. Hollister³, *Richard G. Ohye¹, Glenn E. Green¹

¹University of Michigan, Ann Arbor, MI; ²Materialise USA LLC, Plymouth, MI; ³Georgia Institute of Technology, Atlanta, GA

Objective: To report clinical outcomes and airway patency in patients with severe tracheobronchomalacia (TBM) treated with 3D printed, patient-specific, bioresorbable airway splints. Severe TBM remains a challenge with published mortality rates of up to 80%.

Methods: Patients with life-threatening TBM were evaluated for splint placement under an FDA Expanded Access Program with local IRB approval. Custom MATLAB code was used to generate splint designs based on patient CT data. Splints were then 3D printed via laser sintering. A pre-op, post-op, and follow-up expiratory/inspiratory airway Patency Ratio for each malacic area was calculated using MIMICS software as: Mean Cross Sectional Area (CSA) at expiration divided by Mean CSA at inspiration. A Patency Ratio of <0.5 is considered clinically significant.

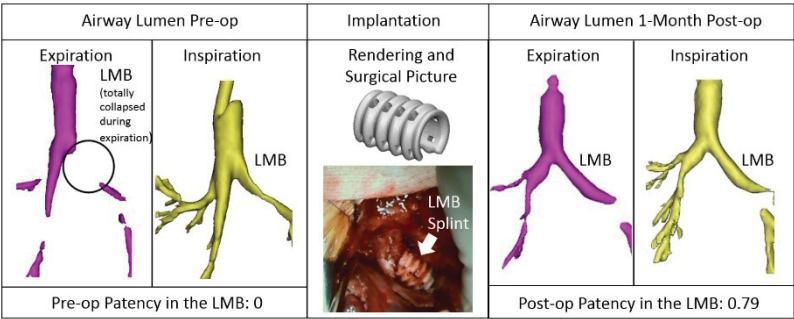
Results: Despite tracheostomy, supraphysiologic positive end-expiratory pressure, sedation and in some cases continuous paralysis, all seven subjects were experiencing acute life-threatening events prior to splint implantation. Median hospitalization before splinting was 5 months (range, 1.5–16 months). Three tracheal, seven left mainstem bronchial, and four right mainstem bronchial splints were implanted at a median age of 7 months (range, 3–16 months). Of the 13 splinted regions for which both pre- and early post-op CT data were available, the mean Patency Ratio improved from 0.36 (SD 0.22) pre-op to 0.81 (SD 0.14) ($p < 0.001$). At a median follow-up of 26 months (range, 9–67 months), one subject died seven months post-op with patent splinted airways, from her underlying single ventricle cardiac defect. The remaining six subjects have been discharged to home. One subject is decannulated. The remaining five continue to have a tracheostomy with: no ventilator ($n = 2$), intermittent ventilation ($n = 2$), and continuous ventilation ($n = 1$). >6-month follow-up CTs were available for four subjects and seven splinted areas. These data show continued patency and airway growth. The

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mean Patency Ratio from the latest CTs (median 17.5 months after implantation; range, 7–49 months) was 0.75 (SD 0.11, $p < 0.001$ compared to pre-op). In addition, the inspiratory CSA in the splinted regions has increased with age in all seven splinted regions compared to the first post-op CT scan, suggesting airway growth. Lastly, in cases where there are serial data on a contralateral normal unsplinted mainstem bronchus, the CSA of the splinted side has increased similarly to the unsplinted side. These finding support that the airway splint provides longer-term airway patency, while also allowing for airway growth. The figure demonstrates data from a typical subject.



Conclusion: Severe TBM remains problematic, with high mortality and limited therapeutic options. We demonstrate successful treatment of life-threatening TBM with custom, patient-specific, 3D printed, bioresorbable airway splints in seven infants.

T10. Trans-Aortic and Pulmonic Modified Konno Procedure and Concomitant Myectomy for Hypertrophic Obstructive Cardiomyopathy

Yasuhiro Kotani, *Shunji Sano, Yosuke Kuroko, Naohiro Horio, Sachiko Kawada, Yasuyuki Kobayashi, Sadahiko Arai, Shingo Kasahara
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Objective: Transaortic myectomy for hypertrophic obstructive cardiomyopathy (HOCM) is a technical challenge and often results in inadequate muscle resection. Modified Konno procedure is a good option for patients with tunnel-like left ventricular outflow tract (LVOT) obstruction to relieve the mid-LV level obstruction; however, this procedure needs RVotomy that potentially cause RV outflow tract obstruction and late arrhythmia. We report a case of LVOT obstruction that was released using Modified Konno procedure and concomitant myectomy via aorta and pulmonary artery.

Case Video Summary: Fifteen year old girl presented with systolic heart murmur. Echocardiogram showed mean gradient of 40 mmHg across the LVOT. Cardiac magnetic resonance (CMR) showed significantly hypertrophied septum. Surgery was performed via median sternotomy with cardiopulmonary bypass. After cardiac arrest, aortotomy was performed, followed by opening of the main pulmonary artery. Myectomy was performed through the aortic valve. The defect was created (Modified Konno procedure) at the LVOT while care was taken not to compromise the conduction system. Through the pulmonary valve, the defect was enlarged and the additional myectomy was per-



formed toward the apex. There were some tissues between the papillary muscle and the septum causing LVOT obstruction and these were resected. The defect was closed using Goretex patch. Postoperative echocardiogram showed that mean gradient across LVOT was 7 mmHg and CMR showed widely opened LVOT.

Conclusions: Trans-aortic and pulmonic approach is a good option to perform modified Konno procedure. RVotomy is not necessary in this approach which potentially prevents RVOT obstruction and late arrhythmia. Adequate myectomy can be achieved at the mid-LV level by approaching through the created VSD.

T11. Systemic Atrioventricular Valve Replacement with a Melody Valve in an Infant with a Single-Ventricle Physiology

Shuhua Luo, Jennifer Russell, *Glen Van Arsdell, Osmay Honjo

Hospital for Sick Children, Toronto, ON, Canada

Objective: Herein we present a case of systemic atrioventricular (AV) valve replacement with a stented bovine jugular vein valve (Melody valve) in an infant with a single-ventricle physiology.

Case Video Summary: A 3-month-old infant with unbalanced AVSD with significant AV valve regurgitation, who had been listed for heart transplantation, was presented with worsening congestive heart failure requiring intubation, inotropic support, and peritoneal drainage. He previously underwent BT shunt followed by AV valve repair. The decision was made to replace the systemic AV valve in order to stay on the transplant list. He underwent AV replacement with a Melody valve, which was dilated up to 20 mm along with atrial septectomy to avoid pulmonary venous obstruction. Total bypass time was 82 minutes. Aortic cross-clamp time was 64 minutes. Prior to the sternotomy, we prepared the valve. We resected 3 stents out as a wedge resection and then resected edges were reinforced with a 5-0 Prolene suture. Then a 4 mm Gore-Tex tube graft was sewn around the valve as a cuff. Cardiopulmonary bypass was initiated with ascending aortic and bicaval cannulations. AV annulus measured around 20 mm. A total of eleven 4-0 Prolene sutures with pledgets were placed around the AV valve annulus. Care was taken to place very shallow stitch along the conduction system using the AV valve tissue. It was critical important to align the wedge resection part to the left ventricular outflow. Two dilations were performed to make sure that the tip of the Melody valve was completely dilated. The saline test showed trivial AV valve regurgitation. Easily came off bypass with low dose inotropic support. Postoperative echo demonstrated trivial AV valve regurgitation with no paravalvular leak and no inflow gradient. The left ventricular outflow tract was completely unobstructed with a peak gradient of 16 mmHg with good left ventricular systolic function. The chest was closed with no hemodynamic compromise. His recovery was uneventful, was extubated 4 days after surgery. After several days of various degree of AV block, the patient regained sinus rhythm, and currently is waiting for transplant.

Conclusions: The Melody valve can be successfully implanted in the complex systemic AV valve morphology in a single ventricle patient, and has demonstrated an acceptable short-term functional outcome. The techniques to prevent left ventricular outflow tract obstruction and paravalvular leak shown in the current video are critically important.

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T12. Internal Pulmonary Artery Banding: Better Flow Control and Less Complication

Eung Re Kim, Woong-Han Kim, Lim Jae Hong, Jooncheol Min, Jae Gun Kwak

Seoul National University Children's Hospital, Seoul, Republic of Korea

Objective: Although pulmonary artery banding (PAB) is an important option for treating various congenital cardiac anomalies, complications such as volatile banding diameter, migration of banding, and branch pulmonary artery stenosis are well known. In this study, we evaluate the efficacy and safety of internal PAB technique.

Methods: 62 infants who underwent main pulmonary artery banding at our institution from 2003 to 2015 were reviewed retrospectively. Internal PAB was performed if the patient required cardiopulmonary bypass for correcting congenital intracardiac or aortic anomalies at the time of initial surgery. Under cardiopulmonary bypass, a transverse incision was made in the main pulmonary artery. A doughnut-shaped expanded polytetrafluoroethylene membrane was placed and sutured perpendicularly inside the vessel lumen to control the blood flow. The diameter of the central hole was decided based on the patient's body weight and associated cardiac anomalies. Perioperative course and follow-up data including echocardiogram were collected and analyzed.

Results: Internal PAB was performed in 28 patients (45.2%) at a median age of 13 days (range 1 to 89 days) with a mean body weight of 3.44 ± 0.58 kg. Mean pressure gradient across the banding site was similar between the two groups at the time of discharge (3.76 ± 0.07 m/s vs. 3.6 ± 0.12 m/s, $P = 0.27$). However, the coefficient of variation was significantly lower in the internal PAB group (9.14% vs. 17.86%) showing that this technique can provide a more congregated and predictable pressure gradient. Although internal PAB group had a higher Risk-Adjusted Congenital Heart Surgery Score compared to external PAB group (3.96 ± 0.1 vs. 3.12 ± 0.06 , $P < 0.0001$), it showed similar inter-stage mortality rate (10.7% vs. 20.6%, $P = 0.15$) and less reoperation rate for banding size adjustment (0% vs. 14.7%, $p = 0.0172$) compared to external PAB group. Pulmonary artery angioplasty was required in 16.7% (4/24) in internal PAB group and 33.3% (9/27) in external PAB group. Between the first and second stage operation, the pulmonary annulus of the internal PAB group grew significantly in size from 10.87 ± 1.71 mm to 12.82 ± 2.55 mm ($p = 0.0051$).

Internal banding (n=28)			External banding (n=34)	
1 (3.6%)		Early mortality after PA banding	4 (11.8%)	
0		Adjustment of banding	5 (14.7%)	
			Tightening	3
			Loosening	2
0		Banding migration	0	
0		PA wall complication	0	
4 (14.3%)			9 (26.5%)	
Single- ventricle	4/12	Need of PA angioplasty	Single- ventricle	4/15
Bi-ventricle	0/12		Bi-ventricle	5/12

Conclusions: In carefully selected patients, internal PAB technique is can be a safe and effective treatment option with excellent and reliable control over the pulmonary blood flow.

T13. Superior 5-Year Durability of Custom-Constructed Extracellular Matrix Right Ventricle-to-Pulmonary Artery Valved-Conduits in Children Under 2 Years of Age

Patrick I. McConnell¹, Zachary Daniels², Daniel Gomez¹

¹Nationwide Children's Hospital, Columbus, OH; ²Ohio University, Dublin, OH

Introduction: Extracellular matrix (ECM) derived from porcine small intestinal submucosa has been used for the custom-construction of right ventricle-to-pulmonary artery (RV-PA) valved-conduits (ECM-VC). The long-term durability of these conduits as compared to traditional aortic or pulmonary homograft conduits has not been reported.

Methods: After IRB approval, a retrospective analysis of consecutive patients with complete follow-up, 2 years old or younger, that were treated with an ECM-VC since May 2012 or an aortic/pulmonary valved allograft (HG) since October 2007 were identified. Demographic, diagnostic, operative and serial echocardiographic data was collected. Statistical analysis was performed using Kaplan-Meier analysis, t-test and 2-way ANOVA with repeated measures where appropriate.

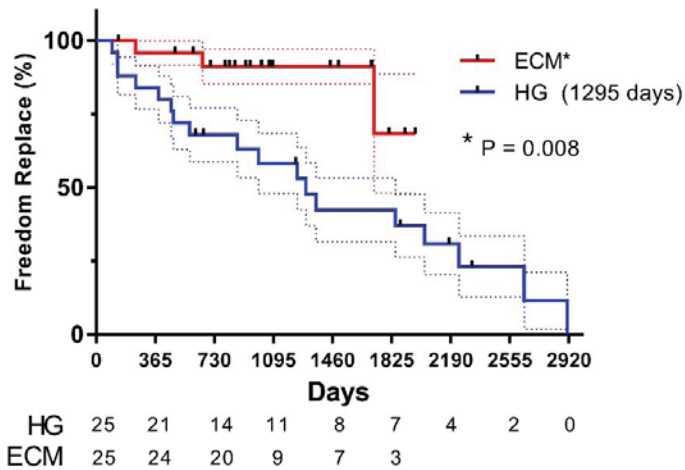
Results: Fifty patients under 2 years of age with complete follow-up through October 1, 2017 were identified. Twenty-five patients were implanted with an ECM-VC and 24 patients were implanted with 25 HGs. Average age (206 ± 24 days) and weight (6.1 ± 0.3 Kg) at surgery were similar for both groups; however, conduit size (13.6 ± 2.0 vs. 11.2 ± 2.4 mm; $p < 0.001$) and Z-score (1.8 ± 0.6 vs. 0.2 ± 1.3 ; $p < 0.001$) were larger for the ECM-VCs versus HGs, respectively. Estimated conduit peak gradients, with or without intervention, were significantly lower beyond 3 years for ECM-VCs versus HGs. Median time to severe insufficiency was 365 days for both groups ($p = \text{NS}$). Freedom from first conduit intervention (53% vs. 29%; log-rank $p = 0.04$) or conduit replacement (68% vs. 37%; log-rank $p = 0.008$) were better at 5 years for ECM-VCs versus HGs, respectively. All replaced HGs ($n = 16$) were for stenosis while only 1 of 3 replaced ECM-VCs was for conduit stenosis—the remaining 2 conduits were replaced for conduit insufficiency at the time of another primary procedure.

Conclusions: In this initial single-center, retrospective cohort, ECM-VCs had superior durability as compared to aortic or pulmonary allografts for restoring RV-PA continuity in children less than 2 years old. Conduit insufficiency remained a problem for both conduit types. Improved durability was a result of less primary conduit stenosis and more effective catheter intervention delaying replacement.

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Valved Conduits (Under 2 yo.)



T14. Robotic Totally Endoscopic Repair of Isolated Left Partial Anomalous Pulmonary Venous Drainage

Brian Mitzman, Mackenzie Mccrorey, Brooke Patel, *Amit Patel, *Gerhard Ziemer, Husam Balkhy

University of Chicago, Chicago, IL

Objective: Partial anomalous pulmonary venous return is a rare congenital defect that in children is usually not significant enough to lead to right heart dilation and need for surgical correction. As the patient grows however, decreased compliance of the left ventricle can increase the shunt and worsen symptoms.

Case Video Summary: A 50 year old obese female presented with shortness of breath and was found to have isolated left superior pulmonary venous return to the innominate vein. CT scan showed right heart enlargement and evidence of strain. Echo confirmed a severely enlarged right ventricle and decreased right ventricular function. No atrial septal defect was present. On right heart catheterization, left to right shunt was 1.7:1.

The patient underwent a robotic totally endoscopic repair of her anomalous venous return using a beating heart on pump approach. A da Vinci Si robot was docked to left chest ports (using a mirror image configuration to standard robotic mitral valve ports), using a 20 mm working port, two 8 mm robotic arms, a 12 mm stabilizer, and a 12 mm camera port. The aberrant superior pulmonary vein was obvious, and dissected free from surrounding mediastinal pleura prior to going pump. It was divided at the insertion point to the innominate vein, and transposed to the left atrial appendage for anastomosis. The patient tolerated the procedure well and was extubated in the operating room.



Conclusions: A robotic minimally invasive approach can be used to repair partial anomalous pulmonary venous return in adult patients who develop evidence of increased shunt and right heart failure. Avoiding an open approach allows for short length of stay, quick recovery, and minimal postoperative pain.

T15. Comparison of Percutaneous and Surgical Pulmonary Valve Replacement in Large Right Ventricular Outflow Tracts

Xiangbin Pan, Wenbin Ouyang, Keming Yang, Shoujun Li
Fuwai Hospital, Beijing, China

Objective: The Venus P-valve with a maximum diameter of 32 mm is a self-expanding percutaneous stent-valve designed for patients with severe pulmonary regurgitation and large right ventricular outflow tracts (RVOTs). The study was to compare the safety and outcomes of percutaneous and surgical pulmonary valve replacement in patients with large RVOTs.

Methods: The present retrospective study enrolled 22 patients who underwent percutaneous pulmonary valve replacement (PPVR group) and 20 patients who underwent surgical pulmonary valve replacement (SPVR group) from May 2014 to March 2017. Outpatient transthoracic echocardiography was assessed at 1, 3, 6 and 12 months, and yearly thereafter. Several characteristics (e.g., baseline characteristics, endotracheal intubation time, cost) were compared between the two groups.

Results: There were no significant differences between the two groups in terms of age, weight, time after last surgery, right ventricular end-diastolic volume index and right ventricular ejection fraction. Compared with the PPVR group, the SPVR group had larger pulmonary valve annulus (30.0 ± 5.9 mm vs. 26.2 ± 2.9 mm, $P = 0.013$) and smaller implanted valve diameters (24.2 ± 1.0 mm vs. 29.4 ± 2.9 mm, $P = 0.000$). Hospitalization time, intensive care time and endotracheal intubation time of SPVR group were greater than the PPVR group ($P = 0.000$, $P = 0.000$, $P = 0.000$, respectively). The total medical cost in the PPVR group was lower compared with SPVR group (5037.5 ± 1644.5 U.S. \$ vs. 23790.7 ± 7819.3 U.S. \$, $P = 0.000$). All patients discharged uneventfully and all valves were functioning well in follow-up. One patient in PPVR group developed an infective endocarditis in six months after procedure and she was cured after drug treatment.

Conclusions: PPVR using Venus P-valve was a safe and minimally invasive alternative to surgery in patients with large RVOTs. However, patients with PPVR required close follow-up because of contingent infective endocarditis.

8:30 am Adjourn

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7:00 am

**General Thoracic Emerging Technologies and
Techniques/Case Video Forum**

Room 25ABC, SDCC

5 minute presentation, 5 minute discussion

Moderators: *Diego Gonzalez Rivas and ♦Daniel P. Raymond

T16. Autotransplantation for Locally Advanced Central Lung Cancer

Kirsten A. Freeman, *Mauricio Pipkin, *Tiago Machuca

University of Florida, Gainesville, FL

Objective: Surgical resection is the mainstay therapy for non-small cell lung cancer. Many central non-small cell lung cancers require a pneumonectomy for adequate surgical resection, however morbidity and mortality following a pneumonectomy are significant. We describe a case in which a successful autotransplantation was performed in a 43 year old woman with central squamous cell lung cancer.

Case Video Summary: A 43 year old woman presented with a right sided PET avid 3.1 cm hilar squamous cell carcinoma, involving the take off of the right upper lobe and the entire bronchus intermedius. The lesion also invaded the interlobar pulmonary artery. Via a right anterior thoracotomy, the right upper, middle, and lower lobe veins were isolated. The right upper lobe vein was taken with a vascular endostapler, and the anterior truncus of the pulmonary artery was taken in similar fashion. Then 5000 IU of heparin were given followed by taking the right main pulmonary artery with an endostapler. The middle vein was then taken, and finally in order to provide a large inferior pulmonary vein atrial cuff, a bulldog clamp was used in the left atrium so the vein could be transected with a rim of atrial muscle. The right main stem bronchus was then transected and the specimen was removed. The right lung was placed on ice and flushed through the pulmonary artery with 750 cc of 4°C Perfadex, followed by 250 cc retrograde flush through the right lower lobe vein. The lung was ventilated with room air during the flush. The right lower lobe was dissected free from the tumor, and frozen sections confirmed negative margins. The right lower lobe bronchus was then anastomosed with the right main stem bronchus with a 4-0 running polydioxanone in the membranous wall and simple interrupted 4-0 polypropylene sutures in the cartilaginous wall. Next the right main pulmonary artery was anastomosed to the right lower lobe pulmonary artery with a running 5-0 polypropylene. Lastly, the left atrium was clamped and the atrial anastomosis was performed with 4-0 running polypropylene suture. The left atrium and main pulmonary artery were de-aired before reperfusion. The right lower lobe was slowly reperfused over 10 minutes while being inflated. A pedicled muscle flap was harvested from the 4th intercostal space and positioned between the bronchial and pulmonary arterial anastomoses. The patient was extubated in the OR and was discharged home on day 3.

Conclusions: Locally advanced central non-small cell lung cancer can be difficult to manage due to the location. Often these cancers require a pneumonectomy for adequate tumor resection. Pneumonectomies, however, carry significant morbidity and mortality, result in poor pulmonary function, and limit further surgical options should the cancer recur. Combining lung transplantation with thoracic oncology techniques can benefit this patient population and provide a lung-sparing operation.



T17. Resection of Mediastinal Paraganglioma Utilizing Cardiopulmonary Bypass

Tamer Attia, Michael Tong, ♦Daniel Raymond

Cleveland Clinic, Cleveland, OH

Objectives: Paraganglioma is a rare tumor arising from the chromaffin cells of the sympathetic ganglia and sometimes called extra-adrenal pheochromocytomas. When located in the middle mediastinum, it can present technical challenges. Our video demonstrates the key principles of resecting a mediastinal paraganglioma in close proximity to major neurovascular structures.

Case Video Summary: The patient is a 29-year old female who had an incidentally discovered 6 cm middle mediastinal mass during a trauma evaluation. The mass was located between the aorta, pulmonary artery (PA), superior venae cava (SVC) and the trachea. Mediastinal biopsy was done in an outside hospital and was consistent with paraganglioma. Considering the size and location of the mass, she was referred to our center for resection on cardiopulmonary bypass. Extensive discussion of the benefits and risks of the operation including possible injury to the left recurrent laryngeal nerve (RLN), both phrenic nerves, aorta, heart, and SVC.

In the operating room, the patient was placed in supine position. Median sternotomy was performed, followed by entering the pericardial space. Dissection was commenced in a circumferential fashion, partially separating the mass from SVC, innominate vein and right PA. The right femoral artery was exposed and utilized for arterial cannulation, with a 2-stage venous cannula placed directly through the right atrium. Following heparinization and institution of cardiopulmonary bypass, antegrade and retrograde cardioplegia was given to arrest the heart. The aorta was then transected. Dissection proceeded and the mass was freed from SVC, innominate vein, aorta, right and main PA, trachea and left RLN. Once this was completed and satisfactory hemostasis was achieved, the aortic anastomosis was reconstructed using 5/0 polypropylene suture. Drains were placed and chest closed in a routine fashion.

The patient was discharged home on the 3rd postoperative day. Pathological examination of the mass was consistent with paraganglioma.

Conclusions: Paragangliomas can present as middle mediastinal masses with close proximity to major neurovascular structures. Utilization of cardiopulmonary bypass is a safe, effective and sometimes a necessary tool to facilitate complete resection and reconstruction of the adherent or involved main vessels.

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T18. In Vitro Resistance and Gas Transfer Properties of the Pulmonary Assist Device, an Ambulatory ECMO Oxygenator Designed for Destination Therapy

Caitlin T. Demarest¹, David J. Skoog², *Matthew D. Bacchetta¹, Keith E. Cook²

¹Columbia University, New York, NY; ²Carnegie Mellon University, Pittsburgh, PA

Objective: The holy grail of artificial lung advancement is the development of a destination therapy device. However, all previous devices are limited by large size, tremendous surface area, and high resistance. The goal of this work is to develop a small, low resistance, and modular artificial lung designed for destination therapy, or Pulmonary Assist Device (PAD). Modularity, which has never been attempted, will allow for routine, minimally invasive and safe device exchange; also, one or two devices in parallel can be used depending on patient needs. Design goals for the PAD (Figure 1) were devised based on clinical needs of ECMO patients treated at one of the largest and most extensive ECMO programs in America. The goals include: 1) receive up to 4 L/min of cardiac output 2) achieve >95% outlet O₂ saturation, 3) remove 100 mL/min of CO₂, and 4) have a resistance less than 2.5 mmHg/(L/min) at 2L/min per module, much less than any gas exchanger currently on the market. Prototype devices were constructed and *in vitro* testing was performed, confirming that the device meets our clinical needs.

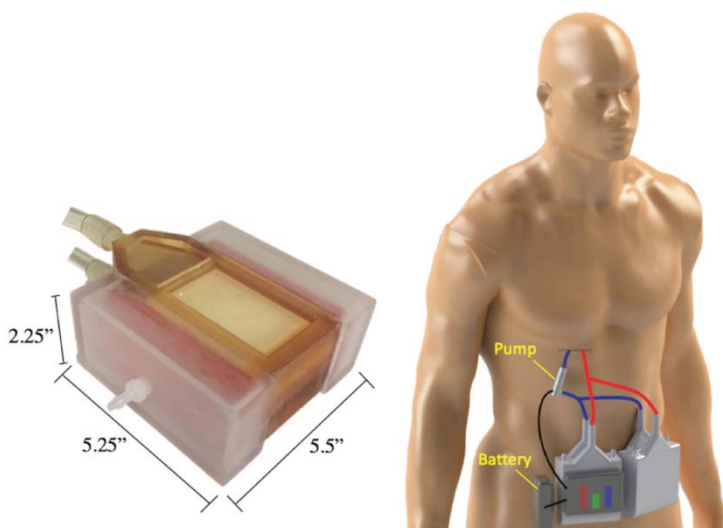


Figure 1: PAD design and patient with 2 PAD modules at the belt

Methods: Six PAD housings were rapid-prototyped using stereolithography and the fiber bundles had a gas exchange surface area of 0.9 m², substantially less than 1.8 m² in current ECMO oxygenators. Bovine blood was pumped through the devices at 0.5, 1, 2, 3, and 4 L/min while measuring pressure drop, and device resistance was calculated at each condition. To measure gas exchange, bovine blood was conditioned to AAMI standards then pumped through the devices at 1, 2, and 3 L/min. Samples were taken from the blood inlet and outlet of the devices as well as the gas outlet to



measure hemoglobin, oxygen saturation and content, and fractional concentration of CO₂ in the gas outlet; results were used to calculate O₂ and CO₂ transfer. Dimensionless analysis was performed to determine the gas exchange constants for our device using the following equation:

$$\Phi * N_{Re}^{-m} = \frac{D_f * por}{4 * (1 - por)} * \left(\frac{\mu}{\rho * Diff_{wb}} \right)^{2/3} * \frac{1}{PL} \int_{P_{O_2in}}^{P_{O_2out}} \frac{(1 + \lambda(P_{O_2}))^{2/3}}{(P_{O_{2g}} - P_{O_{2b}})} dP_{O_2}$$

Results: The average resistance was 2.06 mmHg/(L/min) and the devices saturated blood to 98.1% at 2 L/min blood flow rate, meeting our goals of <2.5 mmHg/(L/min) and 95%. The devices exchanged an average of 141.9 mL/min of CO₂, exceeding our goal of 100 mL/min.

Conclusions: The PAD exceeded both our gas exchange and resistance goals. Its current resistance is approximately 25–50% of commercially available oxygenators, and two modules in parallel will have a resistance approaching the native lung. This is critical to our destination therapy concept for a number of reasons: i) a lower resistance through the device will result in less blood activation and damage, ii) in a pumped setting, the pump can be set on lower RPMs to generate the same flows, thereby decreasing pump-induced blood damage and activation, and iii) the device could be implanted in a PA-LA fashion without putting increased burden on the heart.



T19. Robotic-Assisted Left Upper Lobe Sleeve Lobectomy

Peter J. Kneuert¹, *Jeffrey L. Port², *Brendon M. Stiles², Andrew B. Nguyen², Sebron W. Harrison², *Nasser K. Altorki², Benjamin E. Lee²

¹Ohio State University, Columbus, OH; ²New York Presbyterian Hospital, Weill Cornell Medicine, New York, NY

Objectives: Left upper lobe (LUL) sleeve resections are typically performed open. Particular challenge lies in the location of the left main bronchus deep in the mediastinum. We sought use to demonstrate the feasibility of a totally endoscopic robotic-assisted approach and to highlight technical key maneuvers.

Case Video Summary: The patient is a 60 year old female, never smoker, who presented with nonproductive cough. Workup revealed a left upper lobe endobronchial mass. She underwent bronchoscopy with tumor biopsy and opening of upper lobe bronchus. EBUS and transbronchial FNA of level 4L and 7 were performed. Biopsy revealed Adenoid cystic carcinoma and negative nodes. PET-CT showed a hilar LUL mass with SUV max 12.9. Pulmonary function tests were excellent. LUL sleeve lobectomy was performed using a totally endoscopic four arm approach. Ports were placed along the 8th intercostal space, including three 8 mm ports and one 12 mm port to accommodate the robotic stapler. An additional 12 mm assistant port was placed anteriorly in the 9th intercostal space. After CO₂ insufflation (10 mmHg), the lobectomy was commenced with dissection of the pulmonary artery in the fissure, followed by serial division of upper lobe

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pulmonary artery and vein branches using the vascular load stapler with ski tip. Mediastinal, peribronchial and subcarinal lymph nodes were dissected. Left lower and main bronchi were divided sharply with robotic scissors. We demonstrate the strategic placement of a stay sutures to expose the main bronchus and counter its retraction into the mediastinum. The bronchial anastomosis was performed in running fashion, using three 3-0 PDS sutures. Tension-free tying was facilitated by the use of stay sutures held in place by the 4th robotic arm. Pericardial fat pad was used to buttress the bronchial anastomosis. Estimated blood loss was 50 cc. Recovery was uneventful.

Conclusions: LUL sleeve resection can be performed with a completely port-based robotic approach. Dissection and division of left main bronchus and subsequent bronchial anastomosis can be accomplished robotically. Deliberate use of stay sutures facilitate a tension free anastomosis.

T20. Per-Oral Endoscopic Myotomy for the Treatment of Epiphrenic Esophageal Diverticulum

Igor Brichkov, Ory Wiesel

Maimonides Medical Center, Brooklyn, NY

Objective: Epiphrenic diverticulum is a rare pulsion diverticulum of the lower esophagus. It is believed to result from a herniation of esophageal mucosa across a hypertensive esophageal muscularis. Left, right and bilateral diverticula have been observed.¹

Conventional treatment involves resection of the diverticulum through a thoracic or abdominal approach and esophageal myotomy. The surgical approach carries a 25% morbidity and a possible 15% leak rate. Additionally, location of the diverticulum may make a transabdominal approach difficult requiring transthoracic access¹.

Per-oral endoscopic myotomy (POEM) is a novel non invasive modality for the treatment of achalasia and other spastic motility disorders of the esophagus with equivalent results compared to surgical myotomy. There is limited experience with managing epiphrenic diverticula with POEM.^{2,3}

Case Video Summary: We report a case of an elderly morbidly obese male (BMI 45) with progressive dysphagia and regurgitation. Contrast esophagography revealed a 6 cm right sided epiphrenic diverticulum. Manometry revealed a hypertensive LES. The patient had an elevated right hemidiaphragm and the diverticulum was noted to be 6 cm proximal to the gastroesophageal junction, precluding a laparoscopic approach. Due to the patient's anatomic restrictions and comorbidity, a hybrid approach was selected with a POEM and thoracoscopic resection of the diverticulum.

After endoscopic disimpaction of any retained food debris from the esophagus, a longitudinal mucosotomy was made at the 12 o'clock position at the level of the proximal neck of the diverticulum. The endoscope, fitted with a distal attachment cap, was advanced into the submucosal space and a submucosal tunnel was developed approximately 1–2 cm onto the stomach. An esophageal myotomy was then performed and the mucosotomy was closed with endoscopic clips.



Following this, a 3 port right thoracoscopy was performed and the diaphragm retracted inferiorly using suture. After lysis of pulmonary adhesions to the diverticulum, the diverticulum was dissected down to its neck and resected using a linear stapler. The staple line was buttressed with a mediastinal fat pad and pleura.

Contrast esophagography revealed easy passage of contrast into the stomach and no leak. The patient was started on a liquid diet and discharged.

Conclusion: POEM is a safe and effective modality for the management of epiphrenic diverticula. In selected patients, POEM may be performed without diverticulectomy. When the diverticulum must be resected, POEM may be safely combined with either laparoscopy or thoracoscopy as a hybrid approach, particularly when location and size of the diverticulum preclude a one field approach.

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1. Hirano Y. et al. *Surg. Today*. 2013;43:1–7.
2. Mou Y. et al. *Surg. Endosc.* 2016;30(1)335–8.
3. Demeter M. et al. *Dig. Endosc.* October 2017; doi:10.1111/den.12961.

Late-Breaking Clinical Trial

T21. Lung Transplantation Using NAT (Nucleic Acid Testing) Positive Hepatitis C (HCV) Donors to HCV Negative Recipients

*Marcelo Cypel, Jordan Feld, Lianne G. Singer, Deepali Kumar, Rafaela Vanin Pinto Ribeiro, Marcos Galasso, Jonathan C. Yeung, Laura Donahoe, Andrew Pierre, Nikki Marks, *Kazuhiro Yasufuku, *Marc de Perrot, *Thomas K. Waddell, *Shaf Keshavjee, Atul Humar
Toronto General Hospital, Toronto, ON, Canada

T22. Left Upper Lobe Auto-Transplantation As a Salvage Surgery After Definitive Chemoradiotherapy for Lung Cancer

*Hiroshi Date, Masatsugu Hamaji, Akihiro Aoyama
Kyoto University, Kyoto, Japan

Objective: Pneumonectomy as a salvage surgery after definitive chemoradiotherapy for lung cancer is known to be associated with high rate of operative death. To avoid pneumonectomy, ex-vivo sleeve lobectomy and auto-transplantation of the remaining lobe is an option.

Case Video Summary: The patient was a 51-year-old male with biopsy proved squamous cell carcinoma of the left lower lobe. The tumor was 60 mm in diameter and extending into the left main bronchus. Multiple hilar and mediastinal lymph node metastases (station #4, 5, 6, 11) were identified by PET scan. He was judged as inoperable and definitive chemoradiotherapy (CDDP+TS1+concurrent RT) was given. Radiation dose was

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planned to be 64 Gy but it was stopped at 54 Gy due to possible superior mesenteric artery embolism which was conservatively managed. Radiological good response was obtained in the main tumor as well as mediastinal lymph nodes. However, nine months later, he developed hemoptysis and found have a tumor recurrence and was referred to us for possible salvage surgery. The main tumor was PET positive, however, mediastinal lymph nodes remained to be PET negative. With postero-lateral thoracotomy, left main pulmonary artery, upper and lower pulmonary veins were secured intrapericardially. The dissection of interlobar pulmonary artery was very difficult due to tight adhesion caused by previous chemoradiotherapy. After administration of heparin (2,000 U), the left lung was excised and ex-vivo left lower sleeve lobectomy was performed. The remaining left upper lobe was flushed with lung preservation solution and re-implanted using our technique of living-donor lobar lung transplantation. The bronchial anastomosis was covered with pedicled pericardial fat. Post-operative course was uneventful and good bronchial healing was obtained. The pathology was ypT3N1M0. The patient is alive and well at 2 months.

Conclusions: Auto-transplantation to avoid pneumonectomy is feasible as a salvage surgery after definitive chemoradiotherapy for lung cancer.

T23. Gastric Perfusion Assessment During Esophagectomy Can Identify Patients at Low Risk for Anastomotic Leak

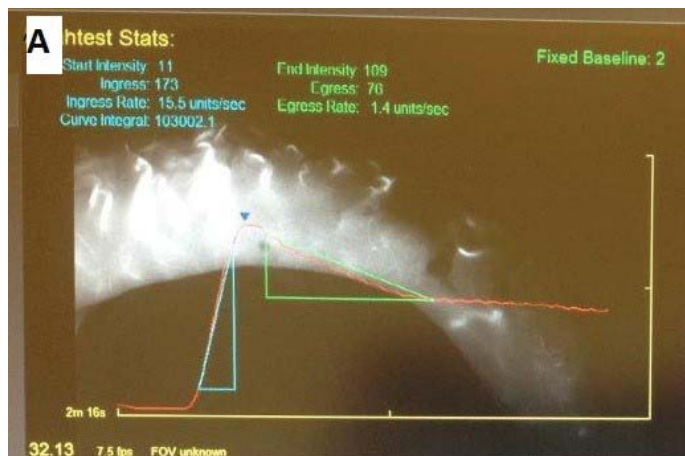
♦Rishindra M. Reddy, Aladdein Mattar, Lili Zhao, *Andrew C. Chang, *Mark B. Orringer, *Jules Lin, Kiran Lagisetty, William Lynch, Philip Carrott
University of Michigan, Ann Arbor, MI

Objective: Post-operative anastomotic leaks are a significant challenge after esophagectomy. Conduit perfusion and viability have been assessed using near infrared spectroscopy but in a limited qualitative manner, not utilizing the robust quantitative data available. We hypothesize that intraoperative gastric perfusion assessment can be used to identify patients at low risk for anastomotic leak and early discharge.

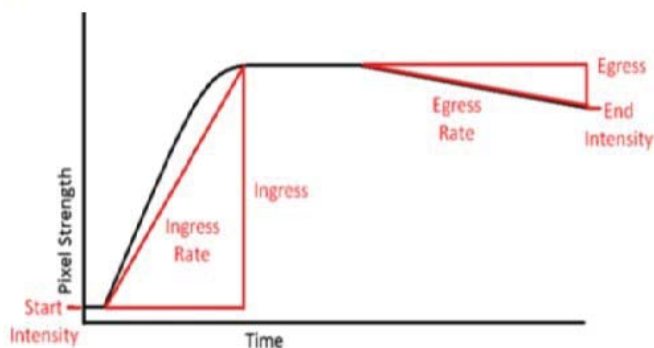
Methods: We retrospectively reviewed gastric perfusion assessments performed using near infrared spectroscopy of indocyanine green distribution during transhiatal esophagectomies at a single, high volume center from 2015–2017. Perfusion measurements, including ingress (inflow/I), ingress rate (IR), egress (outflow/E), egress rate (ER), and quantitative conduit perfusion in the center (PC) and the tip (PT) of the conduit (Figure A: computer output, Figure B: graph displaying measurements), were assessed in order to identify associations with patient characteristics, and patient outcomes using logistic regression and chi-squared tests. ROC curves were plotted for each parameter.

Results: Of 82 patients who had gastric perfusion assessment, 14 (17%) had a post-operative anastomotic leak, grade 2 or worse. There was no correlation between gastric perfusion measures and pre-operative characteristics including diabetes, smoking and use of neoadjuvant chemoradiation. Both IR and PT were associated significantly with anastomotic leak. Patients without leak had an IR 14.20 pixels/s \pm 11.30 versus those with leak 7.39 p/s \pm 5.00 ($p = 0.0372$). Using IR to create an ROC curve yields an AUC

of 0.6970. PT averaged 18.46 (fluorescence units) \pm 27.55 in those without leak, versus 6.71 fu \pm 5.99 in those with leak ($p = 0.0423$). The AUC for PT was 0.7207. Using IR, setting a sensitivity of 93% (and corresponding specificity of 48%), IR values of above 11.85 are at very low risk for leak, and a sensitivity of 100% reveals that IR values of above 19.65 p/s should not leak. Using PT, fluorescent values above 19.5 fu should not leak also. 16 (19.5%) of our patients had IR >19.65 and 15 had a PT above the threshold. Using all 6 perfusion parameters as a composite predictor for leak yielded AUC of 0.7385.



B



Conclusions: Intraoperative assessment of gastric perfusion can be used to identify a subset of patients with lower risk for anastomotic leak which might be used to modify postoperative management of patients undergoing esophagectomy. Expedited discharge may be possible for select patients.

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T24. Sternal Reconstruction for Dehiscence After Cardiac Surgery: A Single Centre Experience Using a Titanium Bar Osteosynthesis System, In Situ Bone Grafting and Omentoplasty

Ian Cummings¹, Metesh Acharya², Hesham Ahmed³, Periklis Perikleous⁴, Nizar Asadi⁴, Henrietta Wilson⁵, Vladimir Anikin⁴

¹*The Royal Brompton Hospital, London, United Kingdom*; ²*St. George's University Hospital, London, United Kingdom*; ³*Menoufia University Hospital, Menoufia, Egypt*; ⁴*Harefield Hospital, London, United Kingdom*; ⁵*St Bart's Hospital, London, United Kingdom*

Objectives: A retrospective analysis was performed of patients who underwent sternal reconstruction in our institution between September 2010 and February 2017. In each, bone graft was harvested from the sternum and ribs and used *in-situ*. Titanium bars were implanted for anterior chest wall reconstruction and an omentoplasty performed in the majority of patients.

Case Video Summary: The video highlights the operative technique involving titanium bar fixation of the sternum in conjunction with *in-situ* bone grafting and omentoplasty in complex sternal dehiscence following cardiac surgery.

Conclusions: Rigid sternal fixation with or without omentoplasty can be performed successfully in the management of sternal wound dehiscence with good outcomes. Patient factors have to be carefully considered and the optimum method of chest wall stabilization remains a matter of debate. This small series adds to the current evidence available for the application of this technique with excellent functional and cosmetic outcomes.

8:30 am Adjourn

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8:40 am

Plenary Scientific Session

Ballroom 20A, SDCC

6 minute presentation, 11 minute discussion

Moderators: *Duke E. Cameron and *Marc R. Moon

77. Mortality and Morbidity of Lobar Versus Sub-Lobar Resection in CALGB 140503 (ALLIANCE)

*Nasser K. Altorki¹, *Dennis Wigle², Xiaofei Wang³, Lin Gu³, Jean Deslauriers⁴, Ahmed Ashrafi⁵, Rodney Landrenau¹, *Daniel Miller⁶, *Daniel Miller⁶, *Moishe Liberman⁷, *David Jones⁸, *Robert Keenan⁹, Massimo Conti⁴, Gavin Wright¹⁰, Linda Veit¹¹, Thomas Stinchcombe³, Everett Vokes¹², *Leslie Kohman¹¹

¹New York-Presbyterian Weill Cornell Medical Center, New York, NY; ²Mayo Clinic, Rochester, NY; ³Duke University, Durham, NC; ⁴Institut Universitaire de Cardiologie et de Pneumologie de Québec, Quebec, QC, Canada; ⁵University of British Columbia, Vancouver, BC, Canada; ⁶WellStar Health System, Marietta, GA; ⁷University of Montreal, Centre Hospitalier de l'Université de Montreal, Montreal, QC, Canada; ⁸Memorial Sloan Kettering Cancer Center, New York, NY; ⁹Moffitt Cancer Center, Tampa, FL; ¹⁰St Vincent's Hospital Melbourne, Melbourne, Australia; ¹¹State University of New York Upstate Medical University, Syracuse, NY; ¹²University of Chicago Comprehensive Cancer Center, Chicago, IL

Invited Discussant: *Scott J. Swanson

Objective: CALGB/ALLIANCE 140503 is a multicenter international trial in which non-small cell lung cancer (NSCLC) patients clinically staged as T1aN0 were randomly assigned to lobar or sub-lobar resection. The trial's primary endpoint is disease-free survival. Here, we report the mortality and morbidity associated with both arms of the trial.

Methods: From 6/2007 to 3/2017, 697 patients were randomized to either lobar (Arm A: 357) or sub-lobar (Arm B: 340) resection. Perioperative mortality was defined as death from any cause within 30 and 90 days of surgical intervention and was calculated on all randomized patients. Morbidity was graded using the Common Terminology Criteria for Adverse Events (CTCAE v4.0). Morbidity data was available on 692 patients (355 in Arm A, 337 in Arm B).

Results: There were no statistically significant differences between the 2 groups in basic demographic or clinical characteristics (Table). Minimally invasive approaches were utilized for 80% of all resections. Overall 30 and 90 day mortality for 697 randomized patients were 0.9% (n = 6) and 1.4% (n = 10). Thirty and 90 day mortality were 1.1% (n = 4) and 1.7% (n = 6) after lobar resection and 0.6% (n = 2) and 1.2% (n = 4) after sub-lobar resection, yielding a rate difference between arms of 0.1% (95% CI: -1.1-2.3) and 0.1% (95% CI: -1.5-2.6), respectively. No complications were observed in 47% of patients (Arm A: 46%, Arm B: 49%). Grade 3/4/5 AEs occurred in 15.2% in Arm A and 14.2% in Arm B. There were no differences between the two arms in cardiac or pulmonary complications. Grade 3 hemorrhage (requiring transfusion) occurred in 6 patients (1.7%) in Arm A and 8 patients (2.4%) in Arm B. Prolonged air leak occurred in 9 patients (2.5%) in Arm A and 2 patients (0.6%) in Arm B.

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Table 1: Demographics, Baseline Clinical Characteristics, and Type of Surgery

	Arm A: Lobectomy (N = 357)	Arm B: Sublobar (N = 340)
Age		
Median	67	68
Range	43–88	37–89
Race		
White	87.7%	92.4%
African American	8.1%	4.7%
Asian	1.1%	0.6%
Am Indian	0.3%	0
Other	2.8%	2.3%
Females	58.8%	55.9%
PS 0	70%	76.7%
PS 1	28.6%	21.2%
PS 2	1.4%	1.5%
Unknown	0	0.6%
Current/former smokers	90.2%	90.6%
Adenocarcinoma	72.3%	75.0%
Squamous	19.0%	16.7%
Carcinoid	0.3%	1.5%
Other	8.1%	6.2%
Unknown	0.3%	0.6%
VATS	79.3%	80.5%
Thoracotomy	14.3%	12.4%
VATS conversion	6.4%	6.5%
Unknown	0	0.6%

Conclusions: In this large, multicenter randomized international trial there were no significant differences in mortality and morbidity between lobar and sub-lobar resection in physically and functionally fit patients with clinical T1aN0 NSCLC. The low overall 30/90 day mortality and morbidity reflect modern day standards for perioperative outcomes in the surgical treatment of early stage NSCLC. Support: U10CA180821, U10CA180882; ClinicalTrials.gov Identifier: NCT00499330



Late-Breaking Clinical Trial

LB6. Three-Year Outcomes of Aortic Valve Replacement with a Bioprosthetic Valve with a Novel Tissue

*[Douglas R. Johnston](#)¹, *John D. Puskas², *Joseph E. Bavaria³, *Eugene H. Blackstone¹, *Bartley Griffith⁴, James S. Gammie⁴, David A. Heimansohn⁵, Jerzy Sadowski⁶, Krzysztof Bartosz⁶, Jacek Rozanski⁷, *Todd Rosengart⁸, *Leonard N. Girardi⁹, Charles T. Klodell¹⁰, Mubashir A. Mumtaz¹¹, *Hiroo Takayama⁹, *Michael Halkos¹², *Vaughn Starnes¹³, Percy Boateng¹⁴, *Tomasz A. Timek¹⁵, William Ryan¹⁶, Shuab Omer¹⁷, *Craig R. Smith⁹, *Lars G. Svensson¹

¹Cleveland Clinic, Cleveland, OH; ²Mount Sinai Saint Luke's, New York, NY; ³Hospital of the University of Pennsylvania, Philadelphia, PA; ⁴University of Maryland, Baltimore, MD; ⁵St. Vincent Heart Center, Indianapolis, IN; ⁶Jagiellonian University, John Paul II Hospital, Krakow, Poland; ⁷National Institute of Cardiology, Warsaw, Poland; ⁸Baylor College of Medicine, Houston, TX; ⁹Columbia University – New York Presbyterian Hospital, New York, NY; ¹⁰University of Florida, Gainesville, FL; ¹¹Pinnacle Health, Harrisburg, PA; ¹²Emory University, Atlanta, GA; ¹³University of Southern California, Los Angeles, CA; ¹⁴Mount Sinai Medical Center, Philadelphia, PA; ¹⁵Spectrum Health Medical Group, Grand Rapids, MI; ¹⁶Heart Hospital Baylor, Plano, TX; ¹⁷Michael E DeBakey VA Medical Center, Houston, TX

Invited Discussant: *Tirone E. David

78. POEM (Per Oral Endoscopic Myotomy): Another Tool in the Tool Box

*[Siva Raja](#), Hafiz Umair Siddiqui, *Sudish Murthy, Usman Ahmad, Andrew Tang, Hari Keshava, Scott Gabbard, Prashanthi Thota, Monica Ray, Neha Wadwa, Madhu Sanaka

Cleveland Clinic, Cleveland, OH

Invited Discussant: *Steven R. DeMeester

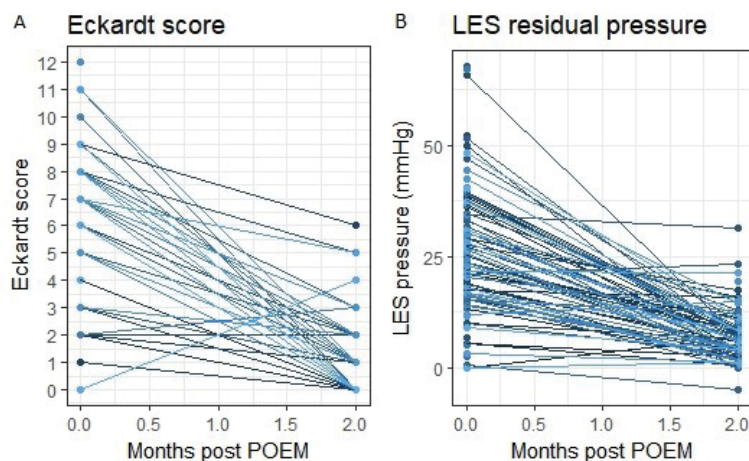
Objectives: Although laparoscopic Heller myotomy is the standard of care for the treatment of achalasia, per oral endoscopic myotomy (POEM) is rapidly increasing in utilization. Expected benefits of POEM include shorter recovery, decreased invasiveness and potentially equivalent outcomes but there is a paucity of definitive data to support these assumptions. In this abstract we report our experience of 120 POEM procedures for the palliation of patients with achalasia.

Methods: Good surgical candidates with type II achalasia and non-dilated esophagus were offered primarily Heller myotomy. For the remaining patients, POEM was offered as an alternative to Heller myotomy or pneumatic dilation. 120 patients with a proven diagnosis of achalasia underwent a POEM procedure at our institution from 4/2014–4/2017. Achalasia was diagnosed with a combination of upper endoscopy, manometry and Timed Barium Esophagram (TBE). The median age was 62, BMI was 28 and 56% were male. Type II achalasia was the most prominent subtype at 52% followed by type I at 26%. There were 25 patients who had a prior Heller myotomy. End points measured were post-operative Eckhardt scores for subjective assessment and Integrated Relaxation Pressure (IRP) along with TBE column height and width for objective assessment of palliation at 2 months.

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Results: The POEM procedure was successfully performed in 118 patients (98.3) with 2 cases aborted after a tunnel could not be established due to fusion of tissue planes. The median length of myotomy on the esophagus and stomach were 5 cms and 4 cms respectively. The median operative time and length of stay were 100 min and 1 day. The operative times decreased from a mean time of 139 min for the first 20 cases to 86 min for the last 20 cases. The most common morbidity was mucosal perforation in 2 patients (1.7%) and bleeding in 1 patient (0.9%). There were no mortalities. At 2 months, the median Eckhardt score dropped from 7 to 1 (Figure 1 panel A). Similarly, the IRP dropped from 24 to 6 mmHg ($p < 0.0000001$) (Figure 1 panel B) and the TBE column height and width dropped almost 50% from 10.5 and 3.2 cms to 5.5 and 1.5 cms ($p < 0.0000001$) respectively. The median time to return to activities of daily living or work was 7 days. There was a 43% rate of abnormal acid exposure on 24 hour pH testing in this patient population post procedure.

Conclusions: POEM is a safe and effective means of providing palliation and improving esophageal emptying in patients with achalasia. Patients undergoing a POEM appear to have a very short time to return to activities of daily living or work making this an especially good option for frail patients. The high rate of abnormal acid exposure raises concerns about future sequelae such as esophagitis and stricture. Continued study is needed to determine if this group of patients has equivalent long term palliation compared to Heller myotomy.



79. Anomalous Aortic Origin of a Coronary Artery (AAOCA): Are We Closer to Risk Stratification?

Anusha Jegatheeswaran¹, Paul J. Devlin¹, Brian W. McCrindle¹, *William G. Williams¹, *Christopher A. Caldarone¹, *William M. DeCamp², *J. William Gaynor³, *Marshall L. Jacobs⁴, *James K. Kirklin⁵, Richard O. Lorber⁶, Carlos M. Mery⁷, Silvana Molossi⁷, James D. St. Louis⁸, Julie A. Brothers³

¹Hospital for Sick Children, Toronto, ON, Canada; ²Arnold Palmer Hospital for Children, Orlando, FL; ³Children's Hospital of Philadelphia, Philadelphia, PA; ⁴Johns Hopkins University, Baltimore, MD; ⁵University of Alabama, Birmingham, AL; ⁶Cleveland Clinic Foundation, Cleveland, OH; ⁷Texas Children's Hospital, Toronto, ON; ⁸Children's Mercy Hospital and Clinics, Kansas City, MO

Invited Discussant: *Charles D. Fraser

Objectives: Anomalous aortic origin of a coronary artery (AAOCA) is a rare congenital cardiac anomaly associated with myocardial ischemia. From the Congenital Heart Surgeons' Society AAOCA Registry, we characterized patients with ischemia or a sudden event [sudden cardiac arrest (SCA) or death (SCD)] at presentation and their surgical management.

Methods: Between 1/1/98–12/31/16, 560 patients ≤30 years (y) of age at diagnosis, were enrolled from 40 institutions. Ischemia was defined as exertional syncope or arrhythmia, SCA, SCD, or an abnormal stress test (exercise, echocardiogram or nuclear perfusion). Patients were categorized as non-ischemic (by testing), or ischemic. Ischemic patients were further divided into those with and without sudden events. We reviewed demographic, anatomic and operative details.

Results: Within the cohort of 560, 275 patients were untested and unclassified (not compared), 236 patients were non-ischemic (Table 1A), and 49 (9%) were ischemic (Table 1B). Of the ischemic patients, 31 did not have sudden events (Table 1C), and 18 did (Table 1D). There was a greater proportion of left AAOCA (AAOLCA) patients in the ischemic versus (vs.) the non-ischemic group [28/49 (57%) vs. 46/236 (19%), $p < 0.0001$], but not in the sudden event vs. the non-sudden event subgroup [12/18 (67%) vs. 16/31 (52%) $p = 0.3$]. When comparing the ischemic and non-ischemic group, there was a difference in median diagnosis age [13.5 y (11.5–15.9) vs. 12.7 y (8.3–15.1), $p = 0.05$]. Ischemic AAOLCA patients were more likely to have an intramural course, high orifice, or slit-like orifice, and ischemic right AAOCA (AAORCA) patients had a longer intramural course compared to non-ischemic patients (Table 1B vs. 1A). When comparing the sudden event and non-sudden event subgroup, there was no difference in mean diagnosis age (13.6 y \pm 2.8 vs. 13.1 y \pm 4.8, $p = 0.6$) or anatomic features (Table 1D vs. 1C). A wide age range of patients had sudden events (6.0–18.8 y). In the sudden event subgroup, 16/18 (89%) events were exertional, and 2/18 (11%) (both AAORCA) were non-exertional. Of the 40/49 (82%) ischemic patients who had surgery, all but 1 was unroofed. Reoperation occurred in 4/40 (10%), all addressing ostial stenosis. Of the 9 ischemic patients who did not have surgery, 5 had AAOLCA (3 SCA/SCD died, 2 declined surgery) and 4 had AAORCA (1 SCA died, 1 lack of follow up, 2 referred for surgery).

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TABLE 1. COMPARISON OF THE ISCHEMIC GROUP TO THE NON-ISCHEMIC GROUP, AND THE SUDDEN EVENT SUBGROUP TO THE NON-SUDDEN EVENT SUBGROUP									
ANOMALOUS CORONARY ARTERY	TOTAL	DEAD	SURGERY	INTERARTERIAL	INTRAMURAL	INTRAMURAL LENGTH (mm)		HIGH ORIFICE	SPLIT-LIKE ORIFICE
	N (%)	N (%)	N (%)	N (%)	N (%)	MEDIAN (IQR)	M	N (%)	N (%)
A. TESTED NON-ISCHEMIC GROUP									
LEFT MAIN	46/236 (19)	1/46 (2)	23/46 (50)	34/41 (83)	18/35 (51)	7.5 (4.5-10)	5	2/32 (6)	10/28 (36)
RIGHT	184/236 (78)	1/184 (1)	85/184 (46)	158/161 (98)	114/131 (87)	6 (4.8-9)	38	44/105 (42)	62/81 (77)
LAD	3/236 (1)	0	0	0	0	0	0	0	0
CIRCUMFLEX	2/236 (1)	0	0	1/2 (50)	0	0	0	0	0
BOTH (LM & R)	1/236 (0.4)	0	(1/1) 100	0	1/1 (100)	1.5	0	1/1 (100)	1/1 (100)
TOTAL	236/236 (100)	2/236 (1)	109/236 (46)	193/208 (93)	133/170 (78)	6 (4.5-9)	43	47/140 (34)	73/111 (66)
B. ISCHEMIC GROUP									
LEFT MAIN	28/49 (57)	4/28 (14)	23/28 (82)	27/28 (96)	24/28 (86)	7 (3-10)	10	6/20 (30)	13/18 (72)
RIGHT	20/49 (41)	1/20 (5)	16/20 (80)	20/20 (100)	18/20 (90)	8.5 (7-10)	4	9/18 (50)	12/14 (86)
BOTH (LM & R)	1/49 (2)	0	1/1 (100)	1/1 (100)	1/1 (100)	4	0	1/1 (100)	1/1 (100)
TOTAL	49/49 (100)	5/49 (10)	40/49 (82)	48/49 (98)	43/49 (88)	8 (5-10)	14	16/39 (41)	26/33 (79)
A. vs. B. P-VALUES FOR TESTED NON-ISCHEMIC (A) VS. ISCHEMIC GROUP (B)									
LEFT MAIN	<0.0001	0.06	0.006	0.13	0.007	0.5		0.04	0.02
RIGHT	<0.0001	0.2	0.005	1	1	0.04		0.5	0.7
TOTAL	~	0.002	<0.001	0.32	0.14	0.3		0.4	0.2
C. NON-SUDDEN EVENT ISCHEMIC SUBGROUP									
LEFT MAIN	16/31 (52)	1/16 (6)	13/16 (81)	15/16 (94)	14/16 (88)	7 (4-10)	4	5/13 (38)	7/12 (58)
RIGHT	14/31 (45)	0	11/14 (79)	14/14 (100)	13/14 (93)	9 (8-10)	4	6/12 (50)	7/9 (78)
BOTH (LM & R)	1/31 (3)	0	1/1 (100)	1/1 (100)	1/1 (100)	4	0	1/1 (100)	1/1 (100)
TOTAL	31/31 (100)	1/31 (3)	25/31 (81)	30/31 (97)	28/31 (90)	8 (5.5-10)	8	12/26 (46)	15/22 (68)
D. SUDDEN EVENT ISCHEMIC SUBGROUP									
LEFT MAIN	12/18 (67)	3/12 (25)	10/12 (83)	12/12 (100)	10/12 (83)	> (2.8-8.5)	6	1/7 (14)	6/6 (100)
RIGHT	6/18 (33)	1/6 (17)	5/6 (83)	6/6 (100)	5/6 (83)	8 (7-10)	0	3/6 (50)	5/5 (100)
TOTAL	18/18 (100)	4/18 (22)	15/18 (83)	18/18 (100)	15/18 (83)	7 (3-10)	6	4/13 (31)	11/11 (100)
C. vs. D. P-VALUES FOR NON-SUDDEN EVENT VS. SUDDEN EVENT GROUP									
LEFT MAIN	0.3	0.3	1	1	1	0.5		0.4	0.1
RIGHT	0.4	0.3	1	~	0.5	0.6		1	0.5
TOTAL	~	0.05	1	1	0.7	0.5		0.5	0.07

Abbreviations. IQR = interquartile range, LM & R = left main and right, mm = millimeters, M = missing, N = number, vs = versus.

Missing values are not shown can be derived by comparing the denominator to the number of patients in the Total column. High orifice denotes those at or above the sinotubular junction.

Abbreviations. IQR = interquartile range, LM & R = left main and right, mm = millimeters, M = missing, N = number, vs = versus.

Missing values not shown can be derived by comparing the denominator to the number of patients in the Total column. High orifice denotes those at or above the sinotubular junction.

Conclusions: In this multi-institutional cohort, ischemia was more likely with AAOLCA, notably in those with an intramural course, a high and/or a slit-like orifice, while no morphology distinguished sudden events. These features may indicate a higher risk of ischemia and need for surgical referral, and warrant potential inclusion in future guidelines. Additional imaging review is needed to determine if any morphologic features further identify those at highest risk for sudden events, especially those presenting at a younger age.

9:55 am Awards

10:00 am – Coffee Break in the Exhibit Hall

10:40 am

10:10 am – 10:40 am
ICU Staffing Models: Are Open or
Closed Units the Future?

AATS CT Theater I
Booth #134, Exhibit Hall
Not for Credit

See page 64 for details.



10:40 am

Plenary Scientific Session

Ballroom 20A, SDCC

6 minute presentation, 11 minute discussion

Moderators: *Duke E. Cameron and *Marc R. Moon

AATS C. Walton Lillehei Resident Forum Award

Lillehei Winner Presentation

Introduced by: *Christian Pizarro,
Research Scholarship Committee Co-Chair

80. Spinal Cord Deficit After 1109 Extent II Open Thoracoabdominal Aortic Aneurysm Repairs

*Joseph S. Coselli, Matt D. Price, Qianzi Zhang, *Ourania Preventza, Kim I. de la Cruz, Hiruni S. Amarasekara, Susan Y. Green, *Scott A. LeMaire

Baylor College of Medicine, Houston, TX

Invited Discussant: *Lars G. Svensson

Objective: Spinal cord deficit (SCD) after open thoracoabdominal aortic aneurysm (TAAA) surgery is particularly deleterious in extensive (Crawford extent II) repair, especially for the most serious type of SCD, persistent paraplegia or paraparesis (PPP). We sought to examine SCD after extent II TAAA repair and to identify predictors of PPP.

Methods: Over time, several adjuncts have been developed to reduce the risk of postoperative SCD; repair has been largely standardized since 2005. From 1991–2017, we performed 1109 extent II TAAA repairs using strategies such as left heart bypass (n = 917, 82.7%), reattachment of intercostal/lumbar arteries (n = 956, 86.1%), and cerebrospinal fluid drainage (n = 699, 63.0%) to mitigate the risk of postoperative SCD. 404 repairs were performed since 2005. We used univariate and multivariable analyses to identify factors associated with SCD and PPP, defined as paraplegia or paraparesis present at time of early death or hospital discharge. Adverse event was defined as operative death or persistent (present at hospital discharge) stroke, paraplegia, paraparesis, or renal failure necessitating dialysis.

Results: SCD developed after 152 (14%) repairs—this included 85 (8%) PPP (52 paraplegia; 33 paraparesis), 65 (6%) transient paraplegia or paraparesis, and 2 isolated cases of neurogenic bladder. Those with SCD were older (median 68 years vs. 65 years, $P < 0.001$) and had more ruptures (7% vs. 2%, $P = 0.001$) and urgent/emergent repairs (27% vs. 17%, $P = 0.005$) compared to those without. Fewer patients with SCD survived repair compared to those without (77% vs. 92%, $P < 0.001$). Likewise, age, rupture and urgent/emergent repair were increased in those with PPP (Table). The development of PPP was immediate in 47 (55%) and delayed in 38 (45%). Predictors of PPP consisted of rupture (relative risk ratio [RRR] = 2.77, $P = 0.05$), preoperative coronary artery disease (RRR = 1.87, $P = 0.01$), and urgent or emergent repair (RRR = 1.95, $P = 0.03$). Heritable disease (RRR = 0.29, $P = 0.02$) and reattachment of intercostal or lumbar arteries (RRR = 0.47, $P = 0.008$) were protective. KM survival was diminished in those with PPP compared to those without.

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Table: Extent II Repair Stratified by the Development of Persistent Paraparesis or Paraplegia

	All (n = 1109)	With Persistent P/P (n = 85)	Without Persistent P/P (n = 1024)	p Value
Age, y	65 [55–72]	69 [63–74]	65 [54–71]	<0.001
Heritable disease	192 (17%)	4 (5%)	188 (18%)	0.002
Coronary artery disease	311 (28%)	35 (41%)	276 (27%)	0.007
Rupture	33 (3%)	8 (9%)	25 (2%)	0.001
Urgent or emergent repair	205 (19%)	24 (28%)	181 (18%)	0.02
Adverse event	212 (19%)	85 (100%)	127 (12%)	<0.001
Operative death	110 (10%)	30 (35%)	80 (8%)	<0.001
Persistent stroke	38 (3%)	8 (9%)	30 (3%)	0.007
Persistent renal failure	84 (8%)	20 (24%)	64 (6%)	<0.001

Conclusions: SCD after extent II TAAA repair remains concerning; early and late survival are reduced in patients with PPP. Several factors contribute to the development of PPP, and nearly half of PPP cases were delayed. The complexity of SCD and its most severe form, PPP, warrant further study.

81. Do the Surgical Results in the National Lung Screening Trial Reflect Modern Thoracic Surgical Practice?

Mohamed K. KameI, Mohamed Rahouma, Benjamin Lee, Sebron Harrison,
Andrew Nguyen, *Jeffrey Port, *Nasser K. Altorki, *Brendon M. Stiles
Weill Cornell Medical Center, New York, NY

Invited Discussant: *Gail E. Darling

Objective: Surgical data from the National Lung Screening Trial (NLST) has not been closely examined. Although published in 2011, the accrual period was 2002–2004. Standardized approaches to nodule evaluation or diagnostic procedures were not utilized. The NLST reported a 32% rate of surgical complications, often portrayed as a “harm” of screening and sometimes used to justify observation or non-surgical therapies for suspicious lung nodules. We sought to analyze surgical procedures and complications from the NLST to determine their relevance to modern surgical practice.

Methods: The NLST database was queried for patients who underwent surgical resection for confirmed lung cancer. Numerical variables were compared using Mann-Whitney U test. Categorical variables were compared using Chi-squared test. Propensity score matching analysis (VATS versus thoracotomy and lobectomy versus sublobar resection) controlling for age, gender, race, tumor size, and stage was done (nearest neighbor, 1:1, matching with no replacement, caliper 0.2). Predictors of major postoperative complications were estimated using uni- and multi-variable logistic regression analysis.

Results: Of patients with resection for lung cancer (n = 1029), only 29.4% had a non-surgical preoperative biopsy confirming cancer and only 71% had a PET within 6 months preoperatively. At operation, 80% of patients had lobectomy/bilobectomy, 4% had pneumonectomy, and 16% had sub-lobar resection (SLR), among whom 69% had wedge resection. Only 32.6% of the cohort had thoracoscopic resection. Of patients with clinical stage documented, 25.5% were upstaged at surgery including unexpected nodal disease in 13%. Although the overall rate of surgical patients with any complication was 30.8%, only 15.5% of patients had “major” complications, most commonly prolonged air leak (7.4%). Respiratory failure (2.7%), prolonged ventilation (0.9%), MI or cardiac arrest (0.7%), and stroke (0.2%) were rare. Mortality in patients undergoing resection was 0.87%. In propensity matched subgroups, a thoracoscopic approach (27% vs. 36% with thoracotomy, n = 301 patients/group, p = 0.02) and SLR (22% vs. 32% with lobectomy, n = 134 patients/group, p = 0.05) were associated with decreased overall rates of complications. By MVA, only smoking pack/years approached significance for predicting complications (HR 1.01, CI 0.99–1.01, p = 0.079).

Table: Major Complications in NLST Lung Cancer Patients Undergoing Surgical Resection

	Total Cohort (n = 1029)
Bronchial stump leak/BP fistula	76 (7%)
Acute resp failure/prolonged ventilation/resp arrest	38 (4%)
MI/cardiac arrest/CHF	8 (1%)
CVA/thromboembolic complications	11 (1%)
Empyema/hemothorax/wound dehiscence/injury to vital organ	26 (3%)
Death	9 (1%)

Conclusions: The NLST surgical lung cancer cohort had relatively poor utilization of pre-operative biopsy and PET. Although operative mortality was quite low, management strategies and operative procedures performed in the cohort may not be representative of modern surgical practice, in which there is increased utilization of minimally invasive approaches and of limited resection for screen detected cancers. The NLST likely over-estimates current surgical morbidity of screen detected early stage lung cancer.

82. Disparity Between Recent Graduates and Experienced Surgeons’ Assessment of Time to Operative Independence

Dawn S. Hui¹, *Richard Lee¹, *Marc R. Moon², Melanie A. Edwards¹, Mina L. Boutros¹, Jessica G.Y. Luc³, *Richard L. Prager⁴, *Keith S. Naunheim¹

¹Saint Louis University, Saint Louis, MO; ²Washington University, Saint Louis, MO;

³University of Alberta, Edmonton, AB; ⁴University of Michigan, Ann Arbor, MI

Invited Discussant: *Ralph J. Damiano, Jr.

Objective: In cardiothoracic surgery, little data exists on the transition to operative independence. This study aimed to describe the current perceptions and comfort levels of cardiothoracic surgeons in their junior years as well as the perceptions of the senior colleagues who oversee their transitional years.

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Methods: An anonymous online survey was sent to currently practicing North American board-certified/eligible cardiothoracic surgeons to assess reported time to operative independence and comfort with 4 categories of operations: Basic Thoracic, Complex Thoracic, Basic Cardiac, and Complex Cardiac. Chi-square analysis and Mann-Whitney U were used to compare junior surgeons' self-reported experience to the junior experience as reported by a cohort of midcareer and senior surgeons. Univariate analysis was performed to assess factors associated with operative independence at 3 months for basic cases and 12 months for complex cases.

Results: Responses from 436 completed surveys were analyzed (82 juniors, 354 midcareer/seniors). 254 midcareer/senior surgeons reported on the experience of 531 of their junior partners. On a 5-point Likert scale (1 = not comfortable, 5 = completely comfortable), juniors reported high immediate post-training comfort with basic cardiac cases (Straightforward CABG and Isolated Valve, median score 5) and moderate comfort with all other categories (Lobectomy 4; Esophagectomy 3; Complex Thoracic 3; Acute Aortic Dissection 4; Complex CABG 3; Complex Valve 3). Time to operative independence was significantly different between juniors' self-report and midcareer/senior reports of their junior partners except for Complex Thoracic cases (Table). Amongst juniors, additional training time was significantly associated with earlier operative independence for juniors for all categories. In midcareer/senior surgeons, non-private practice and larger group size were significantly associated with earlier operative independence of their junior partners for all groups except Complex Thoracic. In logistic regression analysis, only group size predicted junior operative independence for cardiac operations.

Table. Time to operative independence

Time Interval post-training for Junior Surgeon to Operate Independently (months)	Self-Reported Experience of Junior Surgeons	Junior Experience Reported by Midcareer/Senior Surgeons	p-value
Basic Thoracic			
3	75% (39)	45.8% (126)	<0.001
6	82.7% (43)	61.1% (168)	0.003
12	86.5% (45)	76.0% (209)	0.094
Complex Thoracic			
3	23.1% (12)	16.4% (45)	0.242
6	34.6% (18)	28.0% (77)	0.335
12	44.2% (23)	45.8% (126)	0.833
Basic Cardiac			
3	62.7% (32)	23.5% (89)	<0.01
6	74.5% (38)	39.1% (148)	<0.01
12	84.3% (43)	51.5% (195)	<0.01
Complex Cardiac			
3	25.5% (13)	11.3% (43)	0.005
6	51.0% (26)	25.3% (96)	<0.01
12	64.7% (33)	44.9% (170)	0.008

Conclusions: Most junior surgeons perceived operative independence with basic thoracic and both basic and complex cardiac operations early in their surgical career that improved with additional training. This perception differed significantly from the



reporting by midcareer and senior surgeons of their current junior partners. More objective measures of operative independence may eliminate this discrepancy. This study establishes a baseline by which to compare the effects of integrated 6-year programs on operative independence and may also help identify training needs for current programs adjusting to the changing landscape of cardiothoracic surgery.

11:45 am **Invited Guest Speaker: *The Thinking Eye***
Edward R. Tufte, *Yale University*

12:30 pm **Adjourn for Lunch in the Exhibit Hall**

12:40 pm – 1:50 pm **Preparing Yourself for an Academic Career Luncheon** Room 29BCD, SDCC
Available to residents, fellows, and medical students.
Separate Registration Required

12:40 pm – 1:10 pm
AATS/AmSECT Symposium: Acute Kidney Injury After Cardiac Surgery: Impact on Long-Term Outcomes and Cost AATS CT Theater II
Booth #1235, Exhibit Hall
Not for Credit
See page 65 for details.

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12:40 pm **Moderated Poster Competitions**

Adult Cardiac Moderated Poster Competition Aisle 1200, Exhibit Hall, SDCC
3 minute presentation, 2 minute discussion *Not for Credit*

Moderators: *W. Randolph Chitwood, Jr. and *T. Sloane Guy

P1. Septal Myectomy with Versus without Mitral Subvalvular Apparatus Intervention in patients with Hypertrophic Obstructive Cardiomyopathy: Prospective Randomised Study

Alexander Afanasyev¹, Alexander Bogachev-Prokophiev¹, Alexey Pivkin¹, Michail Ovcharov¹, Ravil Sharifulin¹, Sergey Zheleznev¹, Dmitry Kozmin², Alexander Karaskov¹

¹*Meshalkin National Medical Research Center, Novosibirsk, Russian Federation;*

²*Federal Center for Cardiovascular Surgery, Astrakhan, Russian Federation*

Objective: Hypertrophic obstructive cardiomyopathy (HOCM) characterized by left ventricular outflow tract (LVOT) obstruction, mitral valve systolic anterior motion (SAM), produces symptoms of heart failure and sudden cardiac deaths. Myectomy of LVOT described by Morrow is considered the gold standard of surgical treatment in symptomatic patients with HOCM who are refractory to medical therapy and suitable for surgery

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at experienced centres. The role mitral subvalvular apparatus intervention (MSA) for elimination MR and SAM is still unclear. Therefore, we initiated a prospective randomized study comparing results of septal myectomy with vs. without MSA interventions.

Methods: From 2011 to 2014 80 eligible patients with HOCM were randomly assigned to septal myectomy with (MSI group; $n = 41$) vs. without (Control group; $n = 39$) MSA intervention. Mean age was 49.6 ± 14.3 and 52.1 ± 12.8 years, respectively ($p = 0.095$). Mean peak gradient was 92.3 ± 16.9 and 88.1 ± 15.4 mm Hg, respectively ($p = 0.281$). Mean septum thickness was 26.8 ± 4.5 and 26.1 ± 4.2 mm, respectively ($p = 0.504$). SAM syndrome observed in all patients.

Results: There were no early deaths. MSA intervention includes: papillary muscle (PM) mobilization 100% ($n = 41$), secondary chords resection 100% ($n = 41$), PM longitudinal resection 87.8% ($n = 36$), and excision of abnormal PM 26.8% ($n = 11$) cases. Residual MR grade ≥ 2 was not observed in MSA group, while 15.3% ($n = 6$) patients in Control group had residual MR ($p = 0.029$). Residual SAM required second cross-clamping and redo was observed in 2.4% ($n = 1$) and 23.1% ($n = 9$) in MSA and Control groups, respectively ($p = 0.005$). Mean cross clamp time was 60.4 ± 14.1 min and 55.7 ± 13.4 min, respectively ($p = 0.157$). Peak LVOT gradient was 13 ± 5 mm Hg and 14 ± 5 mm Hg, respectively ($p = 0.405$).

At 12-month follow up all patients were alive. There are 87.8% ($n = 36$) and 12.2% ($n = 5$) patients in NYHA I and II classes, respectively, in MSA group. Control group includes 76.9% ($n = 30$) and 23.1% ($n = 9$) in NYHA I and II classes, respectively ($p = 0.200$). Prevalence of moderate MR was 9.8% ($n = 4$) and 33.4% ($n = 13$) in MSA and Control groups, respectively ($p = 0.010$).

Conclusion: Additional MSA intervention during septal myectomy in patients with HOCM and MR is safe and effective option. MSA intervention in addition to septal myectomy more effectively eliminates SAM and provides better freedom from moderate MR 1 year after surgery. There is no clinical benefit of additional MSA intervention at 12-month follow up. Longer term follow up is required.

P3. Ten Years UK Experience in Survival for Surgical TAVI Approaches

Francesca D'Auria, Aung Myat, Uday Trivedi, David Hildick-Smith

Brighton and Sussex University Hospital, Royal Sussex County Hospital, Brighton, United Kingdom

Objective: TAVI has expanded as alternative to surgical AVR, with well more than 250,000 patients treated worldwide since April 16th, 2002. The aim of this study is to compare morbidity and mortality (M&M) associated with different surgical TAVI access alternative to the surgical femoral (SF).

Methods: 2,863 pts underwent surgical TAVI from Jan 2007 to Jan 2016 in the 33 UK TAVI Centers. Primary outcome is long-term survival up to Jul 2017. Secondary outcomes are procedural/in-hospital (in-H) complications (stroke, major vascular complications, bleeding, tamponade, permanent PMK, and renal replacement therapy), in-H, 30-day, and 1-year mortality. Statistical analysis by SPSS 20.0 (IBM Corporation, NY) and Stata 12.1 (Stata-Corp, College Station, TX). Continuous variables presented as median and interquartile range (25 to 75 percentile). Chi-square and Kruskal-Wallis test used



as appropriate. Kaplan-Meier curve computed and a log-rank p value calculated. Cox proportional hazard model applied for primary outcome. P value < 0.001 is significant.

Results: 2,863 pts, Surgical Femoral (SF) = 1,150 + Trans Apical (TA) = 1,216 + Direct Aortic (DA) = 207 + Subclavian (SC) = 290. In-H mortality lowest in SF (3.7%, n = 43, p < 0.0001 vs. pooled no-SF). Among the no-SF, only SC (4.3%, n = 12, p = 0.69) not significantly different from SF, whereas TA (9.5%, n = 116, p < 0.0001) and DA (7.7%, n 16, p < 0.02) associated with higher mortality. In-H M&M summarized in Table 1. Unadjusted Kaplan-Meier survival chart calculated. It showed long-term survival significantly greater in SC than DA and TA. No difference in survival between TA (1-year estimator 74.7 ± 1.6%, p < 0.0001) and DA (1-year estimator 75.2 ± 3.3%), both of which with significantly lower long-term survival than SF (1-year estimator 84.6 ± 0.7%, p < 0.0001). Unadjusted survival rate of the surgical SC cohort not significantly different from SF (1-year estimator 80.5 ± 3%, p = 0.27). Hemofiltration most common in AD and TA compared to SC and SF. Permanent PMK greater in SC and SF than in TA and DA. Average hospitalization reduced in SF and SC compared to TA and DA. A comparison of M&M in the two quarters 2007–2011 vs. 2012–2016 carried out. For each secondary outcome variable, marked improvement over the second 5-years compared to the first one. In UK, DA access implemented since 2013, therefore, Kaplan-Meier for 12 months survival calculated from 2013 to 2016 and comparison performed between 2013–2014 and 2015–2016.

Outcome	Surgical Subclavian (SC) n = 290	Transapical (TA) n = 1216	Direct Aortic (AD) n = 207	Surgical Transfemoral (TF) n = 1150	P Value
In hospital mortality	12 (4.3%)	116 (9.5%)	16 (7.7%)	43 (3.7%)	< 0.0001
30-day mortality	8 (2.9%)	134 (11%)	17 (8.4%)	54 (4.7%)	< 0.0001
6-month mortality	11 (3.8%)	182 (15%)	39 (19%)	59 (5.1%)	< 0.0001
12-month mortality	58 (20%)	328 (27%)	60 (29%)	207 (18%)	< 0.0001
In hospital TIA	6 (2.0%)	12 (1.0%)	0	7 (0.6%)	0.22
In hospital stroke	9 (3.0%)	36 (3.0%)	2 (1.0%)	24 (2.1%)	0.12
Tamponade	6 (2.0%)	12 (1.0%)	2 (1.0%)	9 (0.8%)	0.07
Vascular complication	6 (2.0%)	5 (0.4%)	6 (3.0%)	40 (3.5%)	< 0.0001
Vascular surgery repair	6 (2.0%)	12 (1.0%)	4 (2.0%)	26 (2.3%)	0.59
Emergency V. in valve	12 (4.0%)	12 (1.0%)	2 (1.0%)	31 (2.7%)	0.01
Haemofiltration	12 (4.0%)	85 (7.0%)	21 (10%)	29 (2.5%)	< 0.0001
CI bleeding	3 (1.0%)	24 (2.0%)	0	9 (0.8%)	0.01
PMK implantation	67 (23%)	61 (5.0%)	15 (7.0%)	149 (13%)	< 0.0001
Hospital stay (days)	7.0 (5.0-10.0)	8.0 (5.0-15.0)	8.0 (5.0-16.0)	5.5 (4.0-8.0)	< 0.0001
Follow up (days)	609 (312-994)	567 (225-1056)	421 (202-680)	544 (283-929)	< 0.0001

Table 1. TAVI Outcome according to VARC – 2 criteria.

Conclusions: This is the largest study to compare survival in surgical TAVI access routes using a large dataset retrieved from the UK TAVI registry. TA and DA were associated with almost similar survival, both significantly lower than after SC and SF. SC is the only non-SF approach for which survival was not significantly different from SF. It may represent the safest non-femoral access route for TAVI and it is the safest surgical route until now experienced.

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P4. Subannular Repair in Mitral Valve Surgery for Type IIb Functional Mitral Regurgitation

Eva Karolina Harmel, Jonas Pausch, Christoph Sinning, Jens Kubitz,

*Hermann Reichenspurner, Evaldas Girdauskas

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Objective: The optimal surgical treatment of functional mitral regurgitation (FMR) with restricted leaflet motion during systole (Type IIb) is still controversial. The major drawback of isolated undersized mitral annuloplasty in type IIb MR is the re-occurrence of FMR due to ongoing ventricular remodeling with progressive papillary muscle displacement. Subannular repair techniques have been developed to address this drawback. We aimed to prospectively compare the results of isolated annuloplasty vs. annuloplasty with simultaneous standardized subannular repair.

Methods: A consecutive series of 63 type IIb FMR patients which met the inclusion criteria of (1) left ventricular ejection fraction < 40%, (2) LVEDD >60 mm, (3) tenting height >10 mm, and (4) bileaflet tethering underwent an isolated annuloplasty (n = 41) vs. annuloplasty + subannular repair (repositioning of both papillary muscles using CV-4 GoreTex Sutures) (n = 37). Primary study endpoint was the re-occurrence of MR and echocardiographic parameters of residual leaflet tethering after the surgery.

Results: Baseline variables indicating the severity of left ventricular disease (i.e. LV-EF, LVEDD) and mitral valve tethering parameters (i.e., tenting height, tenting area, PML and AML angle) were comparable between the two groups (i.e., study group (annuloplasty + vs. control group). Isolated mitral valve repair was performed using a minimally invasive right mini-thoracotomy approach in 51.6% (n = 19) study group vs. 34.1% (n = 14) control group respectively. There was no significant difference in in-hospital mortality between the two groups. Post-repair echocardiographic results were compared between both groups early after the surgery and during short-term follow-up. Although there was no significant difference in the residual post-repair mitral regurgitation between study subgroups, residual leaflet tethering parameters (i.e., tenting area (121.5 ± 44.1 (study) vs. 177.9 ± 54.4 (control)), PML angle (23.7 ± 6.7 (study) vs. 28.8 ± 5.4 (control)), AML angle (23.5 ± 6.2 (study) vs. 33.4 ± 5.0 (control))), were significantly increased in the control group ($p < 0.001$).

Conclusions: In this preliminary analysis, combination of annuloplasty with simultaneous standardized subannular repair results in significantly decreased residual leaflet tethering after mitral valve repair for type IIb FMR as compared to annuloplasty alone. Long-term benefit of subannular repair in terms of improved durability of MV competence and better clinical outcome has to be demonstrated.



P5. Cost-Effectiveness of Coronary-Artery Bypass Grafting (CABG) Alone Versus CABG Plus Mitral-Valve Repair for Moderate Ischemic Mitral Regurgitation: Results from a Randomized Clinical Trial

Bart Ferket¹, *Vinod H. Thourani², *Pierre Voisine³, Samuel F. Hohmann⁴, Helena L. Chang¹, *Peter K. Smith⁵, *Robert E. Michler⁶, *Gorav Ailawadi⁷, *Louis P. Perrault⁸, Marissa A. Miller⁹, Karen O'Sullivan¹, Stephanie L. Mick¹⁰, Emilia Bagiella¹, *Michael A. Acker¹¹, Ellen Moquete¹, Judy W. Hung¹², Jessica R. Overbey¹, Kinjal Shah¹, Margaret Iraola¹³, *James Gammie¹⁴, Annetine C. Gelijns¹, Patrick T. O'Gara¹⁵, Alan J. Moskowitz¹

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Objective: We recently reported that both left ventricular reverse remodeling and survival at 2 years did not differ between patients with moderate ischemic mitral regurgitation (MR) randomized to CABG + mitral valve (MV) repair or CABG alone. Although CABG + MV repair provided more durable correction of MR, it increased neurologic events and supraventricular arrhythmias. In light of these trade-offs, we sought to compare the long-term cost-effectiveness of these two procedures.

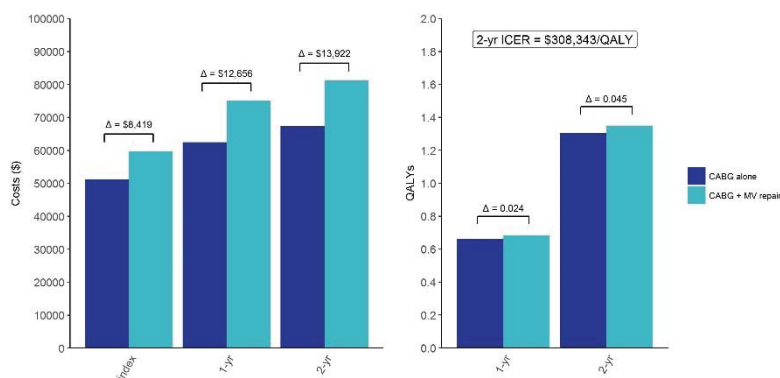
Methods: We conducted a cost-effectiveness analysis based on the results of the trial (n = 150 CABG + MV repair; n = 151 CABG alone). Patient-level data on survival, readmissions, quality-of-life, and U.S. hospital costs were used, and a microsimulation model was developed for extrapolation of outcomes beyond trial duration. We performed bootstrap and deterministic sensitivity analyses to address the influence of parameter uncertainty on estimated costs and quality-adjusted life years (QALYs).

Results: Index hospital costs were higher for CABG + MV repair vs. CABG alone (\$59,745 vs. \$51,326; Δ \$8,419, 95% CI \$2,259 to \$18,757). Two-year cumulative costs were \$81,263 vs. \$67,341 (Δ \$13,922, 95% CI \$2,370 to \$28,888) and QALYs were 1.35 vs. 1.30 (95% CI of Δ -0.04 to 0.14) for CABG + MV repair vs. CABG alone, respectively. The resulting incremental cost-effectiveness ratio (ICER) of CABG + MV repair was high: \$308,343/QALY (Figure). Modeled long-term readmission and death rates were similar for both interventions. At 10 years, cumulative costs remained higher for CABG + MV repair (\$107,733 vs. \$88,583; Δ \$19,150, 95% CI -\$3,866 to \$56,826) and QALYs did not differ (5.08 vs. 5.08; 95% CI of Δ -0.92 to 0.87). The likelihood that CABG + repair would be cost-effective at 10 years, assuming cost-effectiveness thresholds of \$50 k and \$100 k/QALY did not exceed 30 and 37%, i.e., <300 and 370 of 1,000 bootstrap replicates respectively. If death rates for CABG + MV repair in the post-trial years were \geq 5% lower than rates for CABG alone, the ICER of CABG + MV repair fell below \$100 k/QALY, but an ICER < \$50 k/QALY was only reached with rate reductions \geq 60%. Assuming similar relative reductions in cardiovascular readmission rates only minimally improved cost-effectiveness of CABG + MV repair.

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Conclusions: Our analysis suggests that the addition of MV repair to CABG for patients with moderate ischemic MR is unlikely to provide additional quality-adjusted survival at a cost that would meet commonly used cost-effectiveness criteria. The value of this procedure was however sensitive to its uncertain long-term mortality benefits.

P6. Importance of Age in Selection of a Prosthesis for Patients with Aortic Valve Regurgitation: A Propensity Score Matched Analysis of 427 Patients

Ishan K. Shah, *Hartzell V. Schaff, *Richard C. Daly, *Kevin L. Greason, *John M. Stulak, *Alberto Pochettino, Rick A. Nishimura, Brian D. Lahr, *Joseph A. Dearani
Mayo Clinic, Rochester, MN

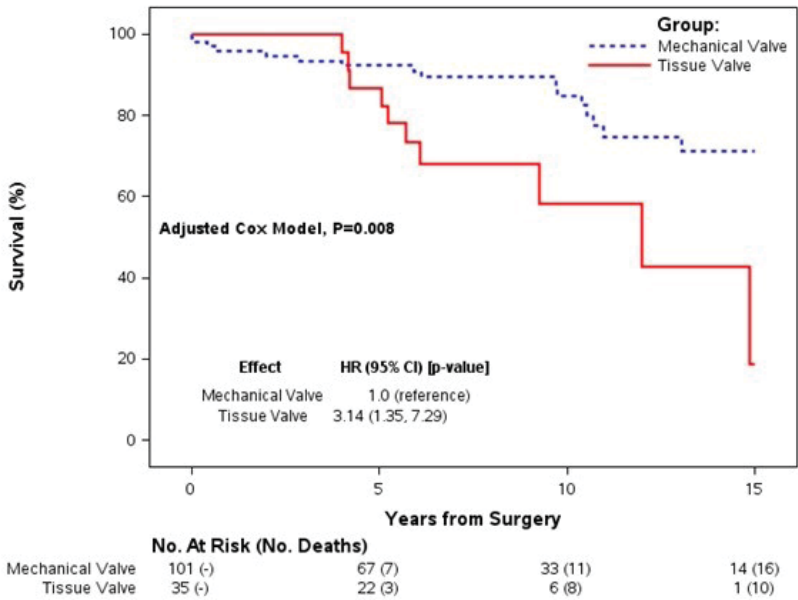
Objective: There is still no consensus regarding the ideal valve prosthesis for patients with aortic regurgitation (AR) requiring aortic valve replacement (AVR). Using multivariable and propensity matched analyses, we examined the impact of valve type on late survival following AVR for AR.

Methods: We reviewed 427 patients (mean age 54.3 ± 15.7 yr., 80% male) who underwent AVR for AR from April 1993 to June 2011, with follow-up through April 2017. We excluded patients with more than mild aortic valve stenosis, active infective endocarditis, prior cardiac surgery, and concomitant cardiac procedures except for aortic root or ascending aortic aneurysm repair. A mechanical prosthesis was implanted in 66% ($n = 283$), while the remaining had a heterograft prosthesis ($n = 144$). Treatment survival comparisons were performed using both multivariable regression and propensity score matched analysis of 71 pairs of patients.

Results: Operative mortality for the entire cohort was 2%, and 1.8% for the subset which had isolated AVR. Overall survival at 1, 5, 10 and 15 years was 98%, 92%, 80% and 60%. Significant predictors of overall mortality in multivariable modeling were older age [HR 1.70 (1.16–2.51), $p < 0.001$], lower preoperative EF [HR 1.29 (1.05, 1.60), $p = 0.018$], concomitant root replacement [HR 1.74 (1.09–2.78), $p = 0.016$], chronic lung

disease [HR 3.75 (2.23–6.30), $p < 0.001$], and hypertension [HR 2.07 (1.35–3.18) $p < 0.001$]. The presence of a bicuspid aortic valve (BAV) was associated with reduced late mortality [HR 0.46 (0.2–0.90) $p = 0.023$]. Because the tissue valve implant HR was not constant over time (test of non-PH, $p = 0.017$), the treatment effect was estimated in two separate intervals. Compared to mechanical valve patients, those treated with tissue valve had comparable mortality [HR 0.77 (0.39–1.54)] during the first five post-operative years, but significantly higher mortality thereafter [HR 2.00 (1.08–3.69)]. Long-term survival for the propensity matched cohort showed no evidence of a time-varying treatment effect ($p = 0.234$) and minimal difference in overall mortality based on valve type [average HR of tissue vs. mechanical 1.38 (0.74–2.56), $p = 0.314$]. However, in propensity adjusted analysis, late survival of patients between the ages of 50 and 70 years was superior in patients with mechanical prostheses (HR for mortality in tissue versus mechanical valves 3.14 (1.35–7.29), $p = 0.008$) (Figure).

Conclusion: Late survival following AVR for AR is influenced by older age and cardiac factors including reduced EF and need for root replacement, but those with BAV had better survival compared to patients with tricuspid valves. In patients 50 to 70 years of age, use of a mechanical prosthesis appeared to be associated with better survival compared to tissue valves, especially beyond 5 years postoperatively.



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P7. Long Term Results After Porcine Xenograft for Aortic-, Mitral- and Doublevalve Replacement

Sven Lehmann, Khalil Jawad, Maja Dieterlen, Stefan Feder, Jens Garbade,

*Michael Borger

Heart Center Leipzig, Leipzig, Germany

Objective: Aim of this study was to evaluate the results after stented porcine xenograft implantation (Epic™, SJM, St.Paul, MN, USA) with Linx™ anticalcification treatment in elderly patients at our high volume tertiary care center.

Methods: A total of 3825 patients receiving aortic (AVR = 2441), mitral (MVR = 892) or double valve (DVR = 492) replacement between 11/2001 and 12/2017 with Epic™ xenograft in our institute were evaluated. All Patients having elective or emergency indications were included. Outcome was assessed by reviewing the prospectively acquired hospital database results as well as regular follow-up information by annual written interview. Follow-up range was from 0 to 15 years and was complete in 100%.

Results: Patient age was 76.4 ± 6 (AVR), 71.2 ± 9 (MVR) and 72.9 ± 8 (DVR) years; 47.7%/52.4%/53.7% were male, 24.9%/16.6%/17.2% had a peripheral arterial disease, 2.3/6.7%/4.3 need preoperative dialysis, active endocarditis was in 4.5%/20.7%/19.7% indication for valve surgery and the logistic EUROSCORE predicted risk for mortality was $15.0 \pm 15\%$ / $20.8 \pm 21\%$ / $19.8 \pm 18\%$, respectively. Additional surgical procedures were mitral valve repair in 232 (9.5%) (AVR) patients, CABG in 1045 [42.8%] (AVR), 219 [24.6] (MVR) and 140 [28.5%] (DVR) patients, cryoablation in 293 [12.0%]/183 [20.5%]/97 [19.7%] patients, and surgery on the thoracic aorta in 187 [7.7%]/49 [5.5%]/56 [11.7%] patients. Mean aortic cross clamp time was 72.0 ± 28 min/ 87.7 ± 44 min/ 114.4 ± 41 min. Mean follow-up was 5.8 ± 4.5 years. Freedom from endocarditis after 10 year was $98.4 \pm 0.3\%$ / $94.5 \pm 1.1\%$ / $95.0 \pm 1.6\%$ (AVR vs. MKR or DVR $p < 0.01$). Freedom for heart reoperation was $93.2 \pm 0.6\%$ / $87.2 \pm 2.1\%$ / $86.6 \pm 2.5\%$ (AVR vs. MKR or DVR $p < 0.01$) and freedom from structural valve disease was $97.3 \pm 0.5\%$ / $98.2 \pm 0.8\%$ / $98.6 \pm 0.8\%$ ($p = \text{n.s.}$) after 10 years. 30 day survival was $91.2 \pm 0.6\%$ / $87.6 \pm 1.1\%$ / $84.7 \pm 1.6\%$ and 10 year survival was $56.7 \pm 1.0\%$ / $59.4 \pm 2.5\%$ / $50.4 \pm 3.1\%$, respectively.

Conclusion: Epic™ stented porcine xenograft is associated with acceptable survival, freedom from valve related complication and freedom from structural valve disease.

P8. Late left Ventricle Remodeling After Repair of degenerative Mitral Regurgitation: Is It Worse in Women? Insights from >1000 Surgical Repair Patients

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Objective: Recent data suggests sex-specific differences in left ventricle (LV) remodeling in patients with ventricular dysfunction or volume overload. Data describing LV remodeling in patients following repair of degenerative mitral regurgitation (MR) is scarce.

Methods: Between 2002 and 2017, 1012 patients underwent repair of MR due to myxomatous degeneration and were followed serially in a dedicated clinic. The mean patient age was 63.8 ± 12.7 years and 277 (27%) were female. One hundred forty nine patients



had no heart failure symptoms prior to surgery, of which 30 were female. Mean preoperative indexed LV end-systolic dimension and LV mass were 19.0 ± 4.3 mm/m² and 218 ± 70 g, respectively. Amongst patients in the largest quartile of indexed LV end-systolic dimension, 29% were women. Clinical and echocardiographic follow-up averaged 6.2 years and extended to 14.7 years. A total of 2659 postoperative echocardiograms were performed for these patients.

Results: Overall, 5- and 10-year freedom from recurrent MR > 2+ was $98.3 \pm 5.5\%$ and $97.2 \pm 8.2\%$, respectively. After a mean of 4.3 years, the mean preoperative indexed LV end-systolic dimension and LV mass were 17.3 ± 4.2 mm/m² and 169 ± 60 g, respectively. Importantly, the postoperative indexed LV end-systolic dimension decreased compared to their preoperative measurement in 64% of patients. Notably, women were less likely to experience a postoperative decrease in indexed LV end-systolic dimension compared to men (hazard ratio, HR, 0.7 ± 0.1 , $p = 0.04$) even after adjusting for differences in age, preoperative atrial fibrillation status, degree of preoperative pulmonary hypertension and the subsequent development of recurrent MR.

Conclusions: Few data are available describing LV remodeling following repair of degenerative MR. In a large population mitral valve repair registry, we have observed sex-specific differences in late LV remodeling. Early surgical intervention for female patients with degenerative MR may be warranted.

P9. Mitral Valve Reoperation for Bioprosthetic Structural Valve Deterioration the Surgical Benchmark

Hoda Javadikasgari, *Eric E. Roselli, Bassman Tappuni, Suyog A. Mokashi, Stephanie Mick, *Jose L. Navia, Ashley M. Lowry, Per Wierup, Milind Y. Desai, *Eugene H. Blackstone, *Lars G. Svensson, *A. Marc Gillinov
Cleveland Clinic, Cleveland, OH

Purpose: With the advent of transcatheter valve-in-valve treatment for management of bioprosthetic mitral valves that have undergone structural valve deterioration (SVD), it is necessary to establish the surgical benchmark. In this study, we sought to evaluate the early outcomes and long-term survival of such patients as well as to identify risk factors associated with mortality.

Methods: From 1/1990 to 1/2017, 1,090 patients underwent redo mitral valve operations including 462 for bioprosthetic SVD, the focus of this study. Preoperative mitral valve regurgitation 3+/4+ was identified in 260 (60%) and the mean gradient of mitral bioprostheses was 12.8 ± 5.62 mmHg with New York Heart Association (NYHA) class III/IV in 223 (49%). Mitral valve replacement was performed as a second reoperation in 324 (69%), third in 107 (23%), fourth in 28 (6%), and fifth in 7 (1.5%). The valve was replaced with surgically implanted bioprostheses in 293 (63%) and mechanical prostheses in 169 (36%). Concomitant procedures included tricuspid valve surgery ($n = 197$, 42%), aortic valve surgery ($n = 142$, 30%) and coronary artery bypass grafting ($n = 100$, 21%). Long-term risk of operation was assessed non-parametrically by the Kaplan-Meier method and parametrically by a multiphase hazard model. Risk factors for death were identified by means of multivariable, multiphase hazard-function analysis.

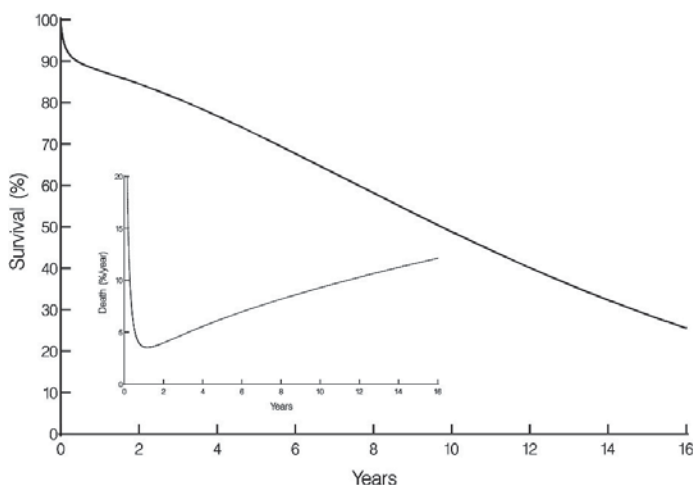
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Results: Hospital mortality was 28 (6%), postoperative renal failure occurred in 18 (7.5%), new-onset atrial fibrillation in 53 (27%), re-exploration for bleeding in 43 (9.2%), and prolonged ventilation in 57 (30%). Survival at 1, 3, 5, 10, and 15 years after mitral valve replacement was 88%, 81%, 72%, 49%, and 29%, respectively. Hazard function analysis yielded an early decreasing phase during the first year after surgery followed by an increasing late phase (Figure). Risk factors for all-cause mortality during the early hazard phase were concomitant atrial septal defect repair, concomitant coronary artery bypass grafting, higher NYHA class, higher preoperative BUN, and preoperative complete heart block. Risk factors for death during the late phase were older age, history of smoking, higher number of cardiac surgeries, history of insulin treated diabetes mellitus, history of myocardial infarction, and higher preoperative creatinine and bilirubin.

Conclusions: In patients with mitral valve reoperation for bioprosthetic SVD, surgical risk and long-term mortality are acceptable and set a benchmark for transcatheter therapies. At this time, patient-specific risk factors associated with early mortality—higher NYHA class, renal dysfunction and heart block—should be used to choose patients for transcatheter therapies.



P10. Influence of Surgical Volume on Outcomes in Low Risk Patients Having Isolated Surgical Aortic Valve Replacement

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Objective: Contemporary data suggests that operative outcomes in intermediate and high-risk patients undergoing isolated surgical aortic valve replacement (AVR) are superior at higher volume programs compared to lower volume programs. The influence of surgical volume on outcomes in low risk AVR patients has not previously been reported. The Texas Quality Initiative (TQI) is a collaborative effort between 30 North Texas hospitals to pool Society of Thoracic Surgeons (STS) data for outcomes research. Using this data, we compared the impact of hospital volume on patient outcomes for low risk patients having isolated AVR.



Methods: Data was analyzed for isolated surgical AVR cases performed between 1/1/2012 and 12/31/2016. Low risk patients were defined as having a predicted risk of mortality using the STS risk algorithm of $\leq 3\%$ with surgical AVR. High volume (HV) centers were defined as those performing ≥ 150 isolated AVR cases over the 5 year time frame, and low volume (LV) programs as those performing < 150 cases. Logistic regression analysis was used to calculate odds ratios for major outcomes after controlling for applicable risk factors.

Results: A total of 1744 AVR cases were available for analysis, with 1203/1744 (69.0%) performed at 5 HV hospitals and 541 (31.0%) done at 25 LV hospitals. There was no statistical difference in the predicted risk of mortality (PROM) for isolated AVR between the HV and LV hospitals (1.58% vs. 1.56%; $p = 0.756$) respectively.

The table shows odds ratios for outcomes between LV programs compared to HV centers.

Parameter	AVR	
	Odds Ratio (95% CI)	p Value
DSWI (Deep Sternal Wound Infection)	3.50 (0.51–24.0)	0.202
Major-Morbidity (No Mortality)	1.13 (0.81–1.59)	0.472
Prolonged Ventilation	1.08 (0.69–1.68)	0.750
Renal Failure	2.53 (1.25–5.10)	0.010
Reoperation	0.83 (0.49–1.41)	0.490
Stroke	0.62 (0.27–1.42)	0.255
Operative Mortality	2.41 (1.25–4.66)	0.009

Conclusions: Operative mortality with isolated AVR is significantly higher in LV centers compared to HV programs for low surgical risk patients. The probability of a major complication, such as renal failure, is also greater in low volume hospitals. Consideration should be given to aggregating even low risk patients with structural heart disease at higher volume programs.

P11. Surgical AVR for Bicuspid Aortic Valve Disease: Is It the Last Stronghold for the Surgeon?

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Objective: Patients with bicuspid aortic valve (BAV) stenosis with fused leaflets and a raphe (90%, Sievers classification type 1) can participate in the Sapien 3 randomized trial (low risk trial). This is based on the outcomes of the Bicuspid TAVR Registry. We reviewed our outcomes for the treatment of BAV with surgical aortic valve replacement (SAVR) over the past 10 years to put TAVR for bicuspid valve into perspective.

Methods: From January 1, 2006 to December 31, 2016, 749 consecutive patients with BAV pathology underwent SAVR, 402 isolated AVR and 331 AVR + aortic conduit. Preoperative, intraoperative characteristics and post procedure outcomes were analyzed and compared between the two surgical groups.

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Results: All 749 patients underwent SAVR with tissue, mechanical or autograft valve substitutes, 402 isolated AVR and 331 with an aortic conduit (AVR + Ao). Preoperative patient characteristics for AVR vs. AVR + Ao were: age, 62.0 ± 14.2 vs. 58.7 ± 13.4 years ($p = 0.001$), female sex, 30.1% vs. 21.8% ($p = 0.01$) respectively, hypertension, diabetes, and creatinine were similar between groups ($p = \text{ns}$). AVR vs. AVR+Ao pathologies were: aortic stenosis, 86.3% vs. 61.9% ($p < 0.0001$), moderate to severe insufficiency, 40.1% vs. 44.4% ($p = 0.24$) and Aortic aneurysm 2.2% vs. 70.1% ($p < 0.0001$). Concomitant coronary bypass or mitral valve surgery were similar ($p = \text{ns}$). Conduit locations for the AVR+Ao cohort were: Ao root, 52.9%, ascending Ao, 96.7% and hemi Ao, 35.3%. Cross clamp times for AVR vs. AVR+Ao were 87.7 ± 31.3 min vs. 114 ± 39.8 min. Postoperative complications were: reop for bleeding, 3.0% vs. 5.7% ($p = 0.01$), stroke, 0.7% vs. 1.8% ($p = 0.31$), pacemaker, 4.2% vs. 5.7% ($p = 0.39$), atrial fibrillation, 24.4% vs. 24.2% ($p = >0.99$). Overall there were seven 30 day deaths (1.0%), AVR vs. AVR+Ao were; 1 (0.2%) vs. 6 (1.8%), ($p = 0.05$).

Conclusions: SAVR surgical mortality for BAV disease in our experience is 0.2% (1 out of 402 patients) and the incidence of pacemaker is 4.2%. Based on published results of TAVR, including 30-day mortality (4.5%) and high incidence of pacemaker implant (10 to 20%), TAVR should not be considered in patients with BAV disease until outcomes become similar to those presented here.

P12. Long Term Survival After Concomitant Surgical Ablation for Atrial Fibrillation in Patients Undergoing Mitral Valve Procedures — Analysis from Polish Nationwide Cardiac Surgery Registry (KROK)

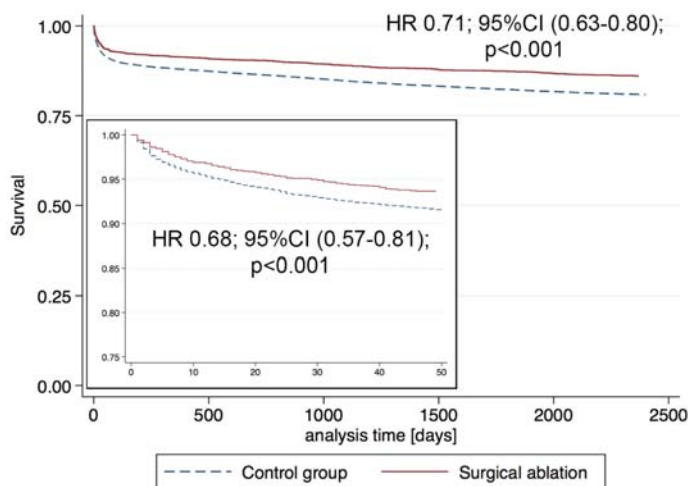
Piotr Suwalski¹, Jakub Staromlynski¹, Marek Jasinski², *Marian Zembala³, Kazimierz Widenka⁴, Mirosław Brykczynski⁵, Jacek Skiba⁶, Michał Oskar Zembala³, Krzysztof Bartus⁷, Tomasz Hirnle⁸, Janusz Sierdziński², Zdzisław Tobota⁹, *Bohdan Maruszewski⁹

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Objective: Surgical ablation for atrial fibrillation (AF) performed at the time of other valvular- or non-valvular cardiac procedures is a mainstay of therapy; yet the data regarding its impact on long term survival are sparse. Objective of current investigation was to evaluate long term survival in patients undergoing mitral valve (MV) surgery with concomitant surgical ablation for AF.

Methods: Procedural data from mandatory and validated Polish Nationwide Cardiac Surgery Registry (KROK) were retrospectively collected. Long-term survival data were provided by local NHS office. There were 13,421 patients (46.3% men, age 64.7 ± 9) undergoing mitral valve surgery between 2006–2016 in 37 reference centers across Poland. Median follow-up was 6 years (6.34 IQR 3.49–9.01). Cox proportional hazards model with exact marginal likelihood was used for computations.

Results: Of included patients, 2,358 (17.6%) underwent concomitant surgical ablation. Patients in this group were significantly younger (62.8 ± 8.6 vs. 64.7 ± 9.0 ; $p < 0.001$) and were at lower baseline surgical risk (EuroSCORE 2.46 vs. 3.05; $p < 0.001$). In an unadjusted analysis, surgical ablation, lower age, -functional NYHA class, -CCS class, -mitral regurgitation grade were all associated with higher survival. MV replacement unlike MV repair was associated with worse long term prognosis. 30-day mortality was lower in patients undergoing surgical ablation (5.51% vs. 8.82%; Hazard Ratio [95% CIs]: 0.68 [0.57–0.81]; $p < 0.001$) as compared to controls; Unadjusted HR for long term survival at 6 years favored surgical ablation: HR 0.71; 95% CI (0.63–0.80); $p < 0.001$ (Figure). After propensity matching (PROBIT model, 484 pairs matched for EuroSCORE, age, gender, NYHA, CCS, MR grade, MV procedure were set). Surgical ablation remained significant prognostic for improved survival ($p < 0.001$) in the univariate analyses; the long term trend was maintained as well with 25% higher survival (HR 0.75; 95% CI [0.35–1.59]); yet the differences were not statistically significant.



Conclusions: Concomitant surgical ablation for atrial fibrillation in patients undergoing mitral valve procedures is associated with improved long-term survival.

P13. Impact of “High-Risk” Donor Heart on the Outcome of Orthotopic Heart Transplant: A Propensity Matched Score Analysis of the United Network for Organ Sharing Database

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Objective: Orthotopic heart transplantation (OHT) remains the gold standard for advanced heart failure. Since 2004, a high risk (HR) donor was categorized by the United Network for Organ Sharing Database (UNOS) according to the Center for Disease Control (CDC) criteria. However, the impact of CDC HR donor hearts on the outcome of adult OHT recipients is still debatable. The aim of this study was to compare the outcome of adult OHT recipients between CDC HR and non-CDC HR donor grafts.

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Methods: Data was obtained from the UNOS database. All adult (age ≥ 18) patients undergoing OHT from 2004 through 2016 were included ($n = 24,751$). Propensity scores for CDC HR donors were calculated by estimating probabilities of CDC HR donor graft utilization using a non-parsimonious multi-variable logistic regression model. Patients were matched 1:1 using a greedy matching algorithm based on the propensity score of each patient, reducing potential biases. The impact of CDC HR donors on the post-transplant outcomes, such as 30-day and overall mortalities were investigated using Cox-proportional hazards. The overall survival probability analyses were performed.

Results: Of 24,751 primary heart transplants from 2004 to 2016, there were 6,740 transplants successfully matched (CDC HR, $n = 3,370$; non-CDC HR, $n = 3,370$). There were no significant differences in recipients' baseline and donors' characteristics (Table). In the Cox-proportional hazards model, the utilization of CDC HR grafts was not associated with 30 day (hazard ratio [HR], 0.91; 95% confidence interval [95% CI], 0.76–1.09; p value = 0.33) and overall mortalities ([HR], 0.94; 95% confidence interval [95% CI], 0.85–1.04; p value = 0.23). Although post-transplant acute rejection episodes were found more often in the CDC-HR group, compared with the non-CDC HR group (CDC HR, $n = 378$ [11.2%]; non-CDC HR, $n = 312$ [9.3%]; $p = 0.008$), there was no significant difference in the overall survival probability between CDC HR and non-CDC HR groups ($p = 0.23$, log-rank test) (Figure).

A propensity score matched analysis

	CDC HR (n=3370)	Non CDC HR (n=3370)	p value
Recipients' baseline characteristics			
Age (y)	53.7 \pm 12.2	53.5 \pm 12.3	0.59
Gender, male, n (%)	2655 (78.8)	2645 (78.5)	0.77
Body mass index (kg/m ²)	27.3 \pm 4.8	27.4 \pm 4.9	0.24
Past medical history			
Diabetes mellitus, n (%)	953 (28.3)	937 (27.8)	0.66
On hemodialysis, n (%)	144 (4.3)	146 (4.3)	0.9
Etiology of heart failure			
Non-ischemic cardiomyopathy, n (%)	1638 (48.6)	1639 (48.6)	0.97
Ischemic cardiomyopathy, n (%)	1158 (34.4)	1153 (34.2)	
Restrictive heart disease, n (%)	103 (3.1)	101 (3.0)	
Congenital heart disease, n (%)	95 (2.8)	97 (2.9)	
Hypertrophic cardiomyopathy, n (%)	78 (2.3)	73 (2.2)	
Valvular heart disease, n (%)	40 (1.2)	50 (1.5)	
Others, n (%)	258 (7.7)	257 (7.6)	
Total waitlist time (years)	0.61 \pm 0.96	0.62 \pm 0.99	0.88
Previous cardiac surgery, n (%)	1813 (53.8)	1789 (53.1)	0.56
Pre-operative life support, n (%)			
Hospitalization in ICU, n (%)	545 (162)	562 (16.7)	0.57
IABP, n (%)	228 (6.8)	235 (7.0)	0.74
ECMO, n (%)	23 (0.7)	22 (0.7)	0.88
Durable VAD, n (%)	1484 (44.0)	1458 (43.3)	0.52
Blood type			
A, n (%)	1369 (40.6)	1349 (40.0)	0.86
B, n (%)	483 (14.3)	488 (14.5)	
AB, n (%)	188 (5.6)	177 (5.3)	
O, n (%)	1330 (39.5)	1356 (40.2)	
Pre-operative data			
Creatinine (mg/dL)	1.34 \pm 0.85	1.35 \pm 0.92	0.55
Total bilirubin (mg/dL)	1.01 \pm 1.07	0.99 \pm 1.19	0.47
Donors' characteristics			
Gender, male, n (%)	2663 (78.1)	2627 (78.0)	0.86
Blood type			
A, n (%)	1183 (35.1)	1178 (35.0)	0.78
B, n (%)	377 (11.2)	354 (10.5)	
AB, n (%)	58 (1.7)	63 (1.9)	
O, n (%)	1752 (52.0)	1775 (52.7)	

CDC=Center for Disease Control, HR=high risk, ICU=intensive care unit, IABP=intra-aortic balloon pump, ECMO=extracorporeal membrane oxygenation, VAD=ventricular assist device.

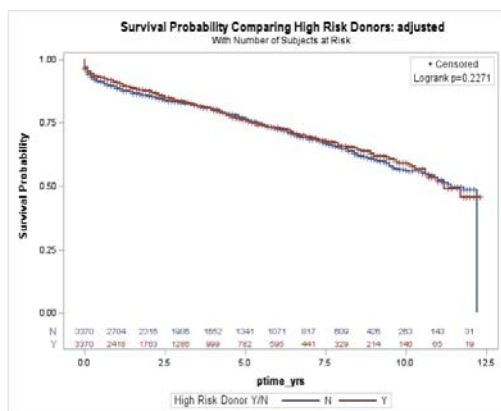


Figure. Kaplan-Meier curve of graft survival probability comparing patients who received high risk (red line) versus non-high risk donor hearts (blue line).

Conclusions: CDC HR status does not have a significant impact on adult OHT recipient survival probability. Increased utilization of CDC HR donor grafts can potentially improve the persistent and worsening shortage of available donor organs, and shorten the waitlist times for heart transplantation.

P14. Repair-Oriented Classification of Bicuspid Aortic Valve Anatomy: A Clinical Study in Aortic Valve Repair Surgery

*Laurent de Kerchove¹, Stefano Mastrobuoni¹, Lennart Froede², *Munir Boodhwani³, *Gebrine el Khoury¹, Hans-Joachim Schäfers²

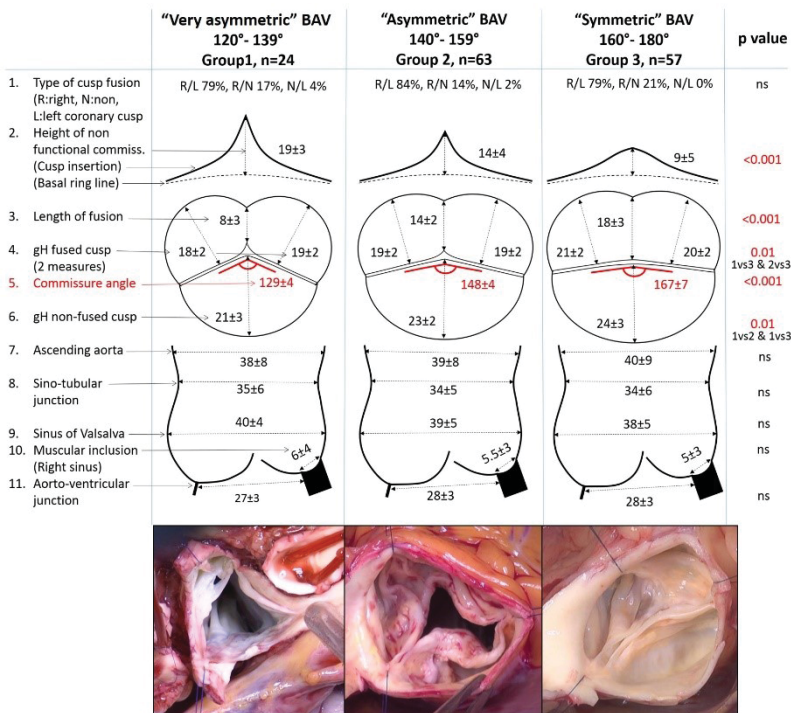
¹*Cliniques Universitaires Saint-Luc, Brussels, Belgium*; ²*Universitätsklinikum des Saarlandes, Homburg, Germany*; ³*University of Ottawa Heart Institute, Ottawa, ON, Canada*

Objective: Bicuspid aortic valve (BAV) presents a large variety of phenotypes insufficiently described by existing classifications. The aim of this study was to assess the anatomic characteristics of the different phenotypes and elaborate a classification to orient repair surgery.

Methods: In two centers experienced in aortic valve repair, between July 2015 and May 2017, the anatomical characteristics of BAV were measured in 115 consecutive patients operated for aortic insufficiency (AI) or aorta dilatation. Inclusion criteria were all repairable BAV. Exclusion criteria were BAV stenosis, tricuspid and unicuspid valve. Mean age was 45 ± 10 years and 83% were male. Eleven anatomical parameters were measured on preoperative echocardiography and intraoperatively (Figure). Patients were divided into 3 groups following their commissural orientation (group 1: Very asymmetric BAV, 120° – 139° , n = 20; group 2: Asymmetric BAV, 140° – 159° , n = 53; group 3: Symmetric BAV, 160° – 180° , n = 42).

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Results: Age, gender, grade of AI, transvalvular gradients, type of cusp fusion, aortic diameters, height of functional commissures and width of muscular inclusion in the left and right sinuses did not differ significantly between the 3 groups. However, the commissure orientation angle correlates positively with the length of fusion of the raphe ($R^2 = 0.56$, $p < 0.001$) and negatively with the height of non-functional commissure ($R^2 = 0.45$, $p < 0.001$). Further, commissure angle, length of fusion and geometric height (gH) of both cusps increase significantly from group 1 to 3. The ratio between length of fusion and mean gH of fused cusp was 0.44 ± 0.1 in group 1, 0.75 ± 0.1 in group 2 and 0.88 ± 0.1 in group 3 ($p < 0.001$). The height of non-functional commissure decrease significantly from group 1 to 3 ($p < 0.001$).

Conclusions: We describe the main anatomical parameters (Commissure orientation, length of raphe fusion, height of the raphe) varying across the spectrum of reparable BAV. We demonstrate that the spectrum of BAV phenotypes extends from very asymmetric tricuspid-like BAV on one extremity to symmetric BAV on the other extremity. We propose a new repair-oriented classification based on those criteria and reflecting directly the degree of BAV symmetry. This classification needs further validation with regards to surgical techniques and outcomes.



Late-Breaking Clinical Trial

LB7. Dissected Aorta Repair Through Stent Implantation (DARTS): First-in-Man Results of a Feasibility, Safety and Performance Trial

Sabin Joseph Bozzo¹, Jeevan Nagendran¹, Roderick G.G. MacArthur¹, Michael W.A. Chu², Bob Kiaii², Ismail El-Hamamsy³, Raymond Cartier³, Ali Shariari⁴, Michael C. Moon¹

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Late-Breaking Clinical Trial

LB8. Long-Term Outcomes of Aortic Root Operations in the United States Among Medicare Beneficiaries: An Analysis of the Society of Thoracic Surgeons Adult Cardiac Surgery Database

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¹Duke University, Durham, NC; ²University of Pennsylvania, Philadelphia, PA; ³Duke Clinical Research Institute, Durham, NC; ⁴Johns Hopkins All Children's Heart Institute, Saint Petersburg, FL; ⁵West Virginia University Heart & Vascular Institute, Morgantown, WV; ⁶Medstar Heart Institute/Washington Hospital Center, Washington, DC

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Congenital Heart Disease

Aisle 1200, Exhibit Hall, SDCC

Moderated Poster Competition

Not for Credit

3 minute presentation, 2 minute discussion

Moderators: *Sitaram M. Emani and *James J. Gangemi

P15. Can We Still Improve Survival Outcomes of Neonatal Biventricular Repairs?

Osami Honjo, Christoph Haller, Shuhua Luo, Kasey Moss, Steve Fan, Cedric Manlhiot, Wenli Xie, Alli Moinshaghagh, Steven Schwartz, *Christopher Caldarone, *Glen Van Aresdell

The Hospital for Sick Children, Toronto, ON, Canada

Objective: It is frequently claimed that survival rates of biventricular repair of congenital heart disease are essentially at a theoretical maximum. We sought to evaluate mortality and re-intervention amongst neonates undergoing biventricular repair over 2 decades at a single center and to delineate modifiable factors that could improve survival.

Methods: We reviewed outcomes of 991 patients who underwent biventricular repair up to 28 days of life from 1995 and to 2016. The cohort was divided by era: Era I (1995–1999), Era II (2000–2007), Era III (2008–2016). Kaplan-Meier method analysis was used to estimate the freedom from death and reintervention among the groups. Univariate and multivariate Cox regression was applied to assess predictors for mortality or reintervention in the contemporary cohort (2000–2016).

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Results: The median age and body weight at operation was 8 days (IQR 5–13) and 3.3 kg (2.9–3.6), respectively. Transposition with intact ventricular septum was the most common diagnosis (32%) followed by transposition with VSD (14.5%) and simple left-to-right shunt lesion (10.9%). There was significant improvement in survival from Era I to Era II and III but there was no difference between Era II and III (At 1 year: 82.1% vs. 89.4% vs. 89.6%, $p < 0.001$ Figure A). Multivariate analysis revealed pre- and postoperative ECMO ($p < 0.001$) and postoperative renal replacement ($p < 0.001$) as independent predictors for death. Predictors that were statistically significant with univariate analysis such as body surface area, diagnosis, RACHS score, cardiopulmonary bypass time, and residual lesions were not significant in multivariate analysis. Re-intervention rate was comparable between Era II and III (at 3 years, 18.3% vs. 20.9%, $p = 0.53$, Figure B). The primary diagnoses, i.e., AVSD, DORV, left/right outflow tract obstruction, and common arterial trunk, were identified as predictors for re-intervention.

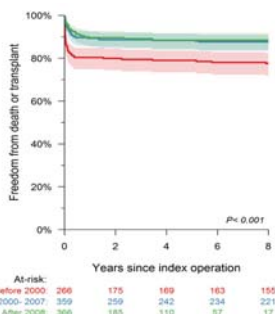


Fig A: The Kaplan-Meier freedom from death or transplant

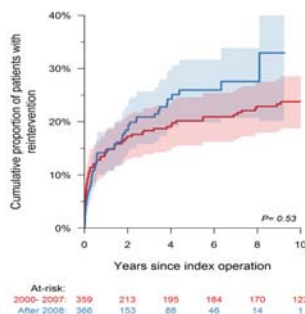


Fig B: The cumulative proportion of patients with re-intervention

Conclusions: There was significant improvement in survival from 1990's to 2000's but there was no further improvement in the last 15 years. There is still opportunity for improvement as there is still approximately 10% mortality in the first year. Predictors for death, i.e., requirement of ECMO and renal replacement therapy, indicate prime importance of refining myocardial and end organ protection strategies in perioperative period. Re-intervention rate remains high in which one fifth of the patients required re-intervention in the first 3 years. Seeking further surgical modifications to minimize re-intervention is warranted.

P16. Aortic Valve Function After Repair of Ventricular Septal Defect and Aortic Regurgitation

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Objective: Aortic regurgitation (AR) is an indication for surgical repair of restrictive ventricular septal defect (VSD). However long-term studies evaluating the effectiveness of VSD closure alone in improving or preventing progression of AR are lacking. We aimed



to evaluate the progression of AR in patients with preoperative aortic valve regurgitation (AR) who underwent perimembranous or sub arterial VSD repair.

Methods: Thirty-seven patients who had longer than 6-months post-operative follow-up were included in the final analysis among sixty-two patients (age at surgery: 2.7 years (0.2 to 16.6)) with restrictive perimembranous or subarterial VSD and AR who underwent surgery between April 2007 and March 2016. Demographic and echocardiographic data were reviewed retrospectively. Mortality and morbidity were analysed. AR grade, left ventricular function and dimensions were compared between the preoperative and last available transthoracic echocardiogram. Multivariate logistic regression analysis was performed to determine factors associated with improvement of aortic valve function.

Results: There was no operative or long-term mortality. No re-operations or re-interventions were required. Seventeen patients had greater than mild AR preoperatively. Only 5 patients had mild or greater AR at follow-up of 4.3 years (0.5 to 10.1). Twenty-eight (76%) of the 37 patients improved their AR grade. Left ventricular end systolic and end diastolic diameter Z-scores were significantly lower at follow-up ($p = 0.007$ and $p < 0.001$, respectively). Multivariable logistic regression identified low preoperative EF as the strongest predictor of non-improvement of AR. (AUC = 0.884, 95% CI: 0.732–0.999, $P = .002$).

Conclusions: VSD repair with accompanying AR can be performed with excellent results without surgical intervention on the aortic valve. Accompanying AR at the time of VSD repair improves in most cases. Low preoperative LVEF is predictive of non-improvement of AR grade.

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P17. Do Patients with an Anomalous Origin of the Left Coronary Artery (ALCAPA) Benefit from an Early Mitral Valve Repair? A Retrospective Observational Study

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Objective: The aim of this study was to determine short term outcomes of patients undergoing repair of anomalous left coronary artery from pulmonary artery (ALCAPA) in terms of ventricular remodeling and re-intervention on mitral valve.

Methods: Patients diagnosed with ALCAPA who underwent surgery from January 2000 to February 2017 were retrospectively evaluated. Patients were divided into those undergoing coronary transfer alone (Group A) vs. those undergoing transfers plus mitral valve annuloplasty (Group B) Mitral regurgitation (MR) grade (none, trivial-mild, moderate, severe), left ventricular ejection fraction (EF) (categorized into $<40\%/40-50\%/>50\%$) and left ventricular (LV) long axis dimension Z scores were assessed by echocardiography preoperatively, early after surgery and at latest follow-up. Rate of mitral valve re-intervention was assessed and changes in MR grade were analyzed by the Wilcoxon signed-ranks test.

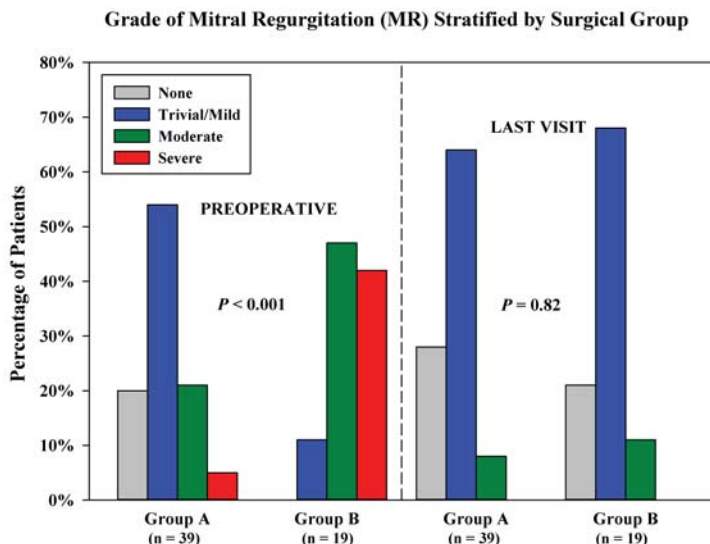
Results: Of 61 patients fulfilling inclusion criteria (67% female, median age 4.4 months, IQR: 2–50 months) 39 patients were in Group A (69%) and 19 in Group B (31%). Both

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groups were comparable in terms of average hospital stay (14.1 days) and median follow-up time (0.7 years). Composite adverse endpoint of mortality and surgical reintervention was reached in 16.7% of the patients in Group A compared to 0% in Group B ($P < 0.05$).

Preoperative grade of MR was significantly different in Group A compared to Group B (Figure 1, $P < 0.001$). Ultimately both groups demonstrated significant improvement in MR grade between preoperative and most recent echocardiogram ($P < 0.001$ for Group A and $P < 0.001$ for Group B) such that the grade of MR was not significantly different between the two groups at latest follow up.



In terms of EF, the two groups did not differ significantly at baseline (group A: 38%/23%/38% vs. group B: 58%/10%/32%, $P = 0.316$) or at the last visit (group A: 18%/15%/67% vs. group B: 26%/16%/58%, $P = 0.745$), but both groups showed significant improvement $P = 0.004$ and $P = 0.014$, respectively.

The mean LV Z-score for groups A and B were 3.1 ± 0.5 and 4.5 ± 0.6 before surgery and 1.5 ± 0.3 and 2.7 ± 0.6 at the last follow-up ($P = 0.77$). A total of 80% out of all patients showed improvement in LV Z-scores, 60% of these were neonates.

Conclusion: Repair of ALCAPA is associated with improvement in mitral regurgitation, ventricular function, and left ventricular dimensions. However, patients with mitral regurgitation undergoing initial ALCAPA repair alone eventually require mitral reintervention. For patients with greater than moderate regurgitation, concomitant mitral and ALCAPA repair should be considered.



P18. An International Survey Comparing Different Physician Models for Health Care Delivery in Pediatric Cardiac Intensive Care

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Objective: To evaluate the training background of currently practicing pediatric cardiac ICU attending physicians at centers performing cardiac surgery. A secondary aim of this survey was to evaluate the impact of varied training background on the strengths and weaknesses of ICU physicians in their day-to-day clinical practice.

Methods: This was a cross-sectional observational survey sent to ~550 practicing cardiac ICU attending physicians at centers performing cardiac surgery (18 countries). In addition, the survey was posted on a website that is a collaborative, independent, and information resource for professionals caring for critically ill children (www.pedscm.org). The 24-item questionnaire survey included ordinal, categorical, and open-ended questions. The final version of the survey is provided for online viewing: <http://j.mp/2pZkWtt>.

Results: Responses were received from 243 ICU attending physicians from 85 centers (12 countries). The primary training background of the respondents included critical care (150 physicians, 61.7%), cardiology (34 physicians, 13.9%), dual training in both critical care and cardiology (39 physicians, 16.1%), and other training background (20 physicians, 8.2%). The respondents also included medical directors from 48 centers (9 countries) who provided the breakdown of training background of ICU physicians at their centers (Figure). We compared the data provided by the medical directors with the data obtained from an administrative dataset, Pediatric Health Information Systems (PHIS). We noted that critical care trained physicians (57.8%) predominantly provide cardiac critical care, followed by dual-trained physicians (18.2%), cardiologists (12.5%), and physicians with other training background (11.4%). Dual trained and cardiology trained physicians were more common in centers with higher surgical volume. Higher proportion of physicians with critical care and dual training felt confident in managing multi-organ failure, neurological conditions, brain death, cardiac arrest, and performing procedures such as advanced airway placement, inserting chest- and abdominal-drains. In contrast, physicians with cardiology and dual training felt more confident in managing intractable arrhythmias, understanding cardio-pulmonary interactions and single ventricle physiology, and interpreting echocardiogram, electrocardiogram, and cardiac catheterization. Overall, only 139 respondents (57.2%) felt most comfortable in managing patients in cardiac ICU with their current level of training.

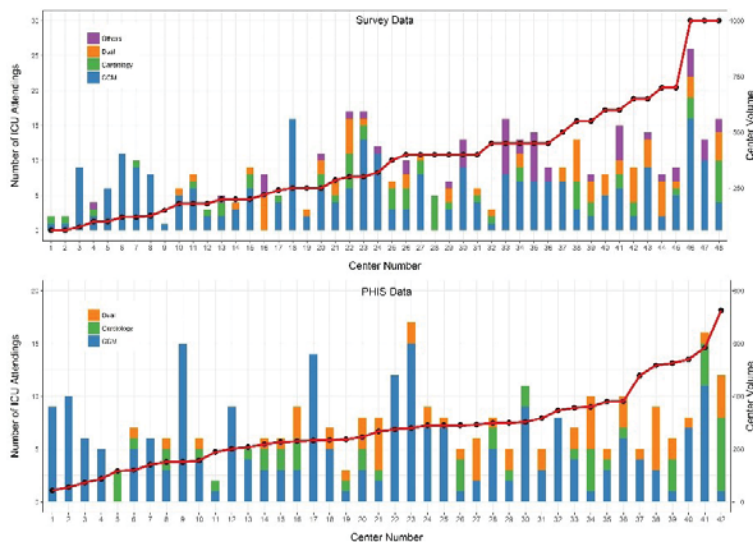
Conclusions: Our survey demonstrates that training background of currently practicing cardiac ICU physicians is extremely variable. Our survey highlights the need for consistencies in cardiac ICU training with need for significant cross training among physicians managing critically ill children with heart disease.

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P19. Revival and Modification of the Mustard Operation for Neglected Patients with TGA in the Developing World

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Objective: The neonatal arterial switch operation (ASO) is currently the procedure of choice for patients with TGA. However, a large number of patients in the developing world, present too late for ASO and are best managed with atrial switch.

Methods: We have used the Mustard operation in its original form or following a new modification to enhance the reservoir, conduit and contractile function of the atrial chamber filling the LV (Figure 1), in an attempt to improve long-term results.

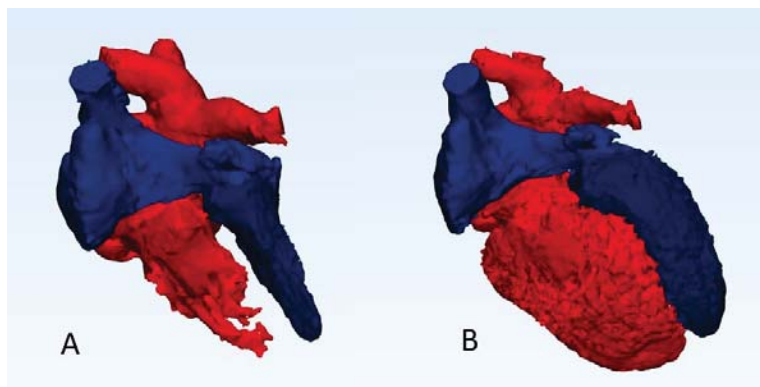


Figure 1: Post-operative 3D models following the modified Mustard operations, showing systolic (A) and diastolic (B) phases.



Results: Between July 2013 and October 2017, a total of 71 patients underwent the Mustard operation, 14 in its original form and 57 in the modified. The median age at operation was 1.5 years (6 months–21 years). 55 patients (77.4%) were males. All patients were severely incapacitated with median preoperative oxygen saturation of 71% (53–86%). Pre-operative hemoglobin level was 17 gm/dl. 7 patients had systolic pulmonary artery pressure more than 30 mmHg, of which 3 had large VSD and underwent palliative Mustard operation, leaving the VSD open. There were no early or late deaths during a follow up period of up to 3 years. All patients had considerable symptomatic improvement. During the early post-operative period, one patient developed temporary heart block and 5 patients had transient nodal rhythm. At latest follow up, all patients were in stable sinus rhythm. There were no baffle leaks. 7 patients had asymptomatic narrowing of the superior baffle, one required balloon dilatation.

Conclusion: The use of the Mustard operation, particularly the modified technique should play an important role in treating neglected patients with TGA in developing countries. Improving the reservoir and contractile function of the atria could enhance the long-term results of the Mustard operation.

P20. Single-Centre 20-Year Experience of Truncus Arteriosus Repair

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Objective: To review a large single-centre series of primary truncus arteriosus (TA) repair and identify risk factors for mortality and reoperations.

Methods: A retrospective study of consecutive patients (n = 97) who underwent primary TA repair between 1997 and 2017 in a single institution.

Results: There were 17 early deaths (17.5%, 17/97). Univariate analysis identified period of operation prior to 2007 (p = 0.001), age more than 30 days (p = 0.03) and direct right ventricle to pulmonary artery (RV-PA) connection (p = 0.001) as risk factors for early mortality, whereas weight less than 2.5 kg, truncal valve (TV) insufficiency more or equal to moderate at the time of presentation, coronary artery abnormalities, presence of coarctation of aorta (CoAo), interrupted aortic arch (IAA), discontinuous pulmonary arteries (DPA's) and 22q11 microdeletion were not associated with poor outcome. Multivariate analysis identified only direct RV-PA connection (p = 0.001) as a risk factor for early death. Follow-up was complete in all patients. There was 10 late deaths with nine of them occurred within 12 months after repair. Overall survival was 68% at 15 years. Truncal valve insufficiency more or equal to moderate at the time of presentation, coronary artery abnormalities, presence of CoAo, IAA, DPA's, weight less than 2.5 kg and 22q11 microdeletion were not associated with late death by Cox-regression analysis. Freedom from the first RV-PA reoperation was 22% at 10 years and freedom from the second RV-PA reoperation was 89% at 15 years, respectively. Fifteen patients underwent TV repair/replacement. Freedom from TV repair/replacement was 84% at 15 years. The necessity for TV repair/replacement was not associated with number of TV cusps, TV insufficiency more or equal to moderate at the time of presentation by Cox-regression analysis. At last follow-up 73% of patients were in New York Heart Association Class I and 27% in Class II, respectively.

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Risk factors for early mortality

Variable	Hospital death, %	Univariate		Multivariate-regression	
		OR (95% CI)	p-value	OR (95% CI)	p-value
Operation prior to 2007	45.2% (14/31)	17.291 (4.451, 67.189)	0.001		NS
Age at operation	-	1.01 (0.99, 1.02)	0.233		NS
Age more than 30 days	26% (13/50)	3.777 (1.133, 12.587)	0.03		NS
Weight ≤ 2.5 kg	0% (0/4)	inestimable	inestimable		NS
HTK solution	6.2% (5/81)	0.022 (0.005, 0.093)	0.001		NS
TV insufficiency ≥ moderate	16.7% (4/24)	0.923 (0.270, 3.157)	0.898		NS
Coronary arteries abnormalities	12.5% (1/8)	0.652 (0.075, 5.674)	0.698		NS
A4 type of truncus arteriosus	0% (0/4)	inestimable	inestimable		NS
A3 type of truncus arteriosus	0% (0/5)	inestimable	inestimable		NS
Direct RV-PA connection	81.8% (9/11)	43.875 (7.046, 239.251)	0.001	17.190 (2.206, 133.959)	0.007
TV repair at the time of operation	18.2% (4/22)	1.060 (0.307, 3.653)	0.927		NS
Delayed sternal closure	15.4% (8/52)	0.727 (0.255, 2.077)	0.552		NS
Syndrome Di-George	7.7% (1/13)	1.083 (0.061, 19.313)	0.957		NS

Conclusions: In the current era TA can be repaired with good immediate and long-term outcome, however, a significant burden of RV-PA reoperation still persists. Direct RV-PA connection was associated with early death.

P21. Ideal Pulmonary Valve Annulus Dimension After Annulus Preservation in Tofis Far Smaller than Normal Annulus Size for Each Patient

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Objective: If ideal right ventricular outflow tract (RVOT) reconstruction in ToF stipulates minimal composite risk of pulmonary stenosis (PS) and pulmonary regurgitation (PR), preservation of the pulmonary valve annulus (PVA) should be accompanied by the minimal intervention on the pulmonary valve (PV) to maintain the structural integrity.

Methods: From January 2016 to September 2017, 61 patients (33 male) with prenatally diagnosed ToF underwent repair (primary repair in 56, repair after systemic-pulmonary shunt in 5). Mean age and body weight at repair were 174 ± 56 days and 7.4 ± 1.2 kg, respectively. Median preoperative PVA Z-score was -1.83 (interquartile range [IQR]; $-2.56 \sim -0.90$). Upon PVA preservation, subvalvar and supra-valvar obstruction were completely eliminated by extensive RVOT resection (with or without patching) and main pulmonary artery patch widening so that pressure gradient developed only at the PV level.

Results: There was no early or late mortality. PVA preservation was achieved in 58 patients (58/61, 95%). Surgical interventions on the PV at repair comprised extensive commissurotomy in 35, commissurotomy with rigid dilator bougienation in 8, and TAP in 3. In the remaining 15 patients, the PV was left intact without any intervention. Median PVA dimension measured by Hegar dilator after PV intervention (or no intervention) was 8 mm (IQR; $7 \sim 9$), which was 3.9 mm (IQR; $2.3 \sim 4.3$) smaller than normal PVA size for each patient and could be translated into -1.84 in Z-score (IQR; $-2.40 \sim -0.78$) based on the echocardiographic normogram. After the procedure, the mean pressure ratio



of right ventricle (RV) and left ventricle (LV) was 0.47 ± 0.12 . On immediate postoperative echocardiography, mean RVOT velocity was 2.60 ± 0.61 m/s, and only two patients had significant PS. No patient was found to have PR equal to or greater than moderate except for three patients who underwent TAP. In patients without intervention on the PV ($n = 15$), PVA dimension measured by Hegar dilator was 8 mm (IQR; 7~9), which was 3.3 mm (IQR; 1~4.6 mm) smaller than the normal value and could be translated into -1.63 (IQR; $-2.51 \sim 0.18$) in Z-score. Median follow-up duration was 353 days (IQR; 191~482 days). During the follow-up, one patient required balloon valvuloplasty and two patients underwent surgical RVOT obstruction relief (redo-valvuloplasty in 1 case, RV-PA conduit implantation in 1 case). Freedom from reintervention or reoperation at 1 year after repair was 90.5%. On late echocardiography, freedom from significant PR and PS at postoperative one year were 88.7% and 90.4%, respectively.

Conclusions: Optimal PVA size after PVA preservation for each patient with ToF is far smaller than expected, provided subvalvar and supra-valvar obstructions are completely eliminated. Based on these findings, no intervention on the PV is desirable for the long-term preservation of PV integrity in patients with a relatively sizable PVA.

P22. Thirty Year Serial Follow-Up of Two Surgical Strategies During Repair of Tetralogy of Fallot

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Objective: Repair of Tetralogy of Fallot (TOF) is commonly associated with ventricular dilation, arrhythmias, and reoperation. Limiting the ventriculotomy at the time of repair may mitigate these events over the short and intermediate term. Whether the benefits of a limited ventriculotomy following TOF repair extend into the long term is unknown.

Methods: Children requiring TOF repair were divided into two groups based upon the type of repair. For group 1 repaired between 1976–1981, an extensive right ventriculotomy (ERV) was made for ventricular septal defect (VSD) closure and infundibular muscle resection, with outflow tract patching performed as needed. For group 2 repaired between 1982–1985, the VSD was closed through the tricuspid valve and a limited right ventriculotomy (LRV) (<2 cm) was made with accompanying muscle resection and right ventricular outflow tract patch. Serial follow-up was obtained in the first, second, and third postoperative decades. 12 lead ECG, 24 hour Holter monitor, exercise stress test to quantify exercise endurance and maximal oxygen consumption (VO_2 max), and echocardiograms to quantify right ventricular dimensions were compared. The primary outcome was the cumulative event rate defined as reoperation, arrhythmia, or death.

Results: The ERV and LRV techniques were used in 21 and 17 children, respectively. The LRV group was significantly younger at the time of repair (Table 1). There was no difference in transannular patch use between groups. Cumulative survival was 98% at 30 years and was also not different between groups. There were 19 reoperations in 12 patients in the ERV group vs. 7 reoperations in 5 patients in the LRV group. There was

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no difference in QRS duration or arrhythmias at any time point between groups. The 10 year (5.9% LRV vs. 42.9% ERV, $p = 0.001$) and 20 year (21.8% LRV vs. 54.2% ERV, $p = 0.02$) event rate favored the LRV technique but the 30 year event rate was not significantly different between groups (60.9% LRV vs. 65.5% ERV, $p = 0.2$). Similarly, the LRV group had significantly greater endurance in the first decade and a significantly higher VO_2 max in the second decade but these differences were not significant at 30 years (Table 1). Unlike cumulative events and endurance, right ventricular end diastolic diameter Z scores were not significantly different between groups in the first two decades. However, 30 year follow-up demonstrated a significantly smaller right ventricular end diastolic diameter Z score in the LRV group (Table 1).

Table 1. Serial Follow-Up after Tetralogy of Fallot Repair

	ERV (n=21)	LRV (n=17)	p value
Baseline Demographics			
Age at repair (yrs)	3.8 \pm 1.0	2.7 \pm 0.9	0.001*
Male gender	57.1 % (12/21)	64.7 % (11/17)	0.74
Exercise testing			
10y endurance time (% predicted)	73.0 \pm 10.7	83.0 \pm 7.2	0.03*
20y endurance time (% predicted)	78.8 \pm 13.8	83.0 \pm 13.1	0.40
30y endurance time (% predicted)	69.3 \pm 11.4	79.6 \pm 13.2	0.15
20y VO_2 max (% predicted)	67.9 \pm 19.7	108.8 \pm 24.8	0.0002*
30y VO_2 max (% predicted)	67.4 \pm 14.2	72.6 \pm 12.4	0.59
Echocardiogram			
10y RVEDD Z score	6.2 \pm 2.5	5.2 \pm 2.7	0.31
20y RVEDD Z score	5.6 \pm 2.1	4.8 \pm 2.3	0.39
30y RVEDD Z score	5.6 \pm 1.7	4.1 \pm 0.6	0.01*

*denotes statistical significance

Abbreviations: ERV= Extensive Right Ventriculotomy, LRV=Limited Right Ventriculotomy, VO_2 max= maximal oxygen consumption, RVEDD= right ventricular end diastolic diameter

Conclusions: Compared to use of an ERV, the LRV approach with transatrial VSD closure during TOF repair limits 10 and 20 year events, improves exercise capacity at 10 and 20 years, and attenuates right ventricular dilation at 30 years.

P23. Impact of Left Atrioventricular Valve Size After Biventricular Repair for Complete Atrioventricular Septal Defect

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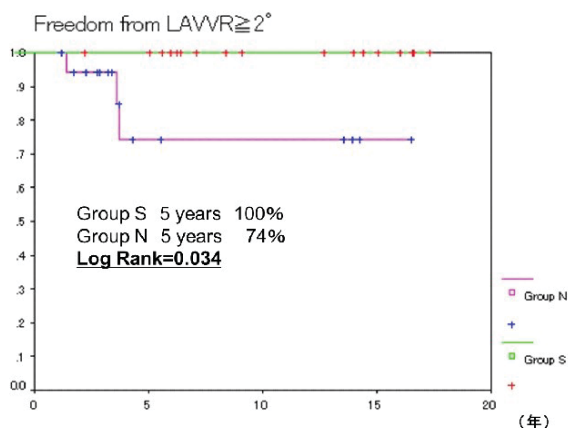
Objective: Surgical repair of complete atrioventricular septal defect (cAVSD) carries low mortality but a significant reoperation rate. We introduced aggressive commissuro-annular-plasty (CAP) in addition to conventional two-patch repair, which allowed the reduction of LAVV annulus down to 80% of normal MV. The purpose of this study was to clarify long-term outcome of our strategy.

Methods: Retrospective chart review was performed for patients with cAVSD who underwent biventricular repair between 1998 and 2016. Excluded Infective endocarditis, Polysplenia, Pulmonary atresia, and Tetralogy of Fallot cases. We measured

diameter of the LAVV annulus, ① at operation by Hegar's dilator at operation, ② at discharge by UCG and ③ in long-term by UCG. We classified them into two groups. The ratio of measured LAVV annulus at operation /normal MV annulus was smaller (Group S) or bigger (Group N) than 100%. Diameter of LAVV, stenosis and regurgitation by echocardiography were analyzed.

Results: 66 complete AVSD cases performed biventricular repair (Rastelli A: 44, Rastelli B: 0, Rastelli C: 22). It was 30 patients in Group S and 36 patients in Group N.. Median age at the operation was 5.0 months (1.0–42 months). Median follow-up was 79.0 months (3–218 months). There were no perioperative or late mortality. In Group S, median LAVV diameter at discharge was 90% (62–123%). However, their LAVV diameter grew-up from 83% to 137% at the last follow-up. In each group, there was eighteen patients with less than mild LAVVR at discharge. In Group S, none of eighteen patients got worse in the long term. Contrarily, three of eighteen patients (17%) got worse to more than moderate LAVVR in the long term in Group N. In patients with less than mild LAVVR at discharge, there was a significantly better prognosis in Group S (Figure 1: Log Rank = 0.034). CAP was performed in 28 patients. In patients with CAP, there was thirteen patients with less than mild LAVVR at discharge. None of thirteen patients got worse in the long term. Contrarily, there was twenty two patients with less than mild LAVVR at discharge in patients without CAP. Three of them (13%) got worse to more than moderate LAVVR. In patients with less than mild LAVVR at discharge, there was a better prognosis in patients with CAP (Log Rank = 0.1862).

LAVVR < 1° : Group S/Group



Conclusions: LAVV annulus after CAP has the potential to grow up and maintain its function. Reducing left atrioventricular valve size with aggressive CAP at primary operation could contribute to preventing exacerbation of LAVVR.

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P24. Therapeutic Heparinization Increases Risk of Bleeding in Pediatric Patients Following Cardiac Surgery

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Objective: To determine the association between unfractionated Heparin (UFH) dosing and post-operative bleeding and thrombosis events in pediatric cardiac surgical patients. We test the hypothesis that higher doses of heparin are associated with increased risk of bleeding in this population.

Methods: This is a prospective, single center, observational study of patients less than 18 years of age admitted to the cardiac intensive care unit (CICU) following open heart surgery between November 2016 and April 2017. Following cessation of immediate post-surgical bleeding (within first 24–36 hrs.), patients were followed to determine rate of delayed post-surgical bleeding and thrombosis in the ICU. Unprovoked bleeding was defined as spontaneous bleeding that was independent of procedural manipulation, following cessation of initial post-surgical bleeding. Postoperative UFH dosing strategy was categorized into three groups: no UFH, low-dose UFH (<15 u/kg/h UFH), and therapeutic UFH (≥ 15 u/kg/h UFH). We used Poisson regression model to compare the incidence of bleeding by UFH group and multivariate logistic regression including age group and diagnosis to identify the risk of bleeding and clotting events among the different treatment groups.

Results: We prospectively observed 412 consecutive patients (median age = 1.1 years, IQR = 0.3, 5.2) for a total of 3,000 post-operative patient-days in the CICU. There were 32 unprovoked bleeding events in 28 patients during follow-up. The incidence of unprovoked bleeding was 1.44 per 100 patient-days on UFH (any dose) and 0.69 per patient-days not on UFH ($p = 0.057$). There was a 2 fold risk for patients on Heparin of any dose (OR = 2.15; 95% CI = 1.005–4.59). There was no significant association between age group ($p = 0.810$) or diagnosis type ($p = 0.393$) with unprovoked bleeding in our multivariate regression model. Patients receiving therapeutic UFH experienced significantly more unprovoked bleeding events compared to patients not receiving UFH (2.78 vs. 0.68, $P = 0.008$, OR = 3.12; 95% CI = 1.37–7.12). Unprovoked bleeding risk was not significantly different in patients receiving low-dose compared to no UFH (OR = 1.37; 95% CI = 0.53–3.52). Risk of thrombosis was not significantly different in patients receiving no UFH compared to low-dose UFH (OR = 0.83; 95% CI = 0.25–2.78). Patients on therapeutic UFH experienced significantly more thrombosis events compared to patients not receiving UFH (OR = 3.81; 95% CI = 1.60–9.12).

Conclusion: Unprovoked bleeding remote from immediate post-surgical bleeding occurs uncommonly in pediatric patients following cardiac surgery. Anticoagulation with therapeutic UFH significantly increases the risk of unprovoked bleeding. Indications for postoperative UFH should be carefully considered to reduce the rate of unprovoked bleeding in this population.



P25. Functional Tricuspid Valve Regurgitation in Adult with Congenital Heart Disease: Which Is the Best Surgical Option for Repair?

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Objectives: Functional tricuspid valve (TV) regurgitation frequently affects adult with congenital heart disease (ACHD) and usually it is the consequence of right ventricle dilatation or dysfunction. The aim of our study was to analyze which surgical repair (suture plasty vs. ring plasty) offers the best post-operative and medium-term tricuspid valve competence in the ACHD population.

Methods: Retrospective study of all ACHD patients that underwent TV repair at our institution from January 2000 to December 2016. Surgical operative notes were reviewed to define the type of repair. Post operative and follow-up echocardiogram TV regurgitation degree were collected. We compared efficacy of ring plasty with suture plasty in terms of early and medium term regurgitation degree.

Results: 142 ACHD patients underwent TV surgery, among them 95 had functional TV regurgitation and were included in our study. Median age at surgery was 41.2 years (IQR: 29.8–55.6 years); 51.6% were male. TV surgery was an associated procedure in 87 pts (91.6%) and only in 8 it was the primary indication. The pre-operative TV regurgitation was mild (n = 6 pts), moderate (n = 42 pts) and severe (n = 47 pts). In 87 patients it was possible to repair the TV using suture plasty in 53 and ring anuloplasty in 34, meanwhile in 8 patients it was replaced. Suture plasty techniques used were different: de Vega (n = 22), Wooler (n = 11) and others (n = 20). The most frequent size ring used was 32 (n = 15). The concomitant primary procedures performed were pulmonary valve implantation (n = 48), atrial septal defect closure (n = 29). Median hospital stay was 12 days (IQR: 8–18) with only 2 hospital deaths (2.1%). At discharge 13.2% of the suture plasty and 11.8% of the ring anuloplasty had moderate TV regurgitation, no one had severe and the remaining were mild or less. After a median follow-up (completeness 91%) of 4.6 years (IQR: 1.4–8.9) there were 6 late deaths giving a 89% survival (95% CI: 79%–94%) at 5 and 10 years. No tricuspid valve reoperation were performed. On follow-up reliable echocardiographic assessment of the TV was available in 69 patients who had repair. At follow-up the suture repair group present a significantly higher incidence of moderate-severe regurgitation (Figure 1) compared to the ring anuloplasty (55% vs. 27.6%, $p = 0.023$).

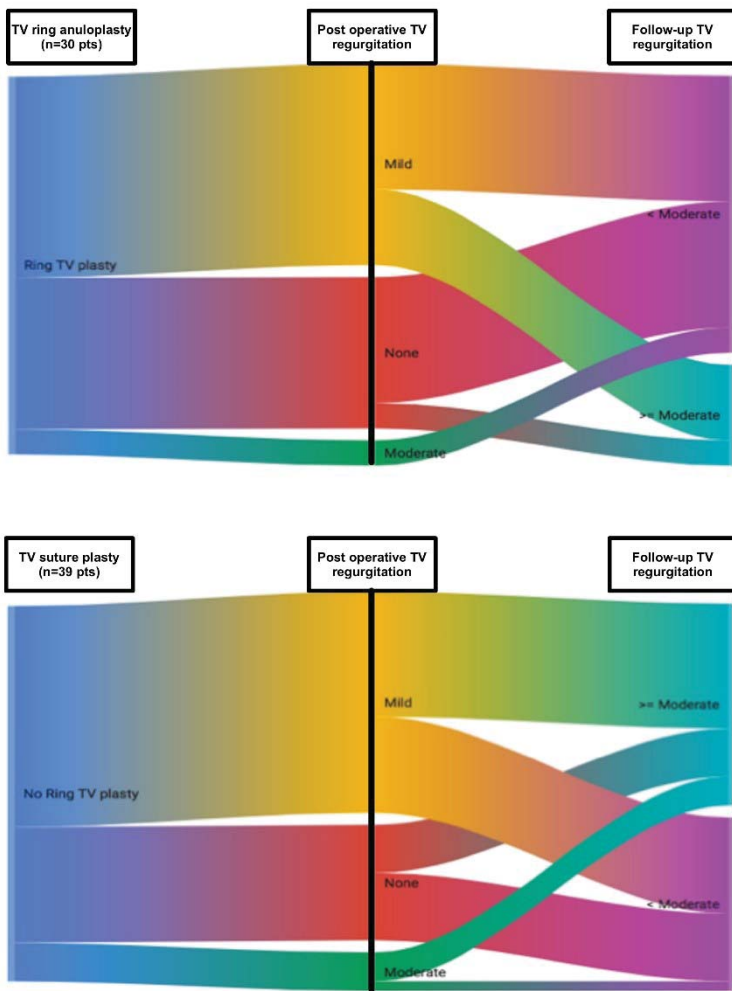
Conclusions: Functional tricuspid valve regurgitation is a common problem in ACHD patients and surgical repair usually is performed in association to other major procedures. Suture plasty and ring anuloplasty have comparable early post-operative results in terms of restoring valve competence. The use of prosthetic rings should be preferred to support the TV because it provides a significantly lower occurrence relevant regurgitation in the medium term.

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Figure 1: Flow diagram of TV regurgitation after repair for patients with complete follow-up



Late-Breaking Clinical Trial

LB9. Outcome Related to Immediate Extubation After Stage 1 Norwood Palliation for Hypoplastic Left Heart Syndrome

Joby Varghese, James M. Hammel, Ali Ibrahimiyeh, Rebecca Siecke, Shelby Kutty
Children's Hospital and Medical Center, Omaha, NE



General Thoracic

Moderated Poster Competition

3 minute presentation, 2 minute discussion

Aisle 1200, Exhibit Hall, SDCC

Not for Credit

Moderators: *Frank A. Baciewicz and *Bernard J. Park

P26. Outcomes and Risk Factors for Morbidity and 30 Day Mortality for Decortication for Empyema and Complex Pleural Effusion

Shamus R. Carr¹, Christopher W. Towe², James M. Donahue³, Sunghee Kim⁴, Whitney M. Burrows¹, Yaron Perry², Luis Argote-Green², *Philip A. Linden²

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⁴Duke Clinical Research Institute, Durham, NC

Objective: We analyzed the Society of Thoracic Surgeons General Thoracic Surgery Database (STS-GTSD) to describe the contemporary status and results of decortication for empyema.

Methods: A retrospective review of patients undergoing pulmonary decortication, excluding hemothorax and malignancy, from 2009–2016 was performed. Pre-operative factors, length of stay (LOS), discharge status, readmission rates, morbidity, and mortality were compared between open and video assisted thoracoscopic surgery (VATS) approach. Major morbidity was defined as: unexpected return to OR, air leak >5 days, ventilator support >48 hours, tracheostomy, myocardial infarction, DVT or pulmonary embolism, new renal failure, surgical site infection, or transfusion. Multivariable models identified risk factors for major morbidity and mortality.

Results: Of 7,316 patients undergoing decortication, 6,961 (95.2%) had a primary diagnosis of empyema. VATS was utilized in 4,435 patients (60.6%) and increased by percentage of the overall total during the study period ($p < 0.001$). Median time from admission to surgery was 4 days (IQR 2–7). Median postoperative LOS was 7 days (IQR 5–11 days). We defined prolonged LOS (PLOS) as the top decile of overall LOS (19 days), and this occurred in 707 patients (9.7%). Perioperative mortality occurred in 228 (3.1%) patients and was higher in the open group (3.7%(106) vs. 2.8%(122); $p = 0.026$). Post-operative complications occurred in 2,875 patients (39.3%), and major events in 1,138 (15.6%). The most frequent complications were blood transfusion (26.3%) and ventilator support for >48 hours (6.8%). Transitional care after discharge occurred in 1,922 patients (26.3%), and readmission within 30 days in 452 patients (8.7%). Compared to VATS, patients undergoing thoracotomy were more likely: male, Caucasian, on preoperative dialysis and current smokers. Perioperative mortality ($p = 0.026$), major morbidity ($p < 0.001$), PLOS ($p < 0.001$), and discharge to other than home ($p < 0.001$) were higher with thoracotomy. In multivariable analysis: age, eGFR <60, ASA level, Zubrod score, and thoracotomy were associated with increased mortality, morbidity, and PLOS (Table 1). Each additional preoperative hospital day (up to 5 days) was associated with increased mortality, with no further risk after 5 days. However, readmission ($p = 0.026$), major morbidity ($p = 0.001$), PLOS ($p < 0.001$), and discharge to transitional care ($p < 0.001$) were all higher when surgery was delayed beyond 5 days.

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Table 1: Multivariable Regression of Factors Associated with Outcomes

Risk Factors	Mortality		Morbidity		PLOS (>19 days)	
	Adjusted OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value	Adjusted OR (95% CI)	p Value
Age per 1-year increase	1.05 (1.03,1.06)	<0.001	1.02 (1.01,1.03)	<0.001	0.99 (0.98,1.00)	0.0007
eGFR < 60	1.94 (1.38,2.74)	0.0002	1.81 (1.54,2.12)	<0.001	2.25 (1.82,2.77)	<0.001
ASA: III/IV/V/VI vs. I/II	10.15 (1.41,73.12)	0.0215	2.07 (1.66,2.60)	<0.001	4.51 (2.60,7.82)	<0.001
Zubrod: In bed/Bedridden/ Moribund vs. Normal activity/Fully ambulatory	2.46 (1.69,3.57)	<0.001	1.84 (1.62,2.09)	<0.001	2.33 (1.88,2.88)	<0.001
VATS	0.74 (0.56,0.99)	0.0444	0.69 (0.60,0.78)	<0.001	0.79 (0.65,0.96)	0.0162
Days from admission to surgery per 1-day increase when < = 5 days	1.20 (1.07,1.33)	0.0015	1.02 (0.98,1.06)	0.4244	1.09 (1.02,1.16)	0.0127
Days from admission to surgery per 1-day increase when >5 days	1.02 (1.00,1.05)	0.0782	1.02 (1.01,1.04)	0.0011	1.07 (1.05,1.09)	<0.001

Conclusions: Surgeons participating in the STS-GTSDB perform decortication for empyema with limited mortality despite substantial postoperative morbidity and high utilization of transitional care after discharge. Further study is required to describe selection criteria for VATS, and determine indications for surgical intervention to reduce delays in operative intervention.

P27. Chest CT Imaging Improves Potential Lung Donor Assessment

Jason Michael Gauthier¹, Andrew Bierhals¹, Keki R. Balsara¹, Ramsey R. Hachem¹, Chad A. Witt¹, Elbert P. Trulock¹, Derek E. Byers¹, Roger D. Yusen¹, Patrick R. Aguilar¹, Gary Marklin², *Bryan F. Meyers¹, *G. Alexander Patterson¹, *Benjamin D. Kozower¹, *Daniel Kreisel¹, *Varun Puri¹

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Objective: Conventional lung donor assessment criteria include age, smoking history, PaO₂, and chest radiograph findings. Anecdotally, chest CT scans are being increasingly utilized for potential lung donor assessment. However, the efficacy of CT scans in this setting remains unknown. We hypothesize that routine chest CT imaging independently impacts the decision-making process of donor lung utilization.

Methods: We retrospectively analyzed all brain-dead organ donors at our organ procurement organization (OPO) from 6/2011 to 11/2016 and assessed the utility of chest CT scans in determining lung procurement. CT scans were independently reviewed by an experienced thoracic radiologist who was blinded to all patient history. Common lung pathologies, such as emphysema, interstitial lung disease (ILD), and traumatic lung injury (TLI), were reported as standardized categorical variables based on severity of disease. Bivariate analysis and multivariate regression analysis were used to determine the relationships among variables. Donors with >20 pack-year smoking history were excluded from the analysis.



Results: 675 donors were managed at our OPO during the study period, of which 259 were lung donors (lung utilization rate (LUR) = 38.4%). 428 (63.4%) potential donors received a chest CT scan, revealing emphysema (13.8%), ILD (2.6%), and TLI (6.8%). LUR was significantly lower in donors with findings of emphysema (44.7% vs. 13.6%, $p < 0.0001$) or ILD (41% vs. 9%, $p = 0.057$). CT findings of TLI, pneumonia, and atelectasis did not adversely impact the LUR. In a multivariate analysis donor age, best PaO₂, bronchoscopy, and emphysema findings (OR = 0.79, 95% CI = 0.66–0.95) were associated with donor lung utilization (Table 1). Distinct models of lung utilization were fitted to donor populations with initial PaO₂ < 300 [suboptimal] or initial PaO₂ > 300 [optimal]. LUR in the initial PaO₂ < 300 and initial PaO₂ > 300 populations were 35.9% and 47.0%, respectively. CT findings of emphysema were associated with lower LUR in both groups.

Table 1: Stepwise Multivariable Logistic Regression Model of Variables and Adjusted Odds Ratio for I

Variable	OR	95% CI for OR	p Value
Age	0.97	0.96–0.99	0.003
Best PaO ₂	1.01	1.01–1.02	<0.0001
Bronchoscopy	10.7	1.29–89.0	0.004
Emphysema score	0.79	0.66–0.95	0.006

Conclusions: In the evaluation of potential lung donors CT findings of irreversible structural lung disease, such as emphysema, were associated with lower lung utilization rates across groups of donors with suboptimal and optimal initial PaO₂. Our findings suggest that chest CT imaging is an important adjunct to conventional lung donor assessment criteria.

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P28. Occult Nodal Metastasis and Nodal Upstaging in Patients Undergoing Anatomic Resection for Small (≤ 2 cm) Clinical Node Negative Non-Small Cell Lung Cancer: A Prospective Cohort Study

Eric Michael Robinson, Ilkka K. Ilonen, Andrew J. Plodkowski, *Manjit S. Bains, *Bernard J. Park, Matthew Bott, *Robert J. Downey, James M. Isbell, *Prasad S. Adusumilli, *Valerie W. Rusch, *David R. Jones, *James Huang
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Objective: To examine rates of nodal upstaging and sites of occult nodal metastasis among patients undergoing anatomic resection (lobectomy and segmentectomy) in a prospective cohort of patients with peripheral, small (≤ 2 cm) clinical node-negative non-small cell lung cancer (NSCLC).

Methods: Patients with peripheral NSCLC (≤ 2 cm on CT) and with no evidence of locally advanced or metastatic disease (clinical T1a–bN0M0, 8th Ed) were prospectively identified based on pre-registration eligibility screening for the Alliance/CALGB 140503 trial. All patients undergoing anatomic resection (lobectomy and segmentectomy) were followed for pathologic outcomes irrespective of their ultimate enrollment status, and all patients underwent hilar dissection and mediastinal nodal dissection or sampling.

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Results: From Nov 2014 to Jan 2017, a total of 58 patients met eligibility criteria and were prospectively followed. 51 patients underwent lobectomy and 7 patients underwent segmentectomy. 16 of the patients were enrolled on the trial, all of whom underwent lobectomy. Mean tumor size on CT was 1.5 cm and mean PET SUV_{max} was 3.9; the mean consolidation-to-tumor ratio was 0.77. Occult nodal metastases were found in 9/58 (15.5%) patients (N1 = 7; N1 + N2 = 1; N2 = 2). Of the N1 positive cases, the occult nodes were located in peripheral peribronchial stations, 11 or higher, in the majority of cases (7/8; 88%). N2 disease was found in an additional 2 cases (2/58; 3.4%). Overall, upstaging rates to N1 and N2 were 12.1% and 3.4% respectively. All upstaged patients had negative CT and PET scans, giving an overall false negative rate of 15.5% for clinical staging.

Conclusion: Among peripheral, small (≤ 2 cm) clinical N0 patients with NSCLC, occult peribronchial N1 metastases are common and the false negative rate for clinical staging remains high. Non-anatomic resections, in the absence of hilar lymphadenectomy, may miss these occult nodes.

P29. Clinical Validation of a Competency Assessment Scale for Anatomic Lung Resection

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*James Huang⁵, Eric L.R. Bédard¹

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Objective: To measure evidence of validity, reliability and acceptability of a scale designed to assess thoracic surgery trainees' competence in anatomic lung resection for cancer.

Methods: Using a modified-Delphi approach and pilot-testing in a pig model simulation, a 35-item checklist-style scale was developed to encompass every critical step of a safe, oncologically effective anatomic lung resection for cancer. This scale was used to assess the competence of trainees performing anatomic lung resections for cancer on real patients over a six-month clinical validation study in four North American training programs. Scores were correlated with an established, validated global competency scale (Objective Structured Assessment of Technical Skill-OSATS). Item analysis was performed with point biserial statistics to determine the most discriminatory items. Trainees and surgeons received a post-study questionnaire regarding their experience.

Results: Seven trainees, in either their first, second or third year of thoracic surgical training, were assessed and self-assessed during 63 anatomic lung resections using the competency assessment tool. Internal consistency was calculated using Cronbach's alpha at 0.93. Inter-rater reliability was acceptable (correlation between surgeon and self-assessments, $k = 0.73$), as was external validation against OSATS ($k = 0.68$). Item difficulty and discrimination corresponded well with the skills being assessed (e.g. ability to safely control the pulmonary artery was statistically one of the most difficult items). The scale was rated highly on the post-study questionnaire (response rate 6/7 trainees = 86%, 11/15 surgeons = 73%) with respect to ease of use, capturing all



essential steps, effective assessment of competence, respondent would use the scale again, utility to the trainee and support for the scale's use in determining a trainee's competence (mean >4 on 5-point Likert for all items). Most participants thought the scale should be used to assess trainees on a monthly basis. Several respondents commented that the scale provided a useful framework on which to structure teaching before and during the operation and to facilitate feedback afterward.

Conclusions: Our recently developed competency assessment scale for anatomic lung resection for cancer demonstrated high initial reliability and evidence of internal and external validity. Feedback, from both surgeons and trainees, was positive, and comments indicated that in addition to providing summative assessment of overall competence, the scale was useful for structuring teaching and providing formative feedback on an ongoing basis. This tool should be considered for use in thoracic surgery training programs to enhance instruction and the assessment of competence in anatomic lung resection.

P30. Opioid Over-Prescription After Open and Laparoscopic Hiatal Hernia Repair

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Objective: Recent studies demonstrate a high prevalence of excessive opioid prescribing after surgery and high persistent opioid use after thoracic surgery. Many factors may contribute to excessive prescribing and its associated morbidity, including lack of procedure-specific guidelines, variation in prescribing practices, and inadequate patient education. This study describes patterns of opioid prescribing for open and laparoscopic hiatal hernia repair (HHR) and characterizes the practices that may contribute to excessive opioid prescribing.

Methods: Retrospective review was completed of 91 opioid naïve patients who underwent open (transthoracic and transabdominal) or laparoscopic HHR between January and December 2016, and who had received any opioid prescription after surgery. Patients were surveyed regarding postoperative opioid use and associated education. The amount of opioid prescribed and used were quantified in oral morphine equivalents (OME). Mann-Whitney U tests were used to compare the OME prescribed vs. patient usage within the cohort. Thoracic physician assistants (PAs) and nurses (RNs) were surveyed about factors contributing to their opioid prescribing and counseling practices.

Results: 91 opioid naïve patients (37 open HHR; 54 laparoscopic HHR) were surveyed, with a response rate of 69% (n = 63, 27 open, 36 lap). Mean age was 59 ± 14 years and 65% were female. Median follow-up time was 305 days (IQR 209–463). Following open HHR, median prescription size was 350 mg OME (IQR 250–420) and median patient use was 225 mg OME (IQR 105–300) (p = 0.001). Following laparoscopic HHR, median prescription size was 270 mg OME (IQR 200–350) and median patient use was 106 mg OME (IQR 6–295) (p < 0.0001) (Figure 1). Of patients undergoing open and laparoscopic

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HHR, 21% and 6%, respectively, reported receiving education regarding the proper disposal of opioids. For both groups, 96% of the opioid prescriptions were written by PAs.

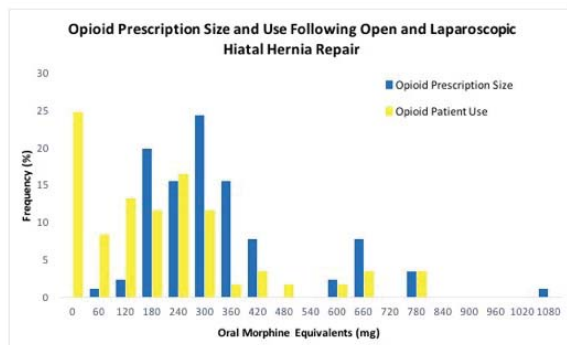


Figure 1. Distribution of opioid prescription size (N=91, blue) and patient-reported opioid prescription use (N=63, yellow) following open and laparoscopic hiatal hernia repair.

Six PAs and 29 RNs completed the provider survey. Most PAs reported that patient's narcotic use history (n = 4, 67%) and narcotic use during hospitalization (n = 5, 83%) had a moderate to high impact on number of opioid pills prescribed. In contrast, most PAs reported that previous training (n = 5, 83%), need for refills (n = 5, 83%), and literature on pain control (n = 4, 67%) had no to slight impact. 100% (n = 29) of RNs reported discussing the use of adjunct pain medications; however, only 7% (n = 2) reported discussing the risks of leftover medication and proper disposal of unused opioids.

Conclusions: Patients use far fewer opioids than are prescribed after open and laparoscopic HHR. Significant variation in prescribing postoperative opioids exists among our practitioners. Establishing procedure specific guidelines and improving patient education may decrease opioid usage and increase proper disposal of leftover medication.

P31. Prevalence and Risk Factors of Reflux After Esophagectomy for Esophageal Cancer

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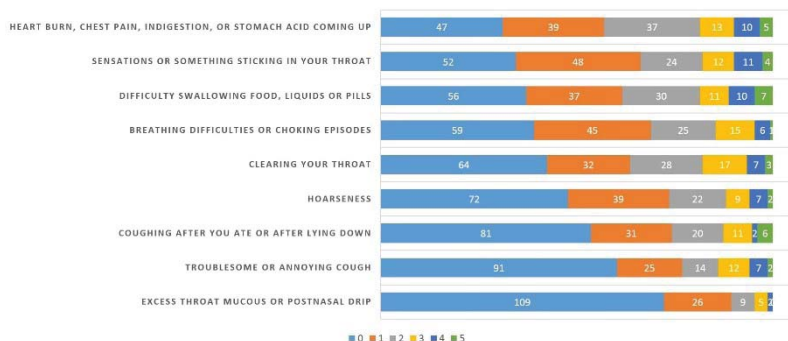
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Objective: Reflux is a frequent symptom after esophagectomy. However, the intensity and presentation of reflux is quite diverse depending on the patients. Therefore, we assessed reflux symptoms using Reflux Symptom Index (RSI) questionnaire in patients who underwent esophagectomy for esophageal cancer.

Methods: From April, 2017 to July, 2017, we prospectively investigated patients who underwent esophagectomy for esophageal cancer at the out-patient clinic. The severity of reflux was evaluated with a self-administered nine-item outcomes instrument, grading 0 (none) to 5 (severe). A RSI score ≥ 13 was defined as a significant reflux.

Results: A total of 151 patients were included. The mean age was 64.1 ± 8.8 years and the majority was male (n = 136, 90.1%). The median time after esophagectomy was

22.6 months. A question regarding heart burn, chest pain, indigestion, or acid coming up was the most frequently being responded ($n = 104$, 68.9%) (Figure). 41 patients (27.2%) presented a significant reflux with the mean RSI score of 19.9 ± 6.3 . Administration of proton-pump inhibitor or prokinetics was not a predisposing factors for RSI score <13 . Cervical anastomosis (OR = 2.3, p-value = 0.04) and post-esophagectomy time below 2 years (OR = 3.5, p-value = 0.002) were significant risk factors for RSI ≥ 13 in multi-variable analysis. Patients who underwent cervical anastomosis with follow up duration below 2 years had a higher risk (OR = 6.7, p-value = 0.005) compared to those underwent thoracic anastomosis with follow up duration over 2 years.



Conclusions: Reflux symptom was frequently reported after esophagectomy. We revealed that the location of anastomosis and short duration after esophagectomy were significant predisposing factors for a reflux after esophagectomy.

P32. Relative Incremental Cost of Complications of Esophagectomy

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Objective: To quantify the cost impact of esophagectomy complications and identify opportunities for reducing costs while optimizing health outcomes.

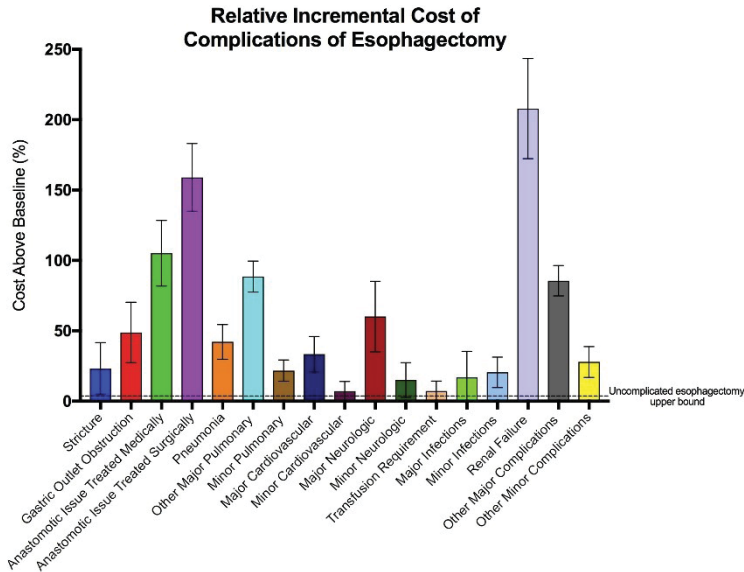
Methods: Patients were identified from an institutional database of patients undergoing esophagectomy between 2002 and 2017. 90-day complication rates were tabulated from clinical data. Direct hospital costs were determined for all encounters between the day of surgery and postoperative day 90. Risk factors for complications were assessed using multivariable logistic regression. The relative incremental cost of complications was assessed using multivariable linear regression. For the sake of generalizability, costs are reported as a percentage of the 90-day direct hospital cost of an uncomplicated esophagectomy.

Results: 763 patients were included in this study. 432 patients (57%) experienced at least 1 complication. Factors associated with increased likelihood of complications included female sex (OR 2.04, $P = .002$), age ≥ 65 (OR 2.08, $P = .02$), cerebrovascular disease (OR 4.36, $P = .024$), diabetes (OR 1.65, $P = .046$), >50 pack-year smoking history

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(OR 1.82, $P = .024$) and surgeon inexperience (OR 2.1, $P = .006$). There was no significant difference in complications comparing Ivor Lewis, thoracoabdominal, and minimally invasive approaches ($P = .52$). Race, performance status, BMI, smoking status, other comorbidities and preoperative steroid use were not associated with increased likelihood of complications. Of the 1,021 complications identified in the cohort, the most common were atrial arrhythmia (13%), transfusion requirement (11%), and atelectasis requiring bronchoscopy (7%). The complications incurring the greatest incremental cost per event were renal failure, defined as creatinine >2 and $>2 \times$ baseline (increasing cost by 208% above baseline, 95% CI 172–244%, $P < .001$), anastomotic complications treated surgically (159%, 95% CI 135–183%, $P < .001$), anastomotic complications treated medically (105%, 95% CI 82–128%, $P < .001$), and other major complications (86%, 95% CI 75–96%, $P < .001$), a category that includes surgical chylothorax and other complications requiring surgery. Pneumonia increased costs by 42% (95% CI 30–54%, $P < .001$) and other major pulmonary complications increased costs by 89% (95% CI 78–99%, $P < .001$). Complications alone accounted for 29.5% of the aggregate total 90-day direct hospital cost for all patients. Major pulmonary complications accounted for 17.2% of all dollars spent treating complications, while other major complications accounted for 19.6%.



Conclusion: Greater understanding of how complications impact cost provides a framework to optimize care for patients undergoing esophagectomy. We identify complications representing high-yield targets for cost reduction and quality improvement, as well as factors associated with higher likelihood of postoperative complications.



P33. The Cost Burden of Esophageal Anastomotic Leak — A Steep Price to Pay

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Objective: The purpose of this study is to evaluate resource consumption of esophageal anastomotic leaks.

Methods: Between 9/1/2008 to 12/31/2014, a prospectively maintained database was used to identify patients with Grade III-IV anastomotic leaks following esophagectomy for esophageal cancer post-neoadjuvant chemoradiation. Patients were excluded for atypical histology or death within 30 days of their index operation. Inflation-adjusted standardized costs were applied to billed services related to leak diagnosis and treatment, from time of leak detection to resumption of oral diet. A matched analysis (matching patients on age, ASA classification, Zubrod score and year of surgery) was used to compare average cost burden and expenditures in patients without leaks vs. patients with an anastomotic leak.

Results: Of 448 patients undergoing esophagectomy following neoadjuvant treatment, 399 patients met inclusion criteria. A total of 24 Grade III-IV anastomotic leaks were identified (6% leak rate). The median age was 61.5 years (range 39–78). Five transhiatal esophagectomies accounted for 20.8% of cases, while nine Ivor Lewis and ten McKeown esophagectomies accounted for 37.5% and 41.7%, respectively. The median time required to treat an anastomotic leak was 73 days (range 14–701). The additional median standardized cost per esophageal leak was \$68,296 (mean, \$119,822). Matched analysis demonstrated that mean treatment costs were 2.6 times greater for patients with an anastomotic leak. This was primarily attributed to prolonged hospitalization, with post-leak detection length of stay ranging from 7–73 days. The largest contributors to cost for all patients were intensive care stay (30%), hospital room (17%), pharmacy (16%), and surgical intervention (13%), see Figure.

Conclusions: Grade III-IV esophageal anastomotic leaks more than double the cost of an esophagectomy and have a significant cost burden, primarily due to intensive care costs. Focus should be placed on preventative measures to avoid leaks at the time of the index operation.

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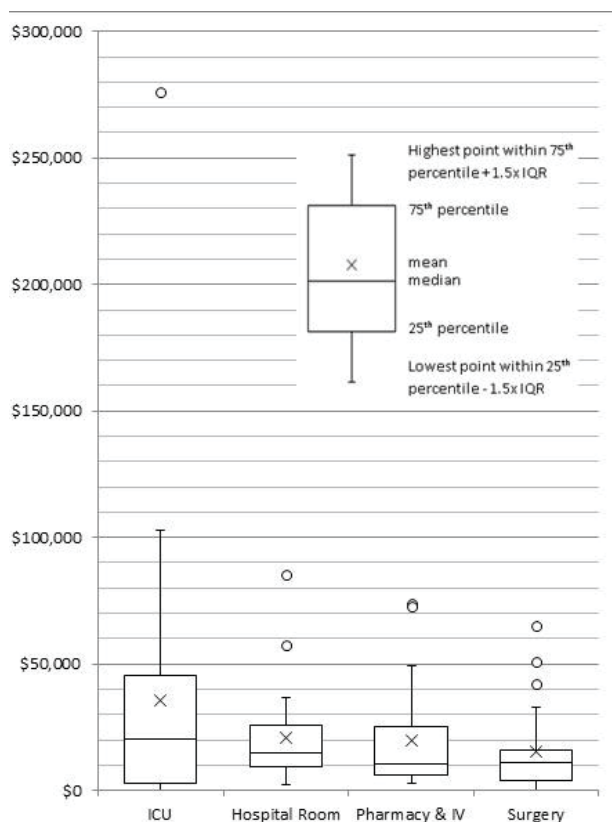


Figure: Total treatment standardized costs per patient.

P34. Personalized Prediction of Improved Survival with Surgery for Advanced Stage Non-Small Cell Lung Cancer Using a Surgical Selection Score

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Objective: Overall survival (OS) for advanced stage (IIIA-IV) non-small cell lung cancer (NSCLC) is highly variable, and retrospective data show a survival advantage for select patients receiving therapeutic intent pulmonary resection. We hypothesized that this variability in OS could be modeled to allow a personalized estimate of OS and quantify factors underlying selection for surgical treatment.

Methods: Using logistic regression, we developed a model (Surgical Selection Score; SSS) that predicts the probability of surgery for patients with advanced NSCLC. The SSS uses the clinical variables: histology, tumor size, tumor stage, nodal stage, metastatic stage, Charlson comorbidity index, age, race, insurance, income, and facility type. In a cohort of advanced stage NSCLC patients from the National Cancer Database, we

assessed the accuracy of SSS to predict OS using Cox proportional hazards models, and determined by stage, the effect of surgery on 3-year survival among people with similar high levels of SSS, using logistic regression.

Results: 300,572 patients were identified; 18,701 (6%) had surgery. The SSS was a strong predictor of OS (C statistic, 0.89; 95% CI, 0.89–0.90). We observed significantly longer OS ($p < 0.001$) among patients who had surgery. Moreover, the odds of surviving 3 years was at least 3–5 times higher for surgical patients in the upper quartile of SSS compared to patients with comparable SSS who did not receive surgical treatment, and the effect increased by stage (Stage IIIA: OR 3.2, 95% CI: 2.9–3.5, Stage IIIB: OR 4.6, 95% CI: 4.2–5.1, Stage IV: OR 5.3, 95% CI: 4.7–5.9). (See Figure 1).

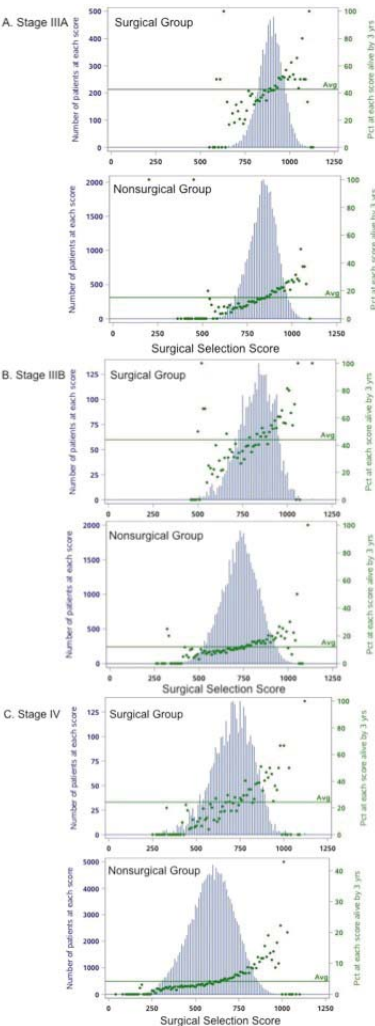


Figure 1. Distribution of Surgical Selection Score and Observed Probability of 3-year Overall Survival.

- A. Stage IIIA: N= 44,126
Surgical N = 7,364 (16.7%)
- B. Stage IIIB: N= 47,650
Surgical N = 3,028 (6.4%)
- C. Stage IV: N= 154,766
Surgical N = 3,602 (2.3%)

Patients with high SSS have significantly longer survival when surgery is included in their treatment regimens. SSS = surgical selection score

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Conclusions: We have developed a SSS, which models selection for surgery and is also highly predictive of individual OS. These findings are important for a more robust evaluation of the likely benefits of surgical resection for these patients. In the future, the SSS can potentially be used as a decision tool during multidisciplinary conference after prospective validation.

P35. CPET and the Prediction of Major Adverse Events in High-Risk Patients Undergoing Lung Resection

Elaine Shien Teh¹, Melanie McCabe², Shubhra Sinha¹, Natasha Joshi¹, Kajan Kamalanathan¹, Mat Molyneux¹, Neil Rasburn¹, Timothy Batchelor¹, Gianluca Casali¹, Eveline Internullo¹, Rakesh Krishnadas¹, Douglas West¹

¹University Hospitals Bristol NHS Foundation Trust, Bristol, United Kingdom; ²University of Cambridge, Cambridge, United Kingdom

Objective: Lung cancer is the commonest cause of cancer death in UK. The ACCP has produced guidance on diagnosis and management of patients with lung cancer. For high risk patients, formal exercise testing, such as cardiopulmonary exercise testing (CPET) for further stratification is recommended. However, the additional predictive benefit of CPET over clinical assessment has not been defined, especially in the era of VATS. We sought to determine whether CPET testing, clinical assessment or a combination of both provided the most accurate prediction of adverse events.

Methods: This is an analysis of high risk patients undergoing lung resection in our unit who had undergone pre-operative CPET between August 2009 and May 2016. Clinical and CPET data were collected from hospital databases. Logistic regression analyses were conducted with 3 models to predict whether morbidity or death occurred within one month of surgery (Model 1 using only clinical variables, Model 2 using clinical and CPET variables and Model 3 using only CPET variables). Complication of Grade II or higher based on the Clavien-Dindo classification is considered significant.

Results: 258 patients underwent CPET following initial assessment, and 218 patients underwent lung resection. 40 patients did not have surgery after CPET. The mean age was 68 ± 8.7 , with 150 (58%) men. 229 (89%) patients were current or ex-smokers. The pre-operative clinical data were (in mean \pm SD) BMI 27 ± 6 , maximum METS 6 ± 6 , %FEV₁ predicted 72 ± 22 , %TLC predicted 63 ± 18 , ASA 2.5 ± 0.6 , MRC 1.2 ± 1 and performance score 0.8 ± 0.7 . The CPET indices were VO₂max/kg 19 ± 5 , O₂ pulse 11 ± 3.5 , %HR peak 89 ± 16 , ventilatory efficiency VE/VCO₂ 32 ± 6 , breathing frequency (BF) peak 33 ± 7 , %BF 119 ± 28 and % breathing rate (BR) 114 ± 62 . Many variables were closely related, which would cause substantial multicollinearity, therefore some were removed due to perfect correlation. 2 indices were created of variables which were highly correlated (%BF+peak BF+% BR and %HR peak+O₂ pulse). 125 patients underwent VATS and 92 had open surgery. Mortality was 3% (n = 7). 93 patients had complications above Grade II. The results of the 3 models tested are shown in Table 1, showing Model 2 reliably distinguished between those who did and did not experience morbidity, χ^2 (25) = 55.61, p < 0.0005. A test of Model 2 against the clinical model was also statistically significant, indicating that the clinical and CPET predictors as a set more reliably distinguished between those who did and did not experience morbidity, when

compared with the clinical predictors alone, $\chi^2 (8) = 31.76$, $p < 0.0005$. Nagelkerke's R^2 of 0.51 indicated a moderately strong relationship between prediction and grouping.

Table 1: Logistic Regression Analyses * $p < 0.001$

	Model 1	Model 2	Model 3
X2	23.85 (17)	55.61 (25)*	15.38 (8)
-2 Log likelihood	135.57	103.81	278.75
Nagelkerke R2	0.25	0.51	0.09
False positives	16	15	27
True positives	37	43	34
False negatives	20	14	59
True positives	42	43	95
% correctly predicted	68.70	74.78	60.00
AUC	0.75	0.86	0.66

Conclusions: In assessing high risk patients, CPET should be interpreted together with clinical parameters for maximum predictive effect. Patients should not be declined surgery based purely on CPET assessment only.

P36. Influence of Geographic and Socioeconomic Factors on the Survival and the Utilization of Trimodality Therapy in Elderly Patients with Locally Advanced Esophageal Cancer: An Analysis of the National Cancer Database

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Objective: Contrary to available evidence supporting the utilization of trimodality therapy (TMT) for locally advanced esophageal cancer, a significant proportion of elderly patients is not optimally treated in the United States. Furthermore, disparities in survival outcomes have been described in this patient population based on several socioeconomic characteristics. We sought to examine the relationship between socioeconomic factors, the utilization of TMT and survival for elderly patients with locally advanced esophageal cancer.

Methods: This retrospective cohort study was conducted using data from the National Cancer Database (NCDB). We included all elderly patients (65 years and above) with locally advanced esophageal adenocarcinoma or squamous cell cancer (AJCC stages II and III) confirmed by histology between 2004–2014. Multivariable Logistic and Cox regression analyses were used to elucidate associations.

Results: A total of 23,194 patients were included. Mean age was 74.3 years (SD: 6.6). Patients treated with TMT were significantly younger 70.6 years (SD: 4.5) vs. 75.4 years (SD: 6.8); $p < 0.001$. TMT was utilized in only 21.8% of patients. TMT was independently less likely to be utilized in patients that were older, female, African-American, less educated, treated at a community cancer program, from the Western or Southern regions of the US, or having a median annual income $< \$38,000$ ($p < 0.05$ for all). Other predictors of underutilization of TMT were Charlson score and squamous cell histology. The

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utilization of TMT was an independent predictor of long-term survival. In addition, all sociodemographic variables listed above independently influenced survival ($p < 0.05$ for all). Among the subset of patients treated with TMT, only age, Charlson score, tumor stage, and grade were identified as predictors of long-term survival. Insurance status was not an independent predictor of either TMT utilization or survival.

Conclusion: TMT is underutilized in elderly patients with locally advanced esophageal cancer in the US, and this can be partially explained by geographic and socioeconomic factors. Addressing these disparities will be paramount to improve the utilization of TMT in this patient population, and help bridge the existing socioeconomic variability in survival outcomes.

P37. Challenging 30-Day Mortality As a Site-Specific Quality Metric in Non-Small Cell Lung Cancer

Carrie B. Moore, Morgan L. Cox, Michael S. Mulvihill, Jacob Klapper, *Thomas A. D'Amico, ♦Matthew G. Hartwig

Duke University, Durham, NC

Objective: Thoracic surgery programs are assessed and ranked by 30-day operative mortality, which is unlikely to be the most accurate measure of quality, given the complexity of lung cancer resection and risk of complications beyond 30 days. The objective of this project was to compare 30-day and 90-day mortality rates after surgery for non-small cell lung cancer (NSCLC) using the National Cancer Data Base (NCDB). Secondly, hospital performance was examined at multiple post-operative time frames to assess changes in ranking based on survival up to one year after surgery.

Methods: Patients who have undergone surgery for NSCLC (Analytical Stage I-IV) between 2004–2014 were identified in the NCDB. Mortality rates at 30-days and 90-days were compared after adjusting for several patient characteristics, tumor variables, and hospital procedural volume. Risk adjusted generalized logistic mixed models were used to identify predictors of mortality for each time point. Subsequently, risk adjusted generalized logistic regression models were employed to evaluate hospital performance based on calculated mortality at pre-specified time points: 30-, 60-, 90-, and 180-days. Hospitals were ranked into highest (10%), middle (80%), and lowest (10%) performance groups at each time point.

Results: A total of 326,228 NSCLC patients were included for analysis. The 90-day mortality was almost double the 30-day mortality (2.9% vs. 5.6%). Specific patient characteristics (increased age, increased comorbidities, government insurance), tumor features (higher stage, squamous cell histology), and lower hospital procedure volume were significantly associated with mortality at both 30-days and 90-days (all $p < 0.001$). The correlation of hospital performance overall rankings (1 to 1,141 facilities) was strongest between the 30-day and 60-day time points (0.79), but it decreased

monotonically after 180 days to just 0.42 at 360 days. When comparing the highest, middle, and lowest hospital percentile rankings at 60-, 90-, and 180-days compared to 30-day rankings, 11.7%, 14.4%, and 19.4% (133, 164, and 221 hospitals) of hospitals changed ranking groups, respectively. The percent change between each adjacent 30-day time point decreased to approximately 7% after 60-days and the nadir was 5% leading up to 180-day mortality.

Table: Number of Hospitals in the Highest, Middle, and Lowest Percentile Rankings Based on Risk Adjusted Mortality at 60-, 90-, and 180-Days Compared to 30-Day

30-Day Mortality				
60-Day Mortality	Highest	Middle	Lowest	Total
Highest	72	34	9	115
Middle	43	851	20	914
Lowest	0	27	85	112
Total	115	912	114	1,141
90-Day Mortality	Highest	Middle	Lowest	Total
Highest	69	39	7	115
Middle	46	834	33	913
Lowest	0	39	74	113
Total	115	912	114	1,141
180-Day Mortality	Highest	Middle	Lowest	Total
Highest	61	47	7	115
Middle	54	805	53	912
Lowest	0	60	54	114
Total	115	912	114	1,141

Conclusions: Within the first year after lung cancer surgery, a significant number of deaths related to the procedure occur both before and after 30 days. Since 30-day mortality is the commonly accepted quality measure for thoracic surgeons due to publically reported outcomes from the STS database and the National Inpatient Sample, hospital rankings may be inaccurate if based on this variable alone. Mortality at 60 to 90 days appears to be a threshold after which there is less variability in hospital ranking and should be considered as an alternative quality metric in lung cancer surgery.

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12:45 pm **Update of Surgical Ablation and** CT Theater I
Coronary Bypass Grafting Booth #134, Exhibit Hall
5 minute presentation, 7 minute discussion *Not for Credit*
Moderators: *Niv Ad and *Douglas R. Johnston

See page 72 for details.

TUESDAY AFTERNOON, MAY 1, 2018

2:00 pm **Aortic/Endovascular Sugery** Room 28ABC, SDCC
Simultaneous Scientific Session
6 minute presentation, 8 minute discussion
Moderators: *Himanshu J. Patel and *Eric E. Roselli

83. The Differential Impact of Intimal Tear Location on Aortic Dilation and Re-Intervention in Acute Type I Aortic Dissection After Total Arch Replacement

Woon Heo¹, Suk-Won Song¹, Kwang-Hun Lee¹, Tae-Hoon Kim¹, Min-Young Baek¹,
Kyung-Jong Yoo¹, *Bum-Koo Cho², Hye Sun Lee¹

¹*Yonsei University, Seoul, Republic of Korea*; ²*The Korea Heart Foundation, Seoul, Republic of Korea*

Invited Discussant: *Anthony L. Estrera

Objectives: To evaluate the differential impact of intimal tear location on aortic dilation and re-intervention after total arch replacement (TAR) of acute type I aortic dissection (AIAD).

Methods: From 2009 to 2016, 274 patients operated for acute type I dissection. Among them, 85 patients underwent total arch replacement with residual dissected thoracoabdominal aorta (TAA). Intimal tear (location, size and number) was analyzed at 3 different levels (level 1; proximal descending thoracic aorta [DTA], level2; distal DTA, level3; abdominal aorta, Figure 1A) and aortic diameter was measured at 4 different levels (pulmonary artery bifurcation [PAB], celiac axis [CA], maximal abdominal aorta [MaxAA] and maximal thoracoabdominal aorta [MaxTAA]) using serial follow-up computed tomographic (CT) scans. The linear mixed model for a repeated measures random intercept and slope model was used. The rate of freedom from re-intervention was also analyzed.

Results: Forty (47%) patients had serial CT scans sufficient for analysis. Among them, 14 patients (35%) underwent TAR with frozen elephant trunk (FET) procedure. The median CT scan follow-up was 33 months (first quartile 10, third quartile 50). Diameter at the level of CA, MaxAA and MaxTAA levels showed an increasing tendency over follow-up period. Ninety-percent of patients had intimal tears in the residual dissected TAA. In unadjusted analysis, initial aortic diameter ≥ 35 mm, number of intimal tear, presence of 3 mm or 5 mm sized intimal tear and FET were not the significant factor of aortic dilation or shrink. The significant factors of aortic dilation were the intimal tear location and the number of visceral branches from false lumen (Table 1). The rate of 3-year freedom from re-intervention was 94.1 % in patients with intimal tear >3 mm at level 3 and 37.5% in patients with intimal tear >3 mm at level 1 (log-rank, $p < 0.001$) (Figure 1B).

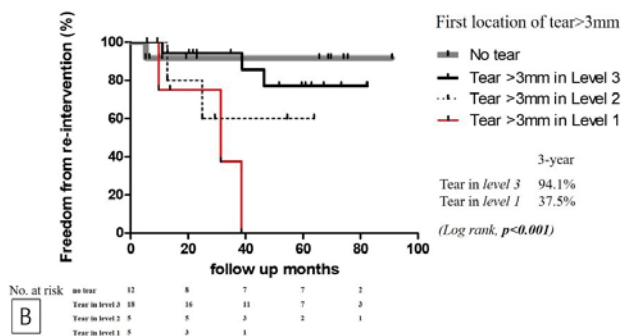
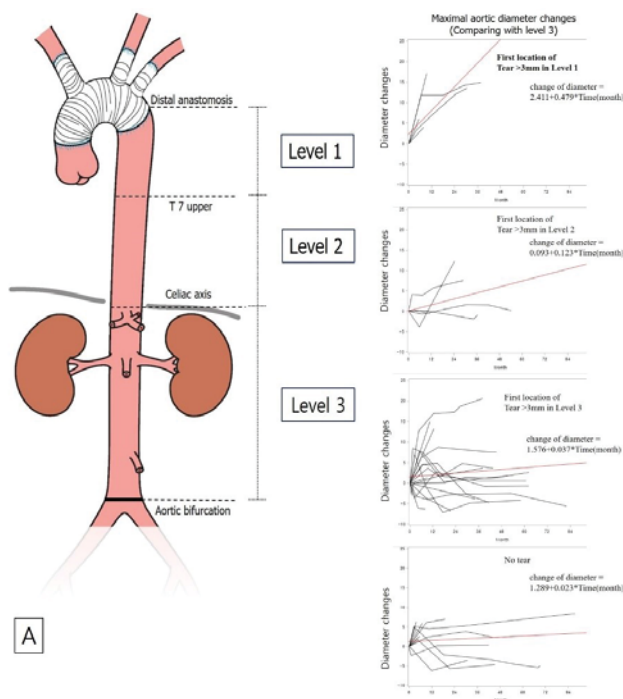


Figure 1. (A) Illustration of level 1,2,3 of aorta and graphs of diameter changes stratified by the first location of tear > 3mm. (B) Kaplan-Meier curves of freedom-from re-intervention.

Conclusions: Intimal tear in the proximal DTA is the most important factor of aortic dilation and re-intervention in acute type I aortic dissection after total arch replacement. We suggest intimal tear in the proximal DTA should be carefully evaluated and additional intervention might be needed.

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Table 1: Diameter Change of MaxTAA Using Linear Mixed Model (Random Intercept & Slope Model)

Variables	Unadjusted Model B (SE)	p Value	Adjusted Model B (SE)	p Value	Unadjusted Model B (SE)	p Value	Adjusted Model B (SE)	p Value
Initial aortic diameter ≥35 mm	0.070 (0.128)	0.585			0.055 (0.023)		0.062 (0.019)	0.002
Number of intimal tear	-0.001 (0.013)	0.976						
					First location of intimal tear >3 mm (Level 1,2,3 and no intimal tear, Comparing with level3)			
Frozen elephant trunk	-0.052 (0.088)	0.558			0.442 (0.131)	0.001	0.400 (0.102)	<0.001
Intimal tear >3 mm	-0.001 (0.094)	0.993			0.087 (0.105)	0.414	0.038 (0.083)	0.645
Intimal tear >5 mm	0.035 (0.093)	0.708			Ref (0)		Ref (0)	
					-0.014(0.081)	0.866	0.037 (0.058)	0.525
					-No intimal tear			



84. Fate of Distal Aorta After Frozen Elephant Trunk for Type A Aortic Dissection in Marfan Syndrome

Yu Chen¹, Wei-Guo Ma¹, Xu-Dong Pan¹, Ai-Hua Zhi², Wei Zhang¹, Mohammad Zafar³, Jun Zheng¹, Yong-Min Liu¹, Jun-Ming Zhu¹, *John A. Elefteriades³, *Li-Zhong Sun¹

¹Capital Medical University, Beijing, China; ²Chinese Academy of Medical Sciences, Beijing, China; ³Yale New Haven Hospital, New Haven, CT

Invited Discussant: *Steven L. Lansman

Objective: To evaluate the changes of distal aorta and late outcomes after frozen elephant trunk (FET) for type A aortic dissection (TAAD) in Marfan syndrome (MFS).

Methods: In 2003–2015, 172 MFS patients (by Ghent criteria) with TAAD (94 acute, 55%) underwent FET and total arch replacement. Mean age was 34.6 ± 9.3 years and 70% were men. Early mortality was 8.1% (14/172). Follow-up was complete in 96.8% (153/158) at 5.7 ± 3.5 years. Temporal changes in the false and true lumens (FL, TL) and maximal aortic size (DMax) on CT scans were analyzed with linear mixed modeling. Risk factors for late adverse events were identified with Cox regression.

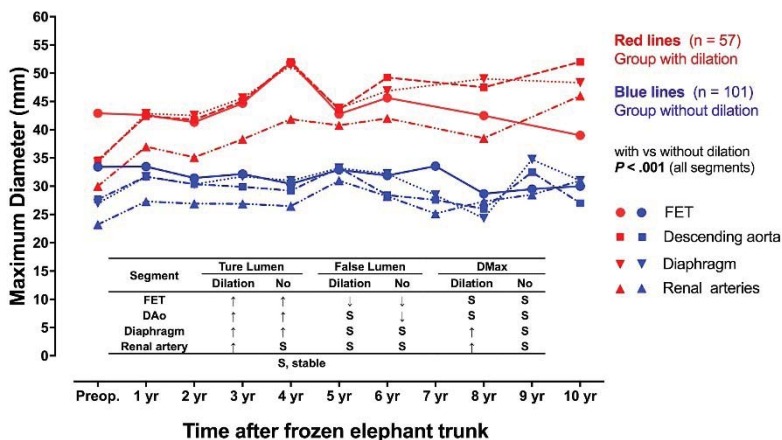
Results: FL obliteration was seen in 86%, 39%, 26% and 21% at the levels of FET, unstented descending aorta (DA), diaphragm (DH) and renal artery (RA), respectively. All 4 segments showed a significant trend of TL expansion over time ($P < .01$), while the FL shrank at the FET ($P = .004$), and was stable at distal levels ($P > .05$). The DMax was stable at FET and RA ($P > .05$), but grew over time at DA ($P = .013$) and DH ($P < .001$). Mean DMax after FET were 40.2, 32.1, 31.6 and 26.9 mm and growth rates were 0.4, 2.8, 3.6 and 2.6 mm/yr at 4 levels, respectively. DMax was stable at 4 levels in chronic TAADs ($P > .05$). In acute TAADs, DMax grew at the DH ($P = .012$) and was stable at 3 other levels ($P > .05$). At 10 years, FL obliteration occurred in 33/33 of TAADs confined to thoracic aorta. Distal DMax was stable in 101 patients (64%; $P > .05$) and grew over time in 57 (36%; $P < .01$; Figure). Late aortic dilation (defined as DMax > 50 mm or growth rate > 5 mm/yr) occurred in 42% (24/57) within 1 year and in 81% (46/57) before 5 years. Mean time to dilation was 3.1 (median 2.0) years. Distal reoperation was done in 23 patients (15%) at 2.7 ± 2.3 years (0–8, median 2.0), including 19 thoracoabdominal aortic repairs and 4 TEVARs, 11 within 1 year (48%) and 20 before 5 years (87%). Late death occurred in 22 (14%). At 10 years, survival was 71%, freedom from dilatation 58% and freedom from reoperation 80%. Distal aortic dilatation was less likely in patients with obliterated FL than those with a patent FL in DA after FET (30% vs. 77%, $P < .001$). In competing risks analysis, the 10-year incidence of aortic death was 14%, reoperation 21%, and event-free survival 65%. Preoperative DMax (mm) was predictive of dilatation and reoperation (odds ratio [OR] 1.11; $P < .001$ and OR 1.07; $P < .001$). Preoperative DMax ≥ 45 mm was a risk factor for late death (OR, 3.29; $P = .027$). A patent FL in DA predicted dilatation (OR, 3.88; $P < .001$), reoperation (OR, 3.36; $P = .014$), and late death (OR, 3.31; $P = .045$).

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Trends of Change in Maximal Aortic Size in Patients with vs without Late Distal Dilation



Conclusions: FET induced favorable distal aortic remodeling in MFS patients with TAAD by expanding the true lumen across the aorta, decreasing or stabilizing the false lumen, and stabilizing the distal aortic segments. FET had a “curative” effect on TAADs limited to thoracic aorta. Preoperative maximal aortic size and patent false lumen were risk factors for late adverse events.

85. TEVAR Has Improved Outcomes Compared to Open Surgical Repair for Descending Thoracic Aneurysms: A Propensity Analysis Among Medicare Patients in the Recent Era

Chase Robert Brown, Zehang Chen, Peter W. Groeneveld, Fabliha Khurshan, Fenton McCarthy, *Joseph Bavaria, *Nimesh Desai
University of Pennsylvania, Philadelphia, PA

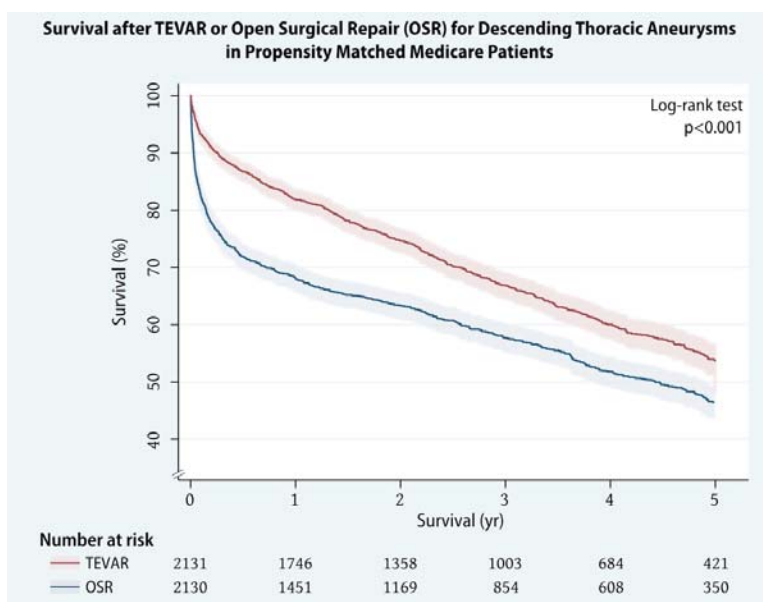
Invited Discussant: *Ourania Preventza

Objective: Thoracic endovascular aortic repair (TEVAR) has transformed the treatment for thoracic aortic aneurysms, greatly decreasing the necessity for open surgical repair (OSR). Despite that, studies have been inconsistent in demonstrating survival benefits for TEVAR over OSR and are lacking in the recent era. Therefore, we compared TEVAR to OSR among propensity matched patients with descending thoracic aneurysms to determine differences in survival and postoperative outcomes.

Methods: From 2009 to 2014, all fee-for service Medicare patients older than 66 years that underwent TEVAR or OSR for descending thoracic aneurysms were included; 8,876 (84.2%) had TEVAR and 1,671 (15.8%) had OSR. Patients with acute and chronic type B dissections or traumatic transections were excluded. A propensity analysis using a nearest neighbor method was used to match 1,950 TEVAR and 1,671 OSR patients with

balanced covariates (Elixhauser Comorbidity Index, sex, age, race, and preoperative aortic rupture). The primary endpoint was all-cause mortality. Secondary endpoints were perioperative complications at 30 days, and 1-year cardiovascular (CV) related hospital readmissions, as well as post-operative reinterventions (either secondary TEVAR or open surgery). Comparison of survival was performed using Kaplan-Meier and log rank test. One-year CV related readmissions, post-operative complications, and need for reinterventions were analyzed with a proportional hazards regression model. The median follow-up time was 2.6 years.

Results: In the propensity matched groups, the average age was 74.7 ± 5.7 years in TEVAR and 74.6 ± 5.4 years in OSR. TEVAR patients had superior survival compared to OSR at 30 days (94.1% vs. 84.8%, $p < 0.001$), 1 year (82.2% vs. 68.5%, $p < 0.001$) and 5 years (54.6% vs. 47.3%, $p = 0.005$) (Figure). Among patients with pre-operative aortic aneurysm rupture, TEVAR also had improved survival compared to OSR ($p = 0.001$). Postoperatively, TEVAR had decreased paraplegia (3.1% vs. 6.6%; HR (hazard ratio) = 0.52, $p < 0.001$) and pulmonary complications (11.1% vs. 27.0%; HR = 0.59, $p < 0.001$). TEVAR and OSR had similar rates of perioperative stroke (14.0% vs. 16.3%; HR = 1.03, $p = 0.594$) and myocardial infarction (5.2% vs. 7.5%; HR = 1.1, $p = 0.39$). However, TEVAR was associated with increased 1-year CV related hospital readmissions (15.5% vs. 13.2%, HR = 1.29 $p = 0.001$) and reinterventions (8.6% vs. 2.7%; HR = 4.3 $p < 0.001$).



Conclusion: Among patients with thoracic aneurysmal disease, TEVAR demonstrated a robust survival benefit over OSR, principally within the first year postoperatively. TEVAR also had fewer perioperative complications, but had higher rates of reinterventions and 1-year CV related readmissions. These observations are encouraging evidence for the comparative effectiveness of TEVAR vs. OSR.

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86. Short- and Long-Term Outcomes of Aortic Root Repair Versus Replacement in Patients Undergoing Acute Type A Aortic Dissection Repair-20-Year Experience

Reilly Hobbs, Elizabeth L. Norton, *Himanshu J. Patel, *G. Michael Deeb, Karen M. Kim, Xiaoting Wu, Whitney E. Hornsby, Donald S. Likosky, Bo Yang
University of Michigan, Ann Arbor, MI

Invited Discussant: *Eric E. Roselli

Objective: To evaluate the perioperative outcomes and long-term survival of aortic root reconstruction vs. aortic root prosthetic replacement (Bentall) in acute type A aortic dissection (ATAAD) patients and to provide evidence for root management during ATAAD surgery.

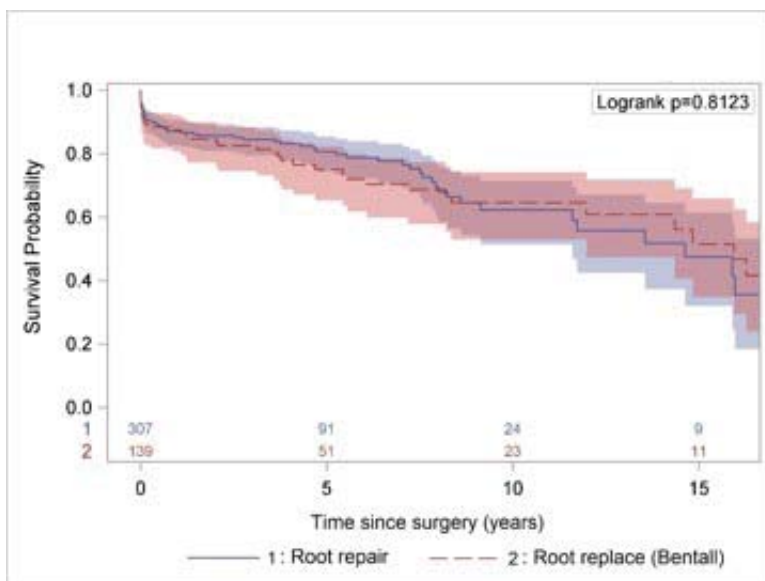
Methods: From 1996–2017, 446 patients had aortic root reconstruction or Bentall procedure for ATAAD surgery. 307 patients underwent reconstruction with preservation of the aortic valve and native root tissue. 139 patients underwent a Bentall Procedure using a mechanical (16%) or a bio-prosthetic device (84%). Indications for a Bentall procedure during ATAAD surgery were: aortic root > 4.5 cm (root aneurysm), primary intimal tear in the root (root tear), connective tissue disease, or unreparable aortic valve. The primary outcomes are operative mortality/morbidity and long-term survival.

Results: Patient characteristics of age, diabetes mellitus, smoking, CAD, peripheral vascular disease, renal failure, and history of stroke or myocardial infarction were similar between groups. Patients undergoing aortic root reconstruction were more likely to be hypertensive (76% vs. 64%; $p = 0.007$) and less likely to have preoperative severe AI (11% vs. 47%; $p = < 0.001$).

Operative data showed that patients undergoing reconstruction had significantly shorter periods of cardiopulmonary bypass (211 vs. 266 mins; $p < 0.001$) and aortic cross-clamp times (134 vs. 208 mins; $p < 0.001$). The reconstruction group had more zone 2 and 3 arch replacements (32% vs. 19%, $p < 0.001$), but circulatory arrest times were similar (38 vs. 37 mins). Both groups had similar rates of concomitant surgery (coronary artery bypass grafting, heart valve intervention, all $p > 0.05$).

There were no significant differences in perioperative outcomes between reconstruction and Bentall groups, including operative mortality (9% vs. 11%), atrial fibrillation (35% vs. 42%), new onset renal failure requiring permanent dialysis (3% vs. 4%), stroke (8% vs. 7%), myocardial infarction (1.3% vs. 1.4%), and sepsis (3% vs. 4%). The Kaplan-Meier 10-year and 15-year survival for Reconstruction vs. Bentall was 62% vs. 62% and 47% vs. 51% respectively (Figure).

Conclusion: In ATAAD, a Bentall procedure did not increase the perioperative mortality/morbidity and achieved good long-term survival despite being a more complex operation for more severe root pathology compared to reconstruction which was used for patients with less root pathology. ATAAD patients with aortic root aneurysm, root tear, connective tissue disease should undergo a Bentall procedure.



87. Outcomes of Two Different Geometric Orientations for Aortic Neoroot Creation in Repair of Sievers Type I Bicuspid Aortic Valve with Root Reimplantation

Mary A. Siki, Andreas Habetheruer, *Joseph E. Bavaria, Caroline Komlo, Maxwell Hunt, Melanie Freas, Rita Karianna Milewski, *Nimesh D. Desai, *Wilson Y. Szeto,

♦Prashanth Vallabhajosyula

University of Pennsylvania, Philadelphia, PA

Invited Discussant: ♦Michael P. Fischbein

Objective: Type I variant of bicuspid aortic valve (BAV) represents non-conjoint and conjoint (with pseudocommissure) cusps oriented along a spectrum of equal ($180^\circ/180^\circ$) or unequal ($150^\circ/210^\circ$) leaflet surface area distribution along the aortic annular plane. At our institution, in patients with aneurysmal type I BAV syndrome, we have taken the approach of respecting the native geometric orientation of the repaired BAV leaflets when creating the aortic neoroot during valve sparing root reimplantation (VSRR) procedures. We investigated midterm clinical and functional outcomes with this two-prong approach for VSRR in type I BAV syndrome.

Methods: Prospectively maintained BAV repair database was queried for type I anatomy and VSRR. Of 68 patients undergoing repair, 61 met inclusion criteria: 26 patients had $180^\circ/180^\circ$ neoroot geometry ($180^\circ/180^\circ$ group), and 36 patients at $150^\circ/210^\circ$ orientation ($150^\circ/210^\circ$ group). Clinical and 1-year echocardiographic follow-up was 100% and 67% complete. Transition state probability model was generated to compare recurrent aortic insufficiency (AI) between the two groups. Multivariate cox regression analysis was performed to study parameters associated with composite long term outcome of mortality, aortic reoperation, or recurrent AI > 2+.

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Results: Preoperative parameters were similar between 180°/180° versus 150°/210° groups. Intraoperative parameters including aortic cross clamp (274 min vs. 286 min, $p = 0.48$) and cardiopulmonary bypass (220 min vs. 238 min, $p = 0.21$) times, and primary cusp repair rates were similar ($p \geq 0.5$). Postoperatively, mortality, stroke, renal failure, reoperation for bleeding, and pacemaker rates were zero in entire cohort. At discharge echocardiography, freedom from AI > 1+ was 100%. Mean follow-up was 38.9 ± 32.1 months for entire cohort. Mortality and stroke rates have remained at zero. Actuarial freedom from composite index of aortic reoperation, recurrent AI > 2+ was 100% and 96% (out to 4 years, $p = 0.74$) for the entire cohort. Transition state model for recurrent AI showed no difference in recurrent AI > 2+ between the two groups (Figure 1). Multivariate cox regression showed that neoroot orientation was not associated with composite outcome over follow-up (HR 0.93, 95% CI [0.07, 11.76]).

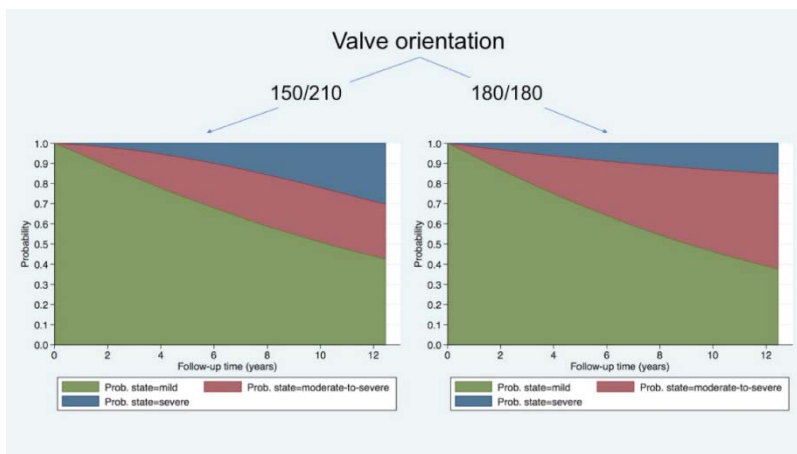


Figure 1: Transition state probability model for recurrent aortic insufficiency shown for the two different aortic neoroot geometric orientations in Sievers Type I bicuspid aortic valve sparing root reimplantation.

Conclusions: Respecting the native type I BAV geometry for VSRR neoroot creation yields excellent long term clinical and functional outcomes. This approach may minimize conjoint cusp leaflet billowing and stress that may occur in “forcing” a 150°/210° oriented valve into a 180°/180° neoroot, and thus improve long term functional outcomes.



88. Long Term Survival, Risk of Re-Intervention, and Surveillance Imaging After Acute Type A Aortic Dissection Repair in the United States

Alexander Iribarne, Anthony DiScipio, Jock McCullough, Gouri Chakraborti, Andrea Austin, Philip Goodney

Dartmouth-Hitchcock Medical Center, Lebanon, NH

Invited Discussant: *John R. Doty

Objective: Current ACC/AHA/AATS guidelines for the management of patients with thoracic aortic disease provide recommendations on surveillance imaging after proximal aortic surgery that are based on level C evidence. The goal of this analysis was to characterize longitudinal survival and surveillance imaging practices in a national cohort of patients undergoing acute type A aortic dissection (AAD) repair.

Methods: All fee-for-service Medicare beneficiaries aged 65 and older, continuously enrolled in Parts A and B for all 12 months of a given calendar year from 2005–2010 ($n = 163,810,697$), were queried for admission diagnoses of AAD and current procedural terminology (CPT) codes for surgery of the proximal aorta and aortic arch (CPT 33860, 33863, 33864, 33870). A total of 2,012 beneficiaries were identified and formed the study cohort. Patients were assigned unique identifiers, and claims were followed longitudinally for 5 years from index surgery to assess survival, thoracic aortic re-intervention procedures, and surveillance imaging frequency and duration.

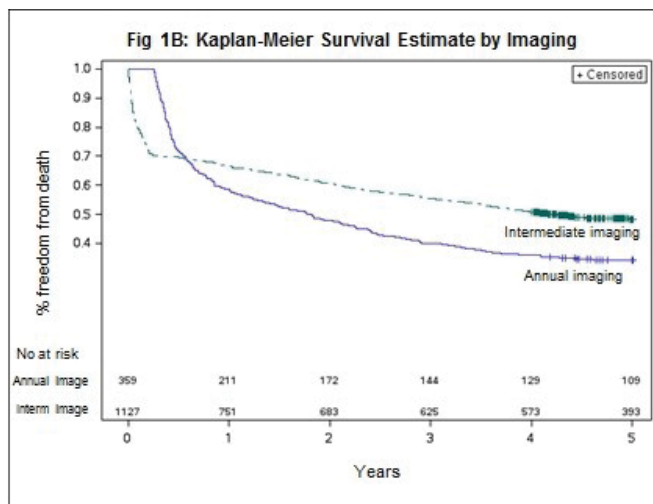
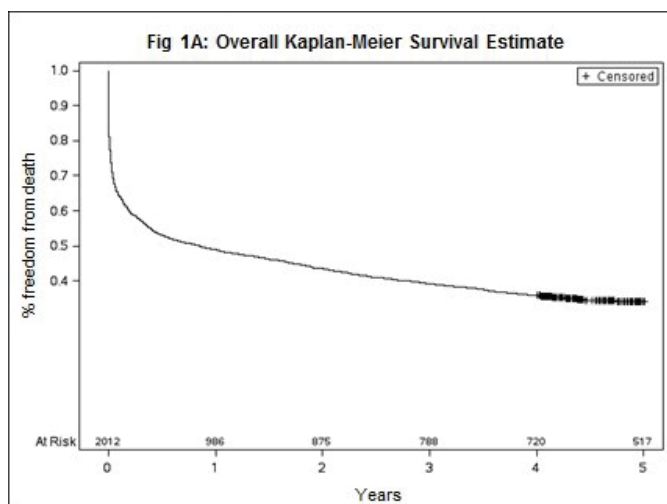
Results: Among the study cohort, 62.6% ($n = 1,247$) underwent isolated ascending aortic graft replacement, 16.7% ($n = 336$) had associated AVR, and 19.4% ($n = 390$) had total aortic arch replacement. The mortality rate was 51% at 1 year, 56.5% at 2 years, and 65.8% at 5 years (Figure 1A). The proportion of patients treated with an aortic re-intervention over the entire study period was 7.3% ($n = 147$) and the mean time to first re-intervention was 381 days. Among patients who underwent re-interventions, the most common procedures included: 24.3% ($n = 489$) endovascular repair of the descending thoracic aorta, 23.6% ($n = 475$) re-operation on the proximal ascending aorta, and 17.4% ($n = 350$) re-operation on the aortic arch. Regarding post-operative surveillance imaging, a total of 5,291 CTAs, 4,930 TTEs, and 207 MRIs were performed during the study period; a mean of 5.2 studies per patient during surveillance. When examining the association between surveillance imaging and survival, we focused on those patients who survived more than one year and either underwent annual imaging (17.8%, $n = 359$) or intermediate imaging (56%, $n = 1,127$) (defined as at least one image during years 1–2 and at least one image during years 3–5). Patients receiving intermediate imaging had lower five-year mortality than those receiving annual imaging (51.4% vs. 65.7%, $p < 0.001$) (Figure 1B).

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Conclusion: Patients undergoing AAD repair are at highest risk of mortality and aortic re-intervention within the first 2 years after surgery. Most patients in the US do not receive annual surveillance imaging, and less intense, intermediate imaging was not associated with reduced survival. Less intense surveillance, focused on imaging within the first 2 years and more liberal surveillance thereafter, may offer an opportunity to limit resource utilization without negatively impacting survival.



89. Does Incidental Splenectomy Impact Survival After Thoracoabdominal Aortic Aneurysm Repair?

Subhasis Chatterjee, *Scott Anthony LeMaire, Hiruni S. Amarasekara, Susan Yvonne Green, Matt Darwin Price, *Ourania Preventza, Chris John Pirko, Qianzi Zhang, Kim Insua de la Cruz, Samuel Rob Todd, *Joseph Stapleton Coselli

Baylor College of Medicine, Houston, TX

Invited Discussant: *Edward P. Chen

Objective: Although incidental splenectomy (IS) is relatively common during thoracoabdominal aortic aneurysm (TAAA) repair—particularly during reoperations—the effect of IS on outcomes has not been reported. We hypothesized that patients who undergo TAAA repair with IS have decreased short and midterm survival compared to those without IS.

Methods: We retrospectively reviewed 1,056 TAAA repairs done at our institution from 2006–2016 using prospectively collected data. After excluding patients aged ≤ 18 years ($n = 9$), those with prior splenectomy ($n = 2$), and intraoperative deaths ($n = 3$), we analyzed 1,042 TAAA repairs. The median patient age was 65 years (interquartile range [IQR], 56–72). The distribution included 257 (25%) Crawford extent I, 336 (32%) extent II, 201 (19%) extent III, and 248 (24%) extent IV TAAA repairs. 422 patients (41%) presented with chronic dissection, 179 (17%) with acute symptoms, 221 (21%) were reoperations with 189 (18%) having prior distal aortic repairs. Multivariable modeling identified predictors of operative death (i.e., death within 30 days of surgery or before final discharge from any hospital) and for cumulative death at 1 and 5 years. After excluding operative deaths, the IS effect on midterm survival was assessed by Kaplan-Meier analysis with log-rank testing.

Table: Thoracoabdominal Aortic Aneurysm Repair Data and Operative Outcomes

Characteristics of Patients Who Underwent TAAA Repair Stratified by Occurrence of Splenectomy				
Variable	Overall ($n = 1,042$)	No Splenectomy ($n = 913$)	Splenectomy ($n = 129$)	p Value
Median Age, yrs [IQR]	65 [56–72]	65 [56–72]	65 [55–71]	0.8
Reoperation (%)	221 (21.2)	174 (19.1)	47 (36.4)	<0.001
Urgent/Emergent (%)	247 (23.7)	209 (22.9)	38 (29.5)	0.13
Median Aortic Clamp Time in Minutes [IQR]	54 [41–70]	54 [41–70]	55 [43–73]	0.3
Operative Death (%)	90 (8.6)	70 (7.7)	20 (15.5)	0.005
Renal Failure: Dialysis on Discharge (%)	77 (7.4)	61 (6.7)	16 (12.4)	0.03
Septic Complications (%)	68 (6.5)	54 (5.9)	14 (10.9)	0.03
Cumulative death at 1 year (%)	168 (16.1)	137 (15.0)	31 (24.0)	0.01
Cumulative death at 5 years (%)	300 (28.8)	245 (26.8)	55 (42.6)	<0.001

Results: IS occurred in 129 patients (12%) and was common in cases of reoperation (36%). Age and aortic clamp time were similar for patients with and without IS. (Table) Operative mortality occurred in 16% ($n = 20$) of those with IS vs. 8% ($n = 70$) in those without IS ($P = 0.005$). Patients with IS were significantly more likely to develop renal failure or septic complications than those without IS. In multivariable analysis, IS was an

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independent predictor of operative mortality (relative risk ratio [RRR] = 2.2; 95% confidence interval [CI], 1.21–3.94; $P = 0.008$). Although IS was associated with increased cumulative death at 1 and 5 years, it was not an independent predictor of cumulative death on multivariable analysis. However, IS was strongly associated with reoperation, an independent risk factor for death at 5 years (RRR = 2.35; 95% CI, 1.50–3.67, $P < 0.001$). Of 109 operative survivors with IS, 101 (93%) patients received triple vaccination during index admission. Kaplan-Meier analysis of early survivors showed 5-year survival of $53\% \pm 6\%$ in those with IS ($n = 109$) and $64\% \pm 2\%$ in those without IS ($n = 843$; $P = 0.08$).

Conclusions: Although IS during TAAA repair was associated with increased operative mortality and adverse events, it was not an independent predictor of 1- or 5-year mortality. Given that IS was an independent predictor of operative mortality, splenic preservation at the time of TAAA repair is encouraged when feasible. Patients undergoing reoperative surgery are at high risk of needing splenectomy.

3:40 pm – Coffee Break in the Exhibit Hall
4:05 pm

90. Fifteen-Year Experience with Valve-Sparing Reimplantation Technique for the Treatment of Aortic Aneurysm and Aortic Regurgitation

Stefano Mastrobuoni, *Laurent de Kerchove, Emiliano Navarra, Philippe Noirhomme,

*Gebrine El Khoury

St. Luc's Hospital, Brussels, Belgium

Invited Discussant: *Abe DeAnda, Jr.

Objective: Aortic valve sparing – root replacement with the reimplantation technique (VSR) has been introduced for the treatment of root aneurysm without significant valve disease. The durability of the valve is questioned in the presence of significant aortic regurgitation (AR). Further, VSR is not usually considered for the treatment of isolated AR. In this study we present our 15-year experience with VSR for conventional indication (root aneurysm without AR) as well as for “debated” indication (aneurysm with AR) and non-conventional indication (isolated AR).

Methods: Between 1995 and 2017, 923 consecutive adult patients were treated for aortic valve repair in Our Institution, of whom 440 (47.7%) underwent VSR and are the object of this study. The mean age of this cohort was 49 ± 15 years, 90.7% of patients were male, 13.8% ($n = 61$) had a previous cardiac surgery of whom 12 patients AV repair and 28 a Ross operation. Indications for surgery were: aortic root aneurysm without AR in 139 patients (31.6%, Group 1), aneurysm with significant AR in 212 (48.2%, Group 2), isolated aortic regurgitation in 76 (17.3%, Group 3) and type-A acute aortic dissection in 12 patients (2.7%). One hundred and seventy-seven patients (40.2%) had a bicuspid valve (BAV). Further, congenital connective tissue disorders affected 36 patients (8.2%). Cusp repair was added in 74.5% of patients (97.1% of BAV and 59.4% of TAV). Further 24.8% of patients had some concomitant cardiac procedure.



Results: In-hospital mortality was 0.7% (n = 3, of whom 2 acute aortic dissection and 1 patient in Group 1). Sixteen patients (3.6%) were lost to follow-up therefore 421 patients were available for long-term analysis. Cumulative follow-up is 2179 patient-years with median duration of 4.8 years (IQR: 1.8–8.4).

Thirty-six patients (8.5%) died during follow-up therefore postoperative survival is $79.7 \pm 3.8\%$ at 10 years. During follow-up we observed a linearized rate of 0.37%, 0.73% and 0.2% patient-year respectively for major bleeding, thromboembolic events and infective endocarditis.

One patient experienced early repair failure and underwent re-repair during the same admission while 19 patients required late aortic valve reoperation. Freedom from valve reoperation is therefore $89.6 \pm 2.9\%$ at 10 years after surgery and is not significantly different between Groups or between TAV and BAV.

Freedom from recurrent AR >2+ was $91.9 \pm 2.6\%$ at 10 years and was not different between Groups or between TAV and BAV.

Conclusions: Our study shows that VSR is associated with low perioperative mortality, a remarkably low rate of valve-related complications and excellent long-term durability. Further, VSR can be safely performed also in patients with isolated AR, the durability of valve repair is similar regardless of the indication for surgery and is particularly effective in cases of bicuspid AV.

91. Complete Thoracic Aorta Remodeling After Endovascular Aortic Repair Is a New Therapeutic Target for Chronic DeBakey IIIb Aneurysm

Tae-Hoon Kim¹, Suk-Won Song¹, Woon Heo¹, Won-Ki Woo¹, Min-Young Baek¹, Kwang-Hun Lee¹, Kyung-Jong Yoo¹, *Bum-Koo Cho²

¹Yonsei University, Seoul, Republic of Korea; ²The Korea Heart Foundation, Seoul, Republic of Korea

Invited Discussant: *G. Chad Hughes

Objective: Although thoracic false lumen thrombosis (TFT) has been considered as an important factor for favorable aortic remodeling after thoracic endovascular aortic repair (TEVAR) in chronic DeBakey IIIb (CDIIIb) aneurysm, the recanalization of the false lumen (FL) frequently occurs even after TFT. We introduce “Complete thoracic aorta remodeling (CTR)” as a new therapeutic target of TEVAR for CDIIIb aneurysm and analyze the risk factors of CTR.

Methods: From 2012 to 2016, 75 patients (mean age: 58.2 years and male: 59 [78.7%] patients) underwent TEVAR for CDIIIb aneurysm. CTR was defined as TFT with FL diameter <5 mm down to T-10 level. Major adverse aortic event (MAAE) was defined as events including mortality, open conversion and FL recanalization after TFT. Aortic diameter including true lumen and FL was measured at 3 levels (left subclavian artery, pulmonary artery bifurcation and celiac axis). The procedure details, the number of visceral branches from the FL and residual intima tears were evaluated as anatomical risk factors.

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Results: Of 75 patients, whole thoracic coverage with stent graft was performed in 58 (77.3%) patients and 60 (80.0%) patients demonstrated TFT. Of those patients with TFT (n = 60), mortality, open conversion, FL recanalization after TFT were occurred in 3 (5%), 3 (5%), 5 (8.3%) patients, respectively. Nineteen (25.3%) of 75 patients demonstrated CTR. In patients with CTR, there was no MAAE during follow-up period (Figure 1). Of TFT patients, the mean time interval to achieve TFT were 3.9 and 8.2 months comparing CTR and non-CTR patients ($p = 0.26$). The mean time interval to achieve CTR was 12.8 months. The number of visceral branches from the FL and residual intima tears were the significant risk factors for CTR (Table 1). On receiver operating characteristic analysis for CTR, the best cutoff values of the number of visceral branches from the FL and residual intima tears were 2 (area under curve [AUC]: 0.648) and 3 (AUC: 0.671), respectively. The estimated probability of CTR within 1-year was 73.3% in patient without residual intima tear and visceral branches from the FL (Figure 2).

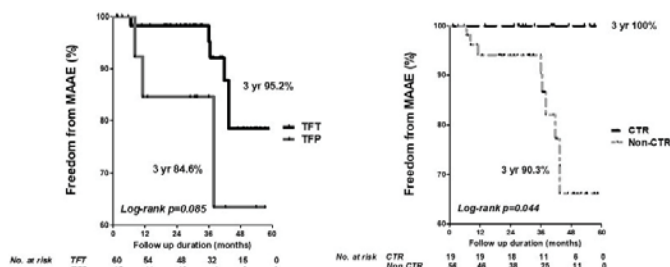


Figure 1. (A) Cumulative curve of freedom from major adverse aortic event (MAAE) comparing thoracic FL thrombosis (TFT) (n=60) vs thoracic FL patent (TFP) (n=15). (B) Cumulative curve of freedom from MAAE comparing complete thoracic aorta remodeling (CTR) (n=19) vs non-CTR (n=56).

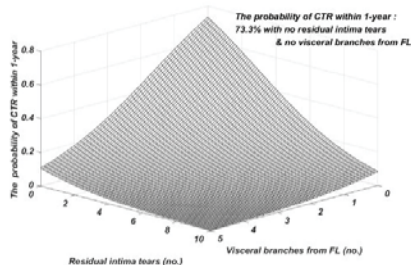


Figure 2. The 3D-plot of estimated probability of complete thoracic aorta remodeling (CTR) within 1 year.

Table 1: Multivariable Cox Regression for Complete Thoracic Aorta Remodeling (CTR)

Variables	Hazard Ratio (95% Confidence Interval)	p Value
Visceral branches from false lumen (no.)	0.627 (0.400–0.982)	0.041
Residual intima tears (no.)	0.754 (0.575–0.990)	0.042

Conclusions: In CDIIb aneurysm, complete thoracic aorta remodeling might be the ideal target of endovascular treatment rather than FL thrombosis. The number of visceral branches from the FL and residual Intimal tears were the significant obstacles for achieving CTR. Additional procedures to eliminate the obstacles of CTR and close follow-up even after thoracic FL thrombosis might be needed to demonstrate the optimal outcome for CDIIb aneurysm.

92. Loeys-Dietz Syndrome: Intermediate-Term Outcomes of Medically and Surgically Managed Patients

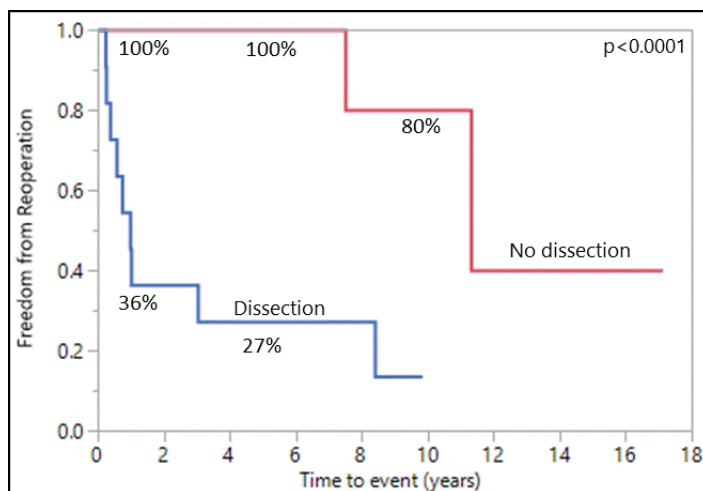
Muhammad Aftab², Frank Cikach, Jr.¹, Jay J. Idrees¹, Yuanjia Zhu¹, Christina M. Rigelsky¹, Vidyasagar Kalahasti¹, *Eric E. Roselli¹, *Lars G. Svensson¹

¹Cleveland Clinic, Cleveland, OH; ²University of Colorado, Aurora, CO

Invited Discussant: *Duke E. Cameron

Objective: Loeys-Dietz syndrome (LDS) is an aggressive connective tissue disorder associated with aortic dissection and rupture at a young age and small diameter. Given the paucity of data on the management of patients with LDS, we report natural history and surgical outcomes to help establish treatment guidelines for this population.

Methods: Review of records from 1998 to 2016, identified 53 patients with genetically confirmed LDS. Of these, 30 (57%) underwent aortic operation (22 elective, 8 urgent), and 23 patients are under close surveillance. Median follow-up was 65.1 months (range 28–99 months). Mean age at operation was 39 ± 14 years and median aortic diameter was 4.3 cm (interquartile range 3.9–4.6 cm). The non-operative cohort was younger (25 ± 19 years), with smaller aortic diameters (median 3.4 cm; interquartile range 2.9–3.7 cm). Six operative patients (20%) underwent previous cardiovascular operations including acute type I dissection repair ($n = 3$), acute type II dissection repair ($n = 1$), aortic valve ($n = 1$) and mitral valve ($n = 1$) replacement. The index operation was modified valve-sparing root replacement in 16 (53.3%), and thoracic endovascular aortic repair (TEVAR) in 2 (6.7%).



Results: There were 2/30 (6.7%) operative deaths, both for urgent indications. There were no deaths after elective operations. Multiple aortic reoperations were performed in 11/30 (36.7%) patients, most with aortic dissection. Estimated freedom from aorta-related reoperations among dissection and non-dissection patients at 1, 5, and 10 years was 36%, 27%, and 13.6% versus 100%, 100%, and 80%, respectively ($p < 0.0001$, Figure). TEVAR was performed prior to index operation in 1, and after index operation

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in 3. Indications for TEVAR included expanding aneurysm in 2, acute dissection with malperfusion in 2, and expansion of residual dissection in 2. Reoperation was required in 3/6 (50%) after TEVAR. Among the non-operative cohort, there was one late death due to descending aortic rupture.

Conclusions: Surgical outcomes for LDS are excellent, especially for prophylactic indications. Need for surgical reintervention is high after aortic dissection. Close surveillance of medically managed and post-operative patients is important to monitor disease progression. Early prophylactic surgery is critical to avoid aortic catastrophe and optimize long-term prognosis. Further analysis and long-term follow-up will help determine the role for endovascular therapy in the treatment of LDS.

93. Decision-Making Algorithm for Ascending Aortic Aneurysm — Real World Effectiveness

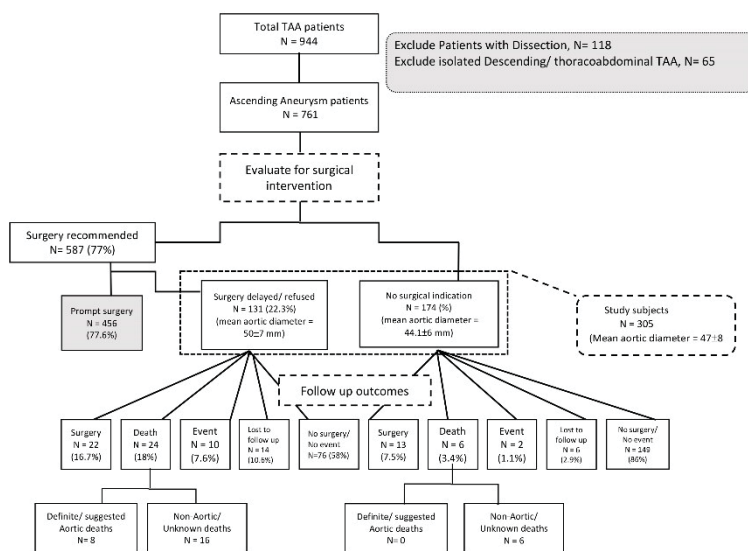
Ayman A. Saeyeldin, Mohammad A. Zafar, Camilo A. Velasquez, Adam J. Brownstein, Syed Usman B. Mahmood, Young Erben, Bulat A. Ziganshin, *John A. Elefteriades
Yale New Haven Hospital, New Haven, CT

Invited Discussant: *Edward P. Chen

Objectives: The natural risk of rupture and dissection in ascending thoracic aortic aneurysms (TAAAs) increases as the aorta enlarges, with high risk at diameters exceeding 5 cm. This study evaluates the “real world” effectiveness of a simple size-based algorithm for preemptive surgical intervention to prevent rupture and dissection.

Methods: 944 consecutive patients with thoracic aortic disease presented to our institution between 2011 and 2016. Of these, 761 with non-dissecting TAAAs form the core group of this study. Upon initial presentation, patients were triaged to either surgical (n = 587, 77%) or medical management (observation) (n = 174, 23%) based on a simple algorithm: surgery for large (>5 cm) or symptomatic aneurysms. A total of 305 out of 761 patients did not undergo surgery. Of these, 131 (43%) had been triaged to prompt surgery but did not undergo surgery for a variety of reasons (“surgery non-compliant” group). Another 174 (54%) were triaged (per algorithm) to medical management (“medical” group).

Results: Follow-up of the “surgery non-compliant” and “medical” non-operated patients permitted evaluation of the effectiveness of the triage algorithm in the real world. Mean ages were 68.1 ± 15.1 vs. 66.3 ± 13.9 years in the “surgery non-compliant” and “medical groups”. Mean aortic diameters were 50 ± 7 vs. 44.1 ± 6 mm. Mean follow-up duration was 36.9 ± 21 months. Among “surgery non-compliant” and “medical” groups, definite or possible aortic events (rupture/dissection) occurred in 10 (7.6%) vs. 2 (1.1%) patients ($p = 0.003$) respectively, indicating that *vulnerable* and *safe* patients were accurately identified. Later elective surgeries (for growth or symptoms) were conducted in 22 (16.7%) vs. 13 (7.5%) respectively in the two groups. Death ensued in 24 (18%) vs. 6 (3.4%) ($p < 0.0001$) respectively. In the “surgery non-compliant” group, 8 out of 24 patients died of definite aortic causes, while in the “medical” group no aortic deaths occurred.



Conclusion: Patients with TAAAs who were triaged to prompt surgical intervention, but did not undergo subsequent repair, experienced worse outcomes (aortic events, eventual surgery, death) compared to medically triaged candidates. Medically triaged patients did well, without aortic events. The simple algorithm based on size and symptoms functioned effectively in real-world application – correctly identifying both “at risk” and “safe” patients.

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94. Surgical Aortic Arch Intervention Is Associated with Increased Mortality: Outcomes from a Longitudinal Analysis

Daniel P. Logsdon, Michael E. Bowdish, *Robbin G. Cohen, Fernando Fleischman, Mark J. Cunningham, Ramsey Elsayed, Joshua Perese, Tiffany Sierrro, Tyler Fugere, *Vaughn A. Starnes

University of Southern California, Los Angeles, CA

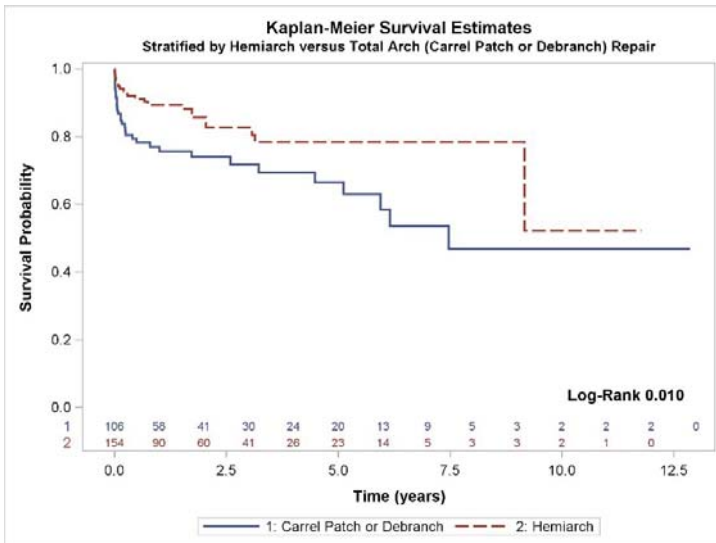
Invited Discussant: *Thoralf M. Sundt, III

Objective: While some advocate aggressive aortic arch replacement in the setting of ascending aortic disease, our approach has been to intervene only when indicated pathologically. The objective of this study was to compare outcomes of hemi versus total arch replacement in the setting of aortic arch pathology.

Methods: A single center retrospective cohort study was conducted of those undergoing surgical aortic arch intervention. Subjects were divided into those undergoing hemi arch or total arch replacement (aortic debranching or a carrel patch technique). Primary endpoints were overall mortality and need for aortic reintervention. Standard univariate analyses were conducted. Unadjusted survival was estimated by Kaplan-Meier methods. Multivariable Cox-Proportional Hazards were used to model overall mortality. Death as a competing outcome was considered in analyses of reintervention.

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Results: Between March 2004 and August 2017, 261 patients underwent surgical aortic arch intervention, of which, 154 underwent hemi arch and 106 underwent total arch repair. Mean age was 60.5 ± 13.6 years and did not differ between groups ($p = 0.62$). The primary indication was acute or chronic dissection in 173 (68%), aneurysm in 72 (28%) and other in 16 (6%). Mean follow up was 2.3 ± 2.5 years. There were 55 deaths during follow up (23 hemi arch, 32 total arch, odds ratio 2.46, 95% confidence intervals 1.34–4.52, $p = 0.003$). Overall survival was 84.4, 78.4, and 73.4% at 1, 3, and 5 years, respectively. Survival for those undergoing hemi arch repair was 89.3, 82.7, and 78.4% at 1, 3, and 5 years while survival for those undergoing total arch repair was 78.2, 71.8, and 66.5% at 1, 3, and 5 years (log rank $p = 0.010$, Figure). Multivariable Cox proportional hazard modeling, adjusted for age and indication showed a significant increased risk of death in the total arch group (hazard ratio 1.80, 95% confidence intervals 1.03–3.16, $p = 0.039$). Fourteen patients underwent aortic reintervention (5 hemi arch, 9 total arch, odds ratio 2.76, 95% CI 0.90–8.50, $p = 0.07$). The cumulative incidence of aortic reintervention was 3.3, 3.3 and 5.0% at 1, 2, and 3 years in the hemi arch group and 4.1 and 10.0% in the total arch group (Grey's test for equality of cumulative incidence functions $p = 0.24$).



Conclusion: Overall survival after aortic arch repair is excellent, however, these patients continue to have significant long-term morbidity and mortality, and those requiring total arch repair have worse survival likely related to their underlying disease pathology. In addition, the need for aortic reintervention in both those undergoing hemi arch and total arch repairs remains significant. These results suggest that a cautious approach to repair of the aortic arch, replacing the aortic arch only when necessary, is a prudent treatment strategy.

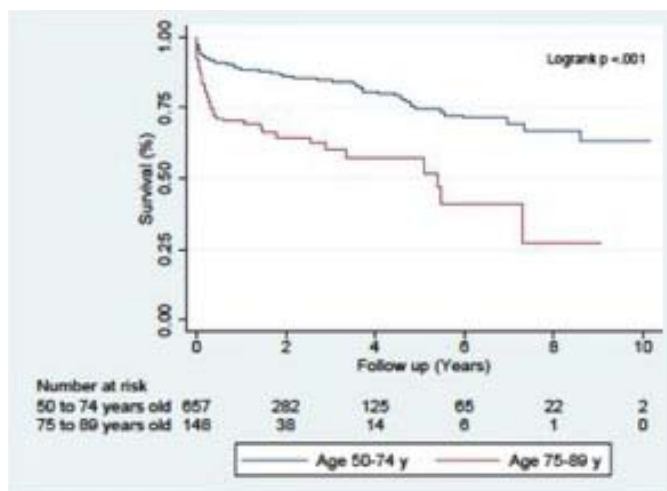
95. In the Endovascular Era Is Elective Open Aortic Arch Surgery in Elderly Patients Greater Than or Equal to 75 Years of Age Still Justified?

*Ourania Preventza, Matt D. Price, Hiruni S. Amarasekara, Vicente Orozco-Sevilla, Subhasis Chatterjee, Qianzi Zhang, Kim I. de la Cruz, *Joseph S. Coselli
Baylor College of Medicine, Houston, TX

Invited Discussant: *S. Chris Malaisrie

Objective: Although the prevalence of cardiovascular disease increases with age, the data supporting performing elective aortic arch surgery in the elderly are equivocal. We evaluated short- and long-term outcomes after elective arch surgery in patients ≥ 75 years old to determine whether complex arch operations are justified in these patients.

Methods: Over a recent 10-year period, 805 patients ≥ 50 years old underwent elective proximal and total arch surgery; 148 of these patients were ≥ 75 years old. Composite adverse outcome was defined as operative mortality, persistent (ie, present at discharge) neurologic event, or persistent hemodialysis. Multivariate logistic regression analysis was performed on the entire cohort and on the patients ≥ 75 years old, and propensity-score analysis was performed to compare patients aged 50–74 years with those aged ≥ 75 years. Kaplan-Meier estimates of survival were also calculated.



Results: Compared with patients 50–74 years old, patients ≥ 75 years old had significantly higher rates of composite adverse outcome (22.3% vs. 9.3%, $P < 0.001$), operative mortality (18.2% vs. 6.2%, $P < 0.001$), and persistent stroke (6.1% vs. 2.6%, $P = 0.039$). Multivariate analysis for the full cohort showed that age at admission independently predicted composite adverse outcome (odds ratio [OR] 1.068, 95% confidence interval [CI] 1.036–1.101, $P < 0.0001$), operative mortality (OR 1.094, 95% CI 1.056–1.134, $P < 0.0001$), and prolonged ventilator support (>48 h) (OR 1.047, 95% CI

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1.026–1.069, $P < 0.0001$), but not stroke. Propensity-matching analysis confirmed the results regarding prolonged ventilatory support (>48 h). Compared with patients 50–74 years old, patients ≥ 75 years old had significantly lower survival rates at 1 year ($69.1\% \pm 4.5\%$ vs. $88.59\% \pm 1.4\%$, $P < 0.001$) and 5 years ($52.0\% \pm 7.3\%$ vs. $73.5\% \pm 3.0\%$) postoperatively.

Conclusion: As endovascular technology evolves, having benchmark surgical data from likely endovascular-therapy candidates is critical. This study, among the few to focus on elective aortic arch surgery in patients ≥ 75 years old, suggests that surgical intervention carries a risk and that novel endovascular therapies are needed.

5:34 pm **Adjourn**

2:00 pm **Congenital Heart Disease** Room 24ABC, SDCC
Simultaneous Scientific Session
8 minute presentation, 10 minute discussion

Moderators: *Charles B. Huddleston and *Christian Pizarro

96. Need for Repair of Partial and Transitional Atrioventricular Septal Defects During Infancy Is Associated with Increased Risk of Reoperation

Carlos M. Mery¹, Rodrigo Zea-Vera¹, Martin A. Chacon-Portillo¹, M. Scott Binder², Wei Zhang¹, William B. Kyle¹, Iki Adachi¹, *Jeffrey S. Heinle¹, *Charles D. Fraser, Jr.¹

¹Texas Children's Hospital, Houston, TX; ²Eastern Virginia Medical School, Norfolk, VA

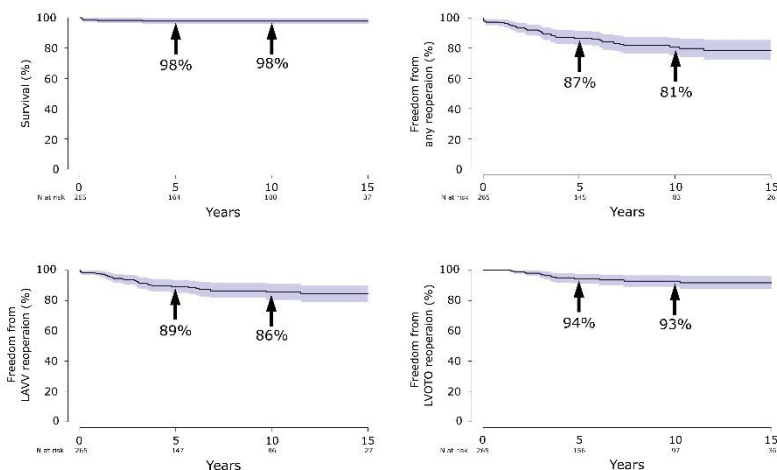
Invited Discussant: *David P. Bichell

Objective: The incidence and risk factors for reoperation in partial and transitional atrioventricular septal defects (P/TAVSD) are unclear, and the optimal timing of repair is unknown. The goal of this study was to assess risk factors for reoperation in P/TAVSD in a large, single-center, contemporary cohort.

Methods: All patients undergoing repair of P/TAVSD from 1995 to 2017 were retrospectively reviewed; patients with heterotaxy were also included. Transitional defects were defined as a common atrioventricular valve, a primum atrial septal defect, and a restrictive inlet ventricular septal defect. Partial defects were defined as primum atrial septal defect and cleft left atrioventricular valve (LAVV). Patients were divided by age into infants (<1 y), toddlers (1–3 y), children (3–18 y), and adults (>18 y). Abnormal LAVV was defined as a double orifice LAVV, deficient left lateral leaflet, or single papillary muscle. Log-rank test and Cox models were used for univariate and multivariable analysis, respectively.

Results: Overall, 265 patients underwent repair of P/TAVSD (partial: 177 [67%]). Median age at repair was 2 years (7 d–55 y). The cohort included 72 (27%) infants, 86 (33%) toddlers, 94 (35%) children, and 13 (5%) adults. Trisomy 21 (T21) was present in 76 (29%) patients. 105 (40%) patients had moderate or worse LAVV insufficiency preoperatively, 41 (15%) had an abnormal LAVV, and 101 (38%) had heart failure symptoms. The most

common indications in infants were heart failure (67%, 48/72) and moderate or worse LAVV insufficiency (15%, 11/72). The cleft was completely closed in 216 (83%) patients. 2 (0.8%) patients died perioperatively; the 1st had biliary atresia awaiting liver transplant and the 2nd had Shone's syndrome, an unbalanced defect, and pulmonary vein stenosis. No patient developed complete heart block. Median follow-up was 7 years (3 d–21 y). The Figure shows long-term survival and freedom from reoperation. On multivariable analysis, T21 (Hazard Ratio [HR] 0.2, 95% Confidence Interval [CI] 0.1–0.6) and older age when compared to infants (toddlers: HR 0.3, 95% CI 0.1–0.7; children: HR 0.2, 95% CI 0.1–0.6), were protective for reoperation, whereas heterotaxy (HR 3.5, 95% CI 1.2–9.7) was a risk factor. For LAVV reoperation, toddlers (HR 0.4, 95% CI 0.1–0.9), children (HR 0.3, 95% CI 0.1–0.8) and T21 (HR 0.1, 95% CI 0.03–0.61) remained protective, whereas an abnormal LAVV (HR 2.8, 95% CI: 1.1–6.7) was a risk factor. For left ventricular outflow tract reoperation, toddlers (HR 0.2, 95% CI 0.1–0.8) and children (HR 0.1, 95% CI 0.01–0.51) were protective, while partial defects increased the risk (HR 8.3, 95% CI 1.1–64.2) compared to transitional.



Conclusion: In this single-center cohort, mortality is minimal after P/TAVSD repair, yet reoperation rates remain high. Patients requiring repair as infants are at higher risk of reoperation. All of these patients require long-term surveillance.

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97. Comparison of Two Cardiopulmonary Bypass Protocols: The Conventional Strategy and a New Strategy Based on Miniature Circuit

Yiqun Ding, Baoying Meng, Fang Chen, Cheng Zhang

Shenzhen Children's Hospital, Shenzhen, China

Invited Discussant: *Mark E. Galantowicz

Objective: Comparing the rates of successful ultra fast-track extubation (UFE) in the operating room (UFE) after congenital heart surgery of two cardiopulmonary bypass (CPB) protocols.

Methods: From April 2015 to June 2017, 810 consecutive patients with congenital heart disease who underwent open-heart surgeries with CPB were enrolled in this study. Group 1 comprised 544 patients administered conventional CPB strategy, which was characterized as regular size tubing with modified ultrafiltration (MUF) after the conclusion of CPB. Group 2 included 266 patients administered the new CPB strategy, which was characterized as follows. 1. Miniature CPB circuit without MUF: for body weight (BW) less than 5 kg, the priming volume (PV) was 80 ml; for 5–8 kg, the PV was 100 ml; for 8–15 kg, the PV was 120 ml; for 15–25 kg, the PV was 250 ml; for 25–40 kg, the PV was 550 ml; and for 40–60 kg, the PV was 650 ml. 2. Higher preoperative hematocrit (HCT) threshold of priming blood: 40% for neonates or BW lower than 5 kg, 35% for BW 5–8 kg, and less than 30% for BW greater than 8 kg. 3. Furosemide infusion before surgery. Successful UFE was defined as extubation in the operating room immediately after surgery without requiring reintubation or nasal continuous positive airway pressure (NCPAP) thereafter or death in the early postoperative period. All cases were stratified into 3 tiers by the Aristotle score (AS) and age. After propensity score matching (PSM) with a greedy matching algorithm to balance the covariates, the UFE success rates were compared by the chi-squared test.

Table: The Basic Characteristics and Outcomes of Patient Strata with Aristotle Scores and Age

		Before Propensity Score Matching			After Propensity Score Matching		
		Conventional Strategy	New Strategy	p Value	Conventional Strategy	New Strategy	p Value
Number		544	266		251	251	
Tier 1*	Number	433	200		198	198	
	Success UFE	358 (82.7%)	178 (89.0%)	0.040	160 (80.8%)	177 (89.4%)	0.016
Tier 2**	Number	91	54		41	41	
	Success UFE	39 (42.9%)	30 (55.6%)	0.139	17 (41.5%)	22 (53.7%)	0.269
Tier 3***	Number	20	12		12	12	
	Success UFE	7 (35.0%)	2 (16.7%)	0.264	5 (41.7%)	2 (16.7%)	0.178

*: Tier 1, Aristotle scores ≤ 9 & age ≥ 3 month; **: Tier 2, Aristotle ≤ 9 & age < 3 month;

***: Tier 3, Aristotle scores > 9

Results: The UFE success rates of Groups 1 and 2 were 74.3% [404/544] and 78.9% [210/266], respectively. In Tier 1 ($AS \leq 9$ & age ≥ 3 month), there were 433 cases in Group 1 and 200 cases in Group 2 before PSM; after PSM, there were 198 cases in each group. The UFE success rate was 80.8% [160/198] in Group 1 and 89.4% [177/198] in Group 2; this difference was statistically significant ($p = 0.016$). In Tier 2 ($AS \leq 9$ &

age <3 month), there were 91 cases in Group 1 and 54 cases in Group 2 before PSM; after PSM, there were 41 cases in each group. The UFE success rate was 41.5% [17/41] in Group 1 and 53.7% [22/41] in Group 2; but this difference was not significant ($p = 0.269$). In Tier 3 ($AS > 9$), there were 20 cases in Group 1 and 12 cases in Group 2 before PSM; after PSM, there were 12 cases in each group. The UFE success rate was 41.7% [5/12] in Group 1 and 16.7% [2/12] in Group 2, but this difference was not significant ($p = 0.178$).

Conclusions: For infants older than 3 months with simple congenital heart diseases, this new CPB strategy may replace the conventional CPB strategy and achieve higher success rates of UFE extubation. For complicated diseases, MUF may still help to create a larger volume space for the transfusion of platelets, fresh frozen plasma (FFP) and cryoprecipitate and to guarantee hematocrit is maintained in a safe range by water filtration.

98. Complete Unroofing of the Intramural Coronary Artery for Anomalous Aortic Origin of the Coronary Artery — The Role of Aortic Commissural Resuspension

Can Yerebakan, Mahmut Ozturk, Lok Sinha, *Richard A. Jonas, Pranava Sinha
Children's National Heart Institute, Washington, DC

Invited Discussant: *J. William Gaynor

Objective: Surgery for anomalous aortic origin of a coronary artery (AAOCA) has been described as a safe procedure. However, longer-term follow-up suggests ongoing risks of ischemia and aortic regurgitation. We evaluated intermediate term outcomes of patients with AAOCA as related to their surgical repair technique, particularly aortic commissural resuspension.

Methods: Institutional records for 26 consecutive patients who received surgical repair of an AAOCA (10 left; 16 right) in a single center between 2004 and 2016 were reviewed. All patients received a complete unroofing of the entire intramural coronary segment. Earlier patients in the cohort received unroofing only. Aortic commissural resuspension was performed in the subsequent 17 (65%) patients. Overall outcomes as well as outcomes stratified by surgical technique [commissural resuspension (CR group, $n = 17$) vs. no commissural resuspension (NCR group, $n = 9$) were evaluated regarding early and late mortality, morbidity, aortic regurgitation and cardiac performance.

Results: Preoperative, operative and postoperative follow up data are summarized in Table 1. One patient in the NCR Group died 10 years after surgery from prosthetic aortic valve endocarditis after aortic valve replacement. There were no other re-interventions. Exercise stress testing data was available in 12 patients [after median 5 months (2 months–5.9 years)], of which 7 had an endurance level at or below the 25th percentile for age though only one patient showed ST changes. At a median follow-up of 1.9 years (3 months–10.6 years) there was no aortic regurgitation seen in the CR group while 6/9 patients in the NCR group had stable but mild or greater aortic regurgitation. Despite differences in follow up duration between the groups, multivariable regression analysis revealed that commissural resuspension was the only independent variable associated with freedom from mild or greater aortic regurgitation at follow up [CI, -0.91 to -0.38 ($p < 0.001$)].

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Conclusions: Surgical repair of an AAOCA can be performed with excellent early and mid-term outcome. Commissural resuspension of the aortic valve in these patients leads to a lower rate of aortic valve regurgitation without increasing the risk of ischemia.

Table 1 Comparison of patients with two surgical techniques using complete unroofing only and complete unroofing including aortic commissural resuspension.

	Unroofing	Unroofing with Commissural Resuspension	P
Preoperative data			
Age, years	13.83 ± 4.61	17.43 ± 11.51	0.27
Weight, kg	58.32 ± 27.55	57.42 ± 20.87	0.93
Height, cm	163.00 ± 26.03	160.79 ± 21.16	0.83
Female Gender	2 (22.2)	4 (23.5)	0.95
Anomalous L coronary	4 (44.4)	12 (90.6)	0.24
Non Cardiac Anomaly	0	2 (11.8)	0.48
Preoperative Symptoms	1 (11.1)	4 (23.5)	0.54
Operative data			
CPB Time, in min	74.78 ± 41.48	64.06 ± 30.18	0.51
X Clamp Time, min	41.33 ± 19.02	41.47 ± 16.83	0.99
Ventilation Time, h	11.11 ± 9.94	6.84 ± 3.80	0.25
TEE > Moderate AI	1 (11.1)	0	
ICU LOS, d	1.25 ± 0.46	2.88 ± 2.64	0.02
Post op LOS, d	5.44 ± 3.68	4.41 ± 1.87	0.45
Postoperative data			
Follow up, years	7.46 ± 3.11	3.26 ± 1.55	0.0033 [*]
Surgery to EST interval, years	1.65 ± 2.75	0.86 ± 1.06	0.61
Late Mortality	1 (11.1)	0	0.43
Late Symptoms	0	2 (11.6)	0.43
Late follow up > Trivial AI	6 (66.7)	0	0.001 [*]
Ischemia on EST	0	1 (5.9)	0.67
Late Reintervention	1 (11.1)	0	0.43

Data are presented in mean ± standard deviation or number (percentage).

L: left, TEE: transesophageal echocardiography, AI: aortic valve insufficiency, EST: stress test, kg: kilogram, cm: centimeter, CPB: cardiopulmonary bypass, min: minute, X: Cross, h: hour, ICU: intensive care unit, LOS: length of stay, d: day, Post op: postoperative

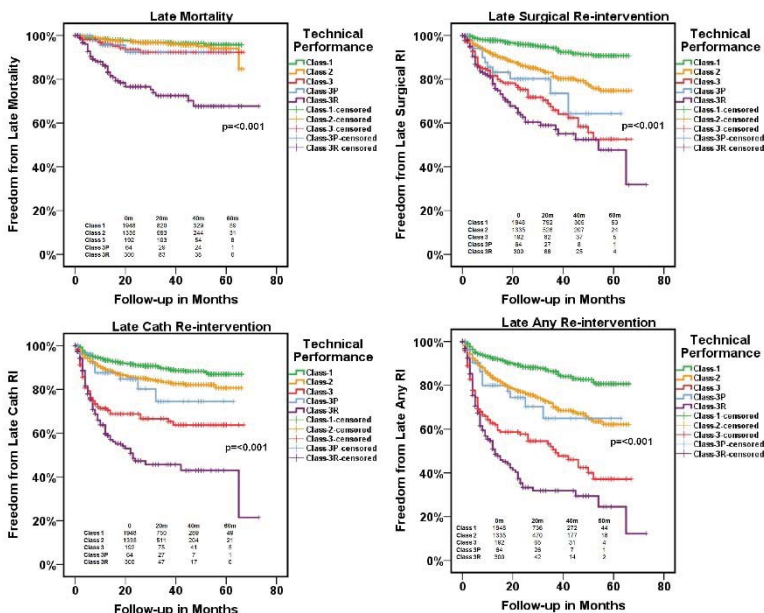
99. The Impact of Residual Lesions on Outcomes After Congenital Cardiac Surgery

♦Meena Nathan, Brielle Tishler, Hua Liu, Caitlin Walsh, Kimberlee Gauvreau, Colan Steven, Mayer John, Jr., *Pedro del Nido
Boston Children's Hospital, Boston, MA

Invited Discussant: *Emile A. Bacha

Objectives: In prior work we have shown that Technical Performance Score (TPS), a measure of residual lesions after congenital cardiac surgery, is a predictor of in-hospital outcomes. We hypothesized that TPS would also be a predictor of late outcomes.

Methods: Consecutive patients who underwent congenital cardiac surgery on cardiopulmonary bypass at our institution from 1/1/2011 to 12/31/2015 were included. Followup information was collected until 12/31/2016. Our primary predictor was TPS assigned based on clinical and echocardiographic criteria at discharge as follows; Class 1: trivial or no residua, Class 2: minor residua, Class 3: major residua, Class 3P: permanent pacemaker for complete heart block during index hospitalization, and Class 3R: major residua requiring reintervention during index hospitalization. Outcomes of interest included post discharge mortality and reinterventions (RI). Only unplanned surgical and/or catheter based reinterventions following discharge from index operation were included. Planned and staged palliative procedures were not included unless additional repair for residua from index operation was performed at the time of staged palliation. Models adjusted for preoperative factors such as age, prematurity, anomalies, STAT mortality categories and combination procedures. Kaplan Meier survival estimates, and Cox regression were used for analysis.



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Results: A total of 3739 index operations were included in the analysis. The TPS distribution was as follows: class 1: 1948 (52%); Class 2: 1335 (36%); Class 3: 192 (5%); Class 3P: 64 (2%); class 3R: 200 (5%). There were 129 (3.3%) late deaths; 334 (8.6%) late surgical reinterventions; 414 (10.7%) late catheter reinterventions, and 611 (15.8%) had either a surgical or cath reintervention. The Kaplan Meier survival curves (Figure 1) demonstrated that Class 3R was associated with late mortality while Class 2, 3, 3P and 3R were all associated with reintervention (All $p < 0.001$). On multivariable Cox regression, hazard ratio (HR) and Confidence intervals (CI) for late mortality, are as follows, TPS Class 3: HR 2.0 (CI 1.9, 4.0; $p = 0.06$), TPS Class 3R HR 5.6 (CI 3.5, 8.9; $p < 0.001$). For late surgical RI, Class 2: HR 3.2 (CI 2.4, 4.3); Class 3: HR 6.9 (CI 4.8, 10.7); Class 3P: HR 4.4 (CI 2.3, 8.4); Class 3R: HR 6.8 (CI 4.8, 9.8); p value < 0.001 for all. For late catheter RI; Class 2: HR 1.7 (CI 1.3, 2.2); Class 3: HR 4.5 (CI 3.2, 6.2); Class 3R: HR 4.8 (CI 3.6, 6.4); p value < 0.001 for all.

Conclusion: We demonstrated that TPS is a strong predictor of late outcomes. Patients who had major residua at discharge had higher late mortality and unplanned post discharge reintervention, while patients with minor residua had higher unplanned post discharge reintervention. Patients with minor or major residua warrant closer monitoring.

100. The Fate of the Branch Pulmonary Arteries Related to Hybrid Approach for Hypoplastic Left Heart Syndrome

Uygar Yörüker, Klaus Valeske, Matthias Müller, Christian Jux, Hakan Akintürk
Justus Liebig University, Gießen, Germany

Invited Discussant:

Objective: Hybrid approach is an alternative technique to palliate hypoplastic left heart syndrome (HLHS). However, the growth of the pulmonary arteries after hybrid palliation is still a concern when applying this technique. We analyze the results of hybrid palliation of HLHS and its variants with an emphasis on the long-term fate of the pulmonary arteries.

Methods: We analyzed 161 patients with HLHS and its variants, who underwent initially bilateral pulmonary artery banding and ductal stenting between 124 patients received comprehensive stage II operation. At comprehensive stage II, after de-banding, balloon dilatation of the branch pulmonary arteries were performed and patch enlargement was also used when needed. Seventy-seven patients could be palliated with Fontan completion. Intraoperative balloon dilatation and a patch enlargement of the pulmonary arteries were performed simultaneously at the time of Fontan completion if needed.

Results: Operative mortality was 3.4%, 6.4% and 1.3% at hybrid stage I, comprehensive stage II and Fontan completion, respectively. Median follow-up of survivors is 5.8 years (0–18.7 years). In 40 patients (32.2%) stent implantation of the left pulmonary artery (LPA) was required after comprehensive stage II. However there was no difference of survival between patients with LPA stent and without stent patients. ($p = 0.3$). Before Fontan completion, median PA pressure was 10 mmHg (range: 6–17 mmHg) and median transpulmonary gradient was 4 mmHg (range: 2–8 mmHg). In 33 patients, between Stage II and Fontan completion the growth of pulmonary arteries was



observed by cardiac magnetic resonance imaging. Mc Goon ratio did not change ($p = 0.99$) between stage II and Fontan operation. Intraoperative balloon dilatation of the LPA was performed in 9 patients (11.7%) and patch enlargement of LPA was required in 12 patients (15.5%) at the time of Fontan completion. After Fontan completion, 20 patients (26%) needed catheter interventions for pulmonary arteries. Eleven patients received a stent implantation and 9 patients received balloon dilatation of the pulmonary arteries. Failing Fontan was observed in 7 patients (9%). Five patients were listed for HTx. Three from these patients received HTx late after Fontan completion. Overall survival in 161 patients in 19 years is 75%.

Conclusion: Hybrid approach can be pursued with a low mortality. The high frequency of catheter and surgical pulmonary artery interventions is still a challenging issue but not significantly differ from other approaches for HLHS. Pulmonary artery interventions have no impact on survival. Failing Fontan rate is acceptable but further studies with longer-follow-up times are needed to make a precise decision.

3:30 pm – Coffee Break in the Exhibit Hall
4:00 pm

101. Systemic Atrioventricular Valve Replacement in Patients with Functional Single Ventricle

Tomohiro Nakata, Takaya Hoashi, Masatoshi Shimada, *Hajime Ichikawa
National Cerebral and Cardiovascular Center, Osaka, Japan

Invited Discussant: *Jonathan M. Chen

Objective: We aimed to evaluate long-term outcomes of systemic atrioventricular valve replacement (SAVVR) in patients with functional single ventricle (FSV) and to identify the factors associated with outcomes.

Methods: We retrospectively reviewed the medical records of all 37 consecutive patients with FSV who underwent SAVVR between 2001 and 2016. Their characteristics were as follows: median age, 24.6 months (range, 1.3–372.7); median weight, 8.4 kg (range, 2.3–71.8); atrial isomerism, 14 patients, hypoplastic left heart syndrome, 9 patients. Systemic atrioventricular valve (SAVV) morphology was common atrioventricular valve in 17 patients, and tricuspid valve in 15. SAVVR was performed at before Glenn, concomitant with Glenn, after Glenn, concomitant with Fontan and after Fontan in 7, 4, 13, 2 and 11 patients, respectively. Twenty-three patients (62.2%) were performed SAVV repair prior to SAVVR. The median interval from repair to SAVVR was 15.1 month (range, 0.4–248.2) All prosthetic valves were mechanical bileaflet valves and valve size ranged from 16 (commercially available smallest valve) to 33 mm.

Results: Kaplan-Meire estimated survival was 72.2%, 65.9% and 58.6% at 1, 5 and 10 years, respectively. There were 10 in-hospital deaths, and 3 late deaths. Univariate analysis showed age less than 1 year ($p = 0.006$), body weight less than 5 kg ($p = 0.008$), without previous SAVV repair ($p = 0.008$), preoperative inotropic support ($p = 0.045$), and ventilator support ($p < 0.001$) were risk factors for mortality. Freedom from redo SAVVR was 87.3% at 1 year and 76.8% at both 5 and 10 years. There was no risk factor for redo SAVVR. Eight patients underwent redo SAVVR. The median interval from SAVVR

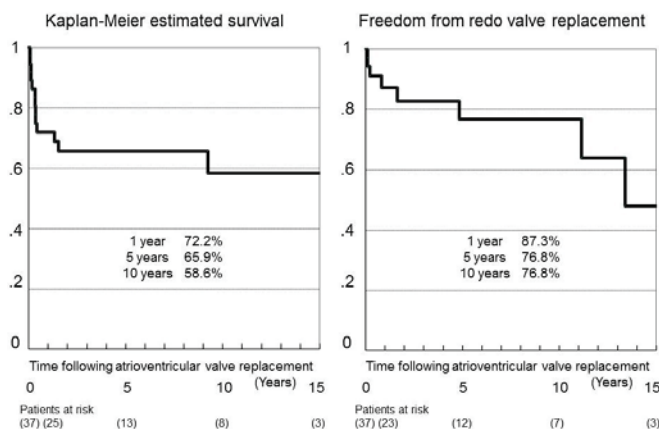
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to redo was 14.7 months (range, 1.1–160.8). The reasons for redo were stuck valve in 6 patients, and patient-prosthetic mismatch in 2. Nine patients underwent pacemaker implantation following SAVVR or redo SAVVR (sick sinus syndrome in 3 patients and atrioventricular block in 6). Cerebral bleeding occurred in 2 patients and cerebral infarction occurred in 3 after SAVVR. A brain natriuretic peptide (BNP) was routinely examined from 2003, and of 22 patients, a preoperative BNP significantly decreased from 361.1 ± 594.0 pg/ml to 131.4 ± 163.2 on latest postdischarge examination ($p = 0.042$). Of 24 patients who underwent SAVVR before Fontan, 7 underwent Fontan, 3 are waiting Fontan, 10 were declined, 1 is out of indication for Glenn (Family's wishes) and 3 are out of indication for Fontan (21 trisomy, e.g.). Of 11 patients who underwent SAVVR after Fontan, 7 underwent follow-up catheterization, which revealed cardiac index significantly improved from 2.3 ± 0.4 L/min/m² to 3.3 ± 0.6 ($p = 0.002$).



Conclusion: SAVVR successfully recruited Fontan circulation. However, SAVVR in small patients for severely dysplastic SAVV which could not be repaired, especially under unstable hemodynamic condition, is still challenging.

102. Single-Center Results of Pulmonary Vein Stenosis Repair in the Current Era

Yaroslav Mykychak, Kostiantyn Krykunov, Yaroslav Ivanov, Andrii Pavlenko, Anna Pavlova, Andrii Maksymenko, Roman Sekelyk, Andrii Kurkevych, Ilyia Yemets
Ukrainian Children's Cardiac Center, Kyiv, Ukraine

Invited Discussant: *Christopher A. Caldarone

Objective: To compare sutureless versus other repair techniques for pulmonary vein stenosis (PVS) effect on survival and to assess outcomes depending on disease severity and extent.

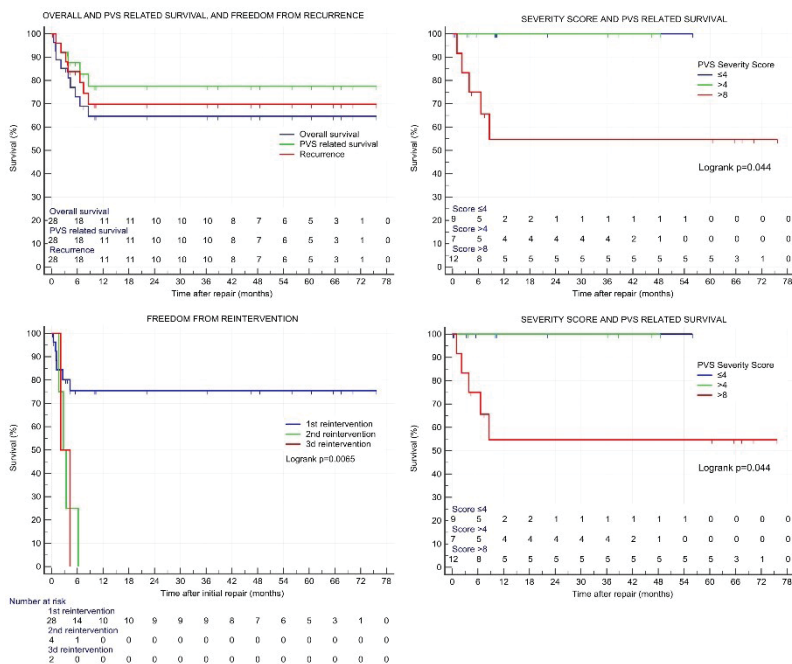
Methods: 28 consecutive patients with either primary or acquired pulmonary veins stenosis underwent repair from March 2010 to October 2016. Diagnosis was established by echocardiography in all patients and verified by angiography (in 13), CT (in 17) and MRI (in one).

16 patients received sutureless repair and 12 underwent other procedures. Pre- and postoperative severity was evaluated by score based on mean gradient and involvement of distal pulmonary veins. Disease extent was categorized by number of veins and lungs involved. Mortality, recurrence- and reintervention-free survival were then analyzed.

Results: Mean follow-up was 24.15 ± 25.67 months. Mean age and weight at index operation were 6.1 ± 4.46 months and 5.44 ± 3.35 kg, respectively. Mean preoperative severity score was 8 ± 4.71 , and 9.56 ± 4.01 in patients selected for sutureless vs. 5.91 ± 4.77 for other repairs ($p = 0.037$). PVS was bilateral in 13 and unilateral in 15 patients, mean number of involved pulmonary veins was 2.68 ± 1.23 . 14 patients had severe pulmonary hypertension.

PVS was associated with TAPVC in 12 patients, with other lesions in 15 (including coarctation of aorta in seven, VSD in five, single ventricle in two, AVSD in two and TGA in one) and isolated in one. It was primary in 14 and acquired in 14. For initial PVS treatment we performed eight endovinectomies, eight pulmonary vein's patch plasties, one hybrid balloon dilation, 13 sutureless repairs and three primary sutureless TAPVC repairs. Surgical technique was selected by surgeon's preference.

Overall mortality was 32% ($n = 9/28$), PVS recurrence developed in 25% ($n = 7/28$) and reintentions occurred in 21% ($n = 6/28$). Overall PVS related mortality was 18% ($n = 5/28$), with 25% ($n = 4/16$) after sutureless repair vs. 8% ($n = 1/12$) after other repairs ($p = 0.42$). PVS related mortality in patients with severity score >8 was 42% ($n = 5/12$) vs. 0% with 4–8 and 0% with <4 ($p = 0.044$), and 38% ($n = 5/13$) in bilateral disease vs. 0% in unilateral ($p = 0.024$).



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Conclusions: Pulmonary vein stenosis still bears high mortality and reintervention rates. We observed unusually high incidence of associated coarctation of aorta at our institution. Primary sutureless repair may be beneficial for TAPVC with small pulmonary veins. Further research of new surgical and medical methods is warranted. Currently, it seems that results are determined more by severity and extent of the disease, rather than repair method.

103. Outcomes of Complete Ventricular Septation for Multiple Muscular Ventricular Septal Defects in Infants Under 4 kg

Damien J. LaPar, Mariana Chavez, *Sitaram M. Emani, Christopher W. Baird

Boston Children's Hospital, Boston, MA

Invited Discussant: *Christopher J. Knott-Craig

Objectives: Surgical approaches to complete repair of multiple muscular ventricular septal defects ("Swiss Cheese VSD") remains a surgical challenge for neonates and infants. The primary objective of this study was to evaluate early outcomes for currently applied surgical techniques.

Methods: A total of 8 neonates with preoperative weight <4 kg undergoing multiple muscular ventricular septal defect (VSD) closure were evaluated at a single institution. Conventional, primary muscular VSD closure as well as a modified patch technique, including complete takedown of RV muscle bundles through a right apical ventriculotomy with patch closure initiated from the left ventricular side, was utilized. Patient characteristics, anatomic features, operative outcomes, and residual lesion scores (RLS) were evaluated by univariate analyses.

Table: Select Postoperative Outcomes and Measures of Hospital Resource Utilization following Neonatal and Infant Repair of Multiple Muscular Ventricular Septal Defects

Factor	Frequency or Median	Statistic % or [Range]
Operative Mortality	0	0%
Residual Muscular VSD	1	12%
Median Residual Lesion Score	2	[1–3]
Permanent Pacemaker Placement	1	12%
Postoperative < Mild RV and LV Dysfunction	0	0%
Median Postoperative CICU LOS (days)	6	[3–22]
Median Postoperative Hospital LOS (days)	15	[7–29]

VSD = Ventricular Septal Defect; RV = Right ventricle; LV = Left ventricle; CICU = Cardiac Intensive Care Unit; LOS = length of stay

Results: Median age at operation was 9 d (range: 4–56 d). Median preoperative weight was 3 kg [range: 3–4 kg]. Median follow-up (100%) was 22 days [7 d–5 yr]. Preoperative RV function was normal in all patients. The most common concomitant cardiac defects included hypoplastic aortic arch with coarctation (75%, n = 6), conoventricular VSD (50%, n = 4), and transposition of the great arteries (12%, n = 1). A patch technique for VSD closure was utilized in 75% of patients and primary VSD closure in 25%. There were no operative mortalities (Table). Clinically significant postoperative residual muscular



VSDs occurred in 1 patch repair patient, requiring pulmonary artery banding. Median RLS score was 2 (range: 1–3). Post-operative heart block requiring permanent pacemaker also occurred in one patient. Importantly, RV and LV function were preserved in all patients. Median postoperative hospital and cardiac intensive care unit lengths of stay were 6 and 15 days, respectively. At a median follow-up of 37 days (range: 7 d–5 yrs), overall survival remained 100%, one patient required closure of a residual apical VSD with the Amplatzer device, and there were no reoperations for residual VSD closure.

Conclusions: Complete and durable repair of multiple muscular ventricular septal defects can be performed safely in <4 kg neonates and infants with acceptable hospital resource utilization and preserved ventricular function. Complete patch closure of all muscular VSDs from the LV side through a right ventriculotomy demonstrates promising outcomes and should be considered to reduce the incidence of residual VSDs.

104. High Waitlist Mortality in Transplantation for Pulmonary Venous Disease: An Analysis of the United Network for Organ Sharing (UNOS) Pediatric Thoracic Transplantation Database

Rachel D. Vanderlaan¹, Kyle Runeckles², Cedric Manlhiot², Anne I. Dipchand²,

*Christopher A. Caldarone²

¹University of Toronto, Toronto, ON, Canada; ²Hospital for Sick Children, Toronto, ON, Canada

Invited Discussant: *Charles B. Huddleston

Objective(s): Pulmonary veno-occlusive disease (PVOD) and pulmonary vein stenosis (PVS) are rare pulmonary venous diseases (PVD) that are associated with high mortality in pediatric patients. For those with end-stage disease, heart-lung (HLTx) or lung (LTx) transplantation is the only treatment option. There is a paucity of literature describing waitlist characteristics and transplant outcomes in PVD pediatric patients. **Therefore, we investigated waitlist mortality and HLTx and LTx outcomes for the treatment of PVD compared to pulmonary arterial hypertension (PAH) in pediatric patients.**

Methods: Pediatric patients (0–18 years) with a diagnosis of PAH or PVD (PVOD or PVS) registered in the UNOS registry (1987–2016) were included. Patient characteristics are described and waitlist mortality and transplantation were used as primary outcome measures.

Results: Within the UNOS registry, we identified 45 patients with a diagnosis of PVD and 233 patients with a diagnosis of PAH. PVD patients were younger at age of listing compared to patients with PAH (median age, 2 (0–11) years vs. 10 (3–13) years; $p = 0.004$), while the majority of PVD patients were male, in contrast to PAH patients (60% (27/45) vs. 40% (92/233); $p = 0.01$). Similar lung allocation scores (34 ± 10 vs. 32 ± 7 ; $p = 0.5$) were seen in both cohorts and ECMO was used pretransplant in 7% (3/45) of PVD patients and 3% (7/233) in PAH patients ($p = 0.2$). Waitlist mortality for PVD patients was significantly higher compared to PAH patients (20% vs. 0%, $p < 0.001$). Of listed patients, 36% (16/45) of PVD patients were transplanted compared to all PAH patients (100%; $p < 0.001$), with PAH patients transplanted earlier than those with a PVD diagnosis ($p < 0.001$, Figure 1). Of note, 81% (21/26) of children with a diagnosis of PVD listed

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prior to 4 years of age did not achieve transplant. HLTx was performed in 34% (80/233) of PAH patients compared to 6% (1/16) of PVD patients. There was no difference in the median age at transplantation for PVD patients compared to PAH patients (8 (1–14) years vs. 11 (4–14) years, $p = 0.8$) and median graft survival was similar between the two cohort (757 (336–1970) days vs. 984 (320–2546) days; $p = 0.9$).

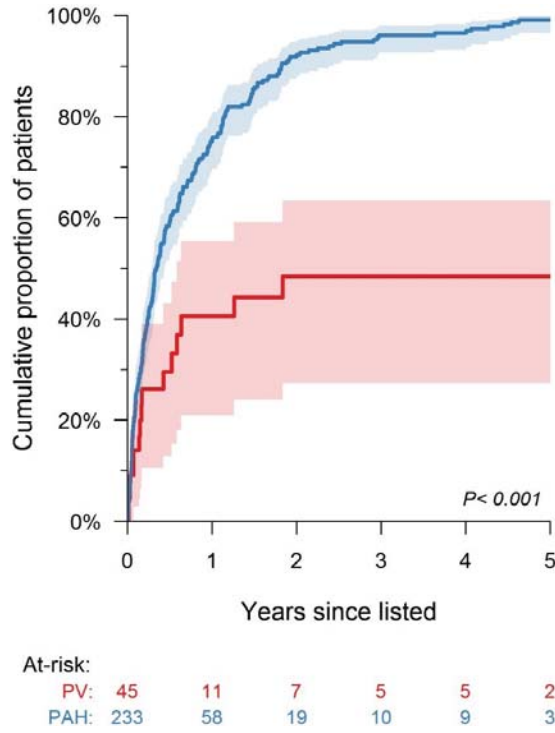


Figure 1: Cumulative incidence rate of transplant in PVD and PAH pediatric patients. PAH patients were transplanted significantly earlier than PVD patients (Gray's test; $p < 0.001$).

Conclusions: PVD patients were less likely to receive a transplant and experienced higher waitlist mortality than PAH patients, with the majority of PVD patients <4 years of age at listing failing to achieve transplant. As UNOS data classification does not capture the full spectrum of PVD, further study is required to capture transplant practices in these cohorts and allow for assessment of risk factors and strategies to mitigate high waitlist mortality. Highly specialized registries (e.g., PVS network) may be appropriate platforms to focus study on these populations.

105. Long-Term Outcomes of Mechanical Aortic Valve Replacement in Children

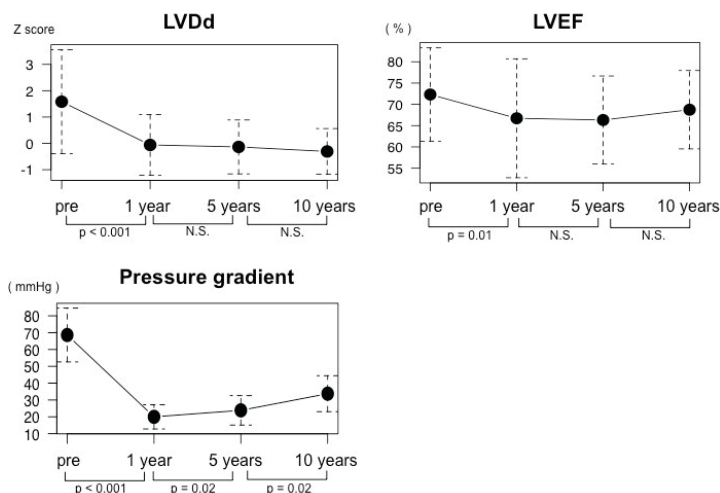
Takashi Kakuta, Takaya Hoashi, Masatoshi Shimada, Hideto Ozawa, Tomohiro Nakata,
*Hajime Ichikawa

National Cerebral and Cardiovascular Research Center, Suita, Japan

Invited Discussant: *Luca A. Vricella

Objective: Mechanical aortic valve replacement (m-AVR) with or without annulus enlargement is a surgical option for children with aortic valve disease for whom AVR with other materials including Ross procedure, or aortic valve repair are not indicated. Herein, this study evaluated long-term outcomes of m-AVR in children, especially focusing on the left ventricular function and implanted valve durability.

Methods: From 1987 to 2017, 51 consecutive children with biventricular circulation underwent m-AVR. The mean age and body surface area at surgery was 9.6 ± 4.9 years old (range, 0.01–17.9) and 0.89 m^2 (range, 0.20–1.64). Morphology of AV was unicuspid in 1 patient (2.0%), bicuspid in 18 (35.2%), tricuspid in 26 (51.0%) and quadricuspid in 6 (11.8%). Annulus enlargement was concomitantly performed in 20 patients (39.2%) such as Nicks in 2 patients or Konno in 18. The size of implanted valve was 16 mm in 6 patients, 17 mm in 3, 18 mm in 3, 19 mm in 5, 20 mm in 4, and greater than 20 mm in 30. Follow-up was completed in 80.3% of patients and the mean follow-up period was 11.5 ± 8.8 years (max, 23.5 years).



Results: Overall survival rate at 1, 5 and 10 years were 96.1%, 93.9% and 88.1%, respectively. Critical aortic stenosis ($p = 0.01$) was the risk factor for mortality by multivariate analysis. Freedom from redo AVR at 1, 5 and 10 years were 97.9%, 97.9% and 88.0%, respectively. Implanted mechanical valve was replaced due to stuck valve in 1 patient and prosthetic valve failure by pannus formation in 5. Body surface area at initial m-AVR

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of less than 0.7 m² ($p = 0.02$), implanted valve size of 20 mm or smaller ($p = 0.02$), and double outlet right ventricle ($p = 0.04$) were the risk factors for redo AVR by multivariate analysis. Left ventricular ejection fraction, Z score of left ventricular end-diastolic diameter, and pressure gradient across mechanical valve calculated by 2D echocardiography at 1, 5 and 10 years after the operation were $67 \pm 15\%$, $66 \pm 14\%$ and $68 \pm 14\%$, -0.05 ± 1.4 , -0.13 ± 1.4 and -0.30 ± 2.1 , and 19.9 ± 10.0 mmHg, 24 ± 13 mmHg and 34 ± 16 mmHg, respectively (Figure).

Conclusions: Although gradual increase of pressure gradient across prosthetic valve should be taken into account, m-AVR in children showed good long-term durability without patient-prosthetic mismatch. Prosthetic valve failure by pannus formation was a main cause for redo AVR.

106. Femoral Vein Homograft As Right Ventricle to Pulmonary Artery Conduit for Stage 1 Norwood Operation: An Update

T.K. Kumar, Mario Briceno-Medina, Hitesh Sandhu, Umar Boston,

*Christopher Knott-Craig

Le Bonheur Children's Hospital, Memphis, TN

Invited Discussant: *Sitaram M. Emani

Objective: The polytetrafluoroethylene tube used as right ventricle to pulmonary artery conduit in stage 1 Norwood operation is associated with risks of suboptimal branch pulmonary artery growth, thrombosis, free insufficiency and long-term right ventricular dysfunction. We describe our experience with the use of valved femoral vein homograft as right ventricle to pulmonary artery conduit.

Methods: A retrospective chart review of 24 neonates with hypoplastic left heart syndrome or complex single ventricle who underwent stage 1 Norwood operation with femoral vein homograft as right ventricle to pulmonary artery conduit between June 2012 and June 2017 was performed. The median age at surgery was 3 days and the mean weight was 3 kg. Size of femoral vein homograft ranged between 5 to 6 mm.

Results: There was one hospital mortality 5 months after stage 1 operation related to refractory sepsis in a child with Turner syndrome. There was no interstage mortality. 21 patients have undergone bidirectional Glenn operation and 9 patients have undergone Fontan operation to date. No patient developed thrombosis of conduit. Most femoral vein conduits remained competent in the first month after stage 1 Norwood operation, although most became insufficient by 3 months of age. Catheter intervention on the conduit was necessary in 13 patients. The median Nakata index at pre-Glenn catheterization was $254 \text{ mm}^2/\text{m}^2$ (IQR $120\text{--}387 \text{ mm}^2/\text{m}^2$). Right ventricular function was preserved in most patients at follow up.

Conclusions: The use of femoral vein homograft as right ventricle to pulmonary artery conduit in the Norwood operation is safe and associated with good pulmonary artery growth and preserved ventricular function. Catheter intervention of the conduit may be necessary prior to stage 2 operation.

5:38 pm

Adjourn



2:00 pm

**General Thoracic Surgery
Simultaneous Scientific Session**

Room 25ABC, SDCC

8 minute presentation, 10 minute discussion

Moderators: *Shaf Keshavjee and ♦Matthew G. Hartwig

107. A National Analysis of Mechanical Ventilation and Extracorporeal Membrane Oxygenation As a Bridge to Lung Transplantation: Closing the Gap

J.W. Awori Hayanga¹, Sari D. Holmes¹, Yue Ren¹, Heather K. Hayanga¹,
Norihiisa Shigemura², Ghulam Abbas¹, *Vinay Badhwar¹

¹West Virginia University, Morgantown, WV; ²Temple University, Philadelphia, PA

Invited Discussant: *Jonathan D'Cunha

Objective: The purpose of this study was to examine the influence of mechanical ventilation (MV) and extracorporeal membrane oxygenation (ECMO) as a bridge to lung transplantation (LT) on outcomes and survival.

Methods: Data from the United Network for Organ Sharing (UNOS) Organ Procurement and Transplantation Network (OPTN) Database pertaining to recipients transplanted between 2005 and 2017 were analyzed. There were 21,576 LT recipients in total. These patients were categorized into 3 groups according to need for pre-transplant MV or ECMO: Control ($n = 19,783$), MV ($n = 1,129$), and MV + ECMO ($n = 664$). Multivariable linear, logistic, and Cox regression analyses examined the effect of study group on outcomes after controlling for clinical characteristics.

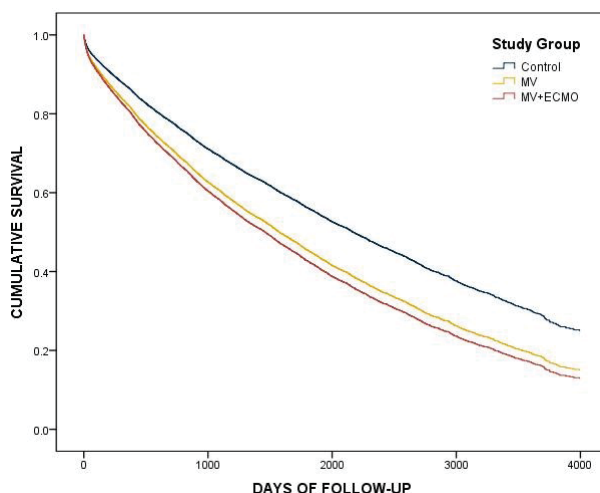
Results: Mean age of this sample was 54 ± 15 years with 41% females. The use of ECMO increased significantly between the early (2005–2011) and late (2012–2017) eras (1% vs. 5%, $P < 0.001$). Therefore era was included as a covariate in the multivariable analyses. Compared to the Control group, patients in the MV group had greater odds for postoperative ventilator support >48 hours (OR = 4.51, $P < 0.001$), in-hospital airway dehiscence (OR = 1.92, $P = 0.005$), in-hospital acute rejection episodes (OR = 1.40, $P = 0.003$), in-hospital stroke (OR = 1.58, $P = 0.022$), in-hospital dialysis (OR = 1.99, $P < 0.001$), and in-hospital reintubation (OR = 1.46, $P < 0.001$). Patients in the MV + ECMO group had greater odds for postoperative ventilator support >48 hours (OR = 6.83, $P < 0.001$), in-hospital acute rejection episodes (OR = 1.53, $P = 0.003$), and in-hospital dialysis (OR = 3.17, $P < 0.001$) compared to the Control group. Patients in the MV (B = 15.0, $P < 0.001$) and MV + ECMO (B = 15.3, $P < 0.001$) groups had increased length of stay compared to the Control group. Patients with MV + ECMO had greater odds for postoperative ventilator support >48 hours (OR = 1.52, $P = 0.003$), in-hospital dialysis (OR = 1.59, $P = 0.003$) and reduced odds for in-hospital reintubation (OR = 0.68, $P = 0.005$) compared to the MV group. Patients in the MV (HR = 1.37, $P < 0.001$) and MV + ECMO (HR = 1.48, $P < 0.001$) groups had greater risk for mortality during follow-up (mean = 3.3 years) compared to the Control group, but the MV and MV + ECMO groups did not differ (HR = 0.93, $P = 0.395$; Figure). Analysis within the MV + ECMO group alone found that risk for 1-year mortality decreased in the later era (HR = 0.54, $P = 0.006$).

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Conclusions: ECMO use as a bridge to LT has increased by over 500% in the past decade. Survival in recipients bridged using ECMO has significantly improved over the past five years and is now equivalent to those bridged on MV. This result suggests gains in use, survival, and safety of ECMO.

108. Inter-Observer Variability in Radiological Judgement Impairs Grading of Primary Graft Dysfunction After Lung Transplantation

Stefan Schwarz, Moritz Muckenhuber, Alberto Benazzo, Lucian Beer, Florian Gittler, Helmut Prosch, *Walter Klepetko, Konrad Hoetzenecker
Medical University of Vienna, Vienna, Austria

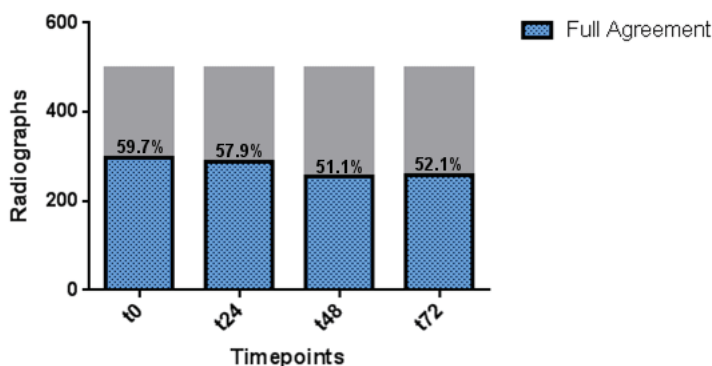
Invited Discussant: *Frank D'Ovidio

Objective: According to the ISHLT classification, grading of primary graft dysfunction (PGD) after lung transplantation is based on P/F ratios as well as the presence/absence of bilateral infiltrations consistent with reperfusion edema in chest radiographs. Radiological judgement has a major impact on this score and can mean the difference between lowest (PGD 0) and highest (PGD 3) grading. In our study we aimed to evaluate the inter-observer variability in detection of infiltrations of trained radiologists and its effect.

Methods: We retrospectively analysed 497 patients who received double lung transplantation between January 2010 and July 2016. Three trained thoracic radiologists were asked to independently examine postoperative chest radiographs performed at t_0 , t_{24} , t_{48} and t_{72} hours after arrival on ICU. They were blinded to the clinical course. We retrospectively analysed inter-observer variability using Cohen's kappa (κ) and averaging the kappa of the three pairs according to Light to determine the level of agreement. Furthermore, we evaluated the impact of the variability on PGD scores.

Results: A total of 1988 chest radiographs were evaluated. Consensus between all three radiologists was found in only 1101 cases (55.38%). In 466 (42.32%) chest radiographies with unanimous diagnosis, infiltrations were present, while in 635 (57.68%) no infiltrations were diagnosed concordantly. At t_0 and t_{24} , only moderate agreement between the three radiologists was found ($\kappa = .486$ and $\kappa = .472$, 95% CI, $p < .0005$) and only fair at t_{48} and t_{72} ($\kappa = .392$ and $\kappa = .412$, 95% CI, $p < .0005$). At t_0 , PGD grading was 0 according to 2 radiologists in 50 of 497 cases (10.06%) where the diagnosis of the third would have led to a PGD 3. At t_{24} this was true for 11 (2.13%), at t_{48} for 8 (1.61%) and at t_{72} for 7 (1.41%) cases, respectively. Conversely, two observers attested PGD 3 to 108 of 497 patients (21.73%) at t_0 , 14 (2.81%) at t_{24} , 19 (3.82%) at t_{48} and 13 (2.61%) at t_{72} while the same radiographs would have led to a PGD 0 based on the judgement of the third radiologist.

Agreement among all 3 radiologists



Conclusions: The current PGD score relies heavily on radiological findings. The substantial inter-observer variability found in our retrospective analysis underlines the difficulty to adequately grade post-transplant organ function. Future revisions of the PGD grading should take this problem into consideration.

109. Interfacility Transport of Patients Requiring Extracorporeal Membrane Oxygenation Support: Single Center Model and Experience

Yuliya Tipograf, Peter Liou, *Matthew Bacchetta, Cara Agerstrand
Columbia University, New York Presbyterian Hospital, New York, NY

Invited Discussant: Christopher Sciortino

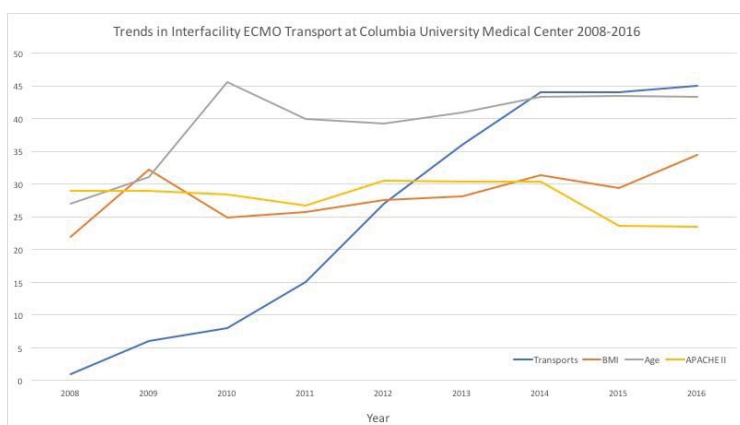
Objective: Extracorporeal membrane oxygenation (ECMO) is used to support patients with severe respiratory or cardiac failure, failing conventional medical management. Referring hospitals often have no further recourse for escalation of care apart from transfer to a tertiary facility capable in providing ECMO support. In certain cases, safe transfer is only possible while the patient is receiving ECMO support. This study aims to examine the characteristics and outcomes of patients transported on ECMO including any issues that may arise during transport.

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Methods: Statistical analysis was performed on data gathered retrospectively from the electronic medical record of adult patients transported on ECMO to Columbia University Medical Center (CUMC) between January 1, 2008 and July 1, 2017.

Results: A total of 253 adult patients were transported during the study period. No transport-related complications adversely affected outcomes. Transport distance ranged from 0.2 to 7084 miles with a median distance of 16.977 miles. 176 (70%) were transported on venovenous ECMO, 68 (27%) on venoarterial ECMO, 6 (2.4%) on venovenous arterial ECMO and 3 (1.2%) on veno-arterial venous ECMO. 199 (78.7%) cannulations were performed by our institution. 76.3% survived to decannulation with 66% 30-day survival and 64% survival to discharge. When cannulated by CUMC at the referring facility, 30-day survival increased to 72.2% ($p < 0.05$). A total of four transport complications were identified including two cases of pump failure, cannula dislodgement, and oxygenator decoupling. No transport-related complications adversely affected outcomes. Transport distance did not affect patient survival.



Conclusions: Interfacility transport on ECMO has been shown to be both safe and effective with minimal complications and favorable outcomes when performed by an experienced tertiary center using stringent protocols.

110. Twenty-Four Years Experience of Open Surgical Repair for Pectus Excavatum

Hiroshi Iida, Ryuta Fukai

Hayama Heart Center, Kanagawa, Japan

Invited Discussant: *Daniel L. Miller

Objective: Nuss developed a novel closed method for pectus excavatum correction which does not require an anterior chest wound and the cut of cartilages and sternum, and gaining popularity. The method has been associated with relatively high morbidity and limitation of patients' age. We review our experiences of open repair procedure with low incidence of complications and high patients' satisfaction.



Methods: From 1993 to August 2017, 414 patients (3–56, 15.5 ± 9.9 yo) underwent surgical repair of pectus excavatum. Modified Sternal-costal elevation (SCE) was adopted for 403 patients. Before 2007, Sternal turnover was employed for 11 adult patients with asymmetric deformity. In our recent standard method of SCE modification 3, a section of the third or fourth to the seventh costal cartilages as well as the lower tip of the sternum were resected. All of the cartilage stumps were drawn and resutured to the sternum. The secured ribs generate tension, pulling the sternum bilaterally. The resultant force raises the concavity and correct irregularities. For 27 patients with severe asymmetric deformity, oblique wedge osteotomy on lower sternal cortex was done to flatten the tilted sternum (SCE4). The right lower edge of the sternum was resected (SCE5) in 8 adult patients with severer asymmetry. Cortical osteotomy on upper sternum and introduction of exogenous material was not employed in SCE.

Results: In all cases the deformities were corrected satisfactorily. The length of the vertical wound in male was 3.7 ± 0.7 cm in patients under 7 yo, and 7.1 ± 2.1 cm in adult patients. In female patients, inframammary curved incision was used. None of the patients required mechanical ventilation after emergence from anesthesia. No patient needed blood transfusion. None of them developed pneumonia, deep wound infection, instability of the chest wall, and any life-threatening complications. No reoperations were required for any reasons. Patients resumed daily activities, including contact sports, within three months after surgery. No recurrence was reported.

Conclusions: Modified SCE provided satisfactory results without major complication for wide range of patients' age groups. Although modified SCE includes resection of the cartilages, we believe that our techniques represent a less invasive procedure for the repair of pectus excavatum.

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111. Carinal Surgery: A Single Institution Experience Spanning Two Decades

Christina L. Costantino, Abraham Geller, *Cameron D. Wright, Harald C. Ott, Ashok Muniappan, *Douglas J. Mathisen, *Michael Lanuti
Massachusetts General Hospital, Boston, MA

Invited Discussant:

Objectives: Complete resection of neoplasms involving the carina are technically challenging. In addition to complex post-operative complications, mortality rates in the literature reach 50%. We sought to examine the last two decades of clinical experience at our institution.

Methods: A retrospective review of 50 patients who underwent carinal resection at a single institution between 1995 and 2017 was performed. Medical records were queried including vital status from the hospital cancer registry. Association of risk factors with complications was assessed using Fisher's exact test.

Results: 50 carinal resections were performed with a median follow-up of 8 months. The procedures included 24 neocarinal reconstructions (48%), 15 right carinal pneumonectomies (30%), 10 left carinal pneumonectomies (20%), and 1 carinal plus lobar resection (2%). Age ranged from 27–74 with (26/50) females. Nine received neoadjuvant chemotherapy and seven had preoperative radiation. Median sternotomy approach

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was used in 15 patients (30%), thoracotomy in 32 patients (64%), one clamshell (2%), and two patients (4%) had a combined thoracotomy/median sternotomy. ECMO and cardiopulmonary bypass were intraoperatively planned for 4 patients with no operative mortality. Bronchial anastomoses were buttressed with a tissue flap (9 omental, 5 pleural, 12 intercostal 13 pericardial, 1 latissimus dorsi, 4 thymic, and in 5 patients two different types of flaps were utilized). Four patients underwent SVC resection and reconstruction. Anastomotic complications occurred in 6 patients; 1 required stent, and a second underwent hyperbaric oxygen therapy. The others were treated conservatively. Post-operative events were observed in 27 patients (54%), including pneumonia (13 patients), blood transfusion (8 patients), and atrial arrhythmias (9 patients). More serious complications such as ARDS (n = 3) and sepsis (n = 3) occurred infrequently. Only 3 patients remained ventilated for greater than 48 hours. Post-operative events were most closely associated with preoperative thoracic radiation (p = 0.011) and cigarette smoking (p = 0.008). There were 5 deaths, yielding an operative 30-day mortality of 10%. One patient died of right heart failure following PE, another patient arrested intraoperatively following a cardiac dysrhythmia, while the other two developed ARDS, multiorgan dysfunction and ultimately died.

Table: Morbidity and Mortality in Carinal Resection and Reconstruction

	n	30-Day Mortality (n)	Operative Morbidity (n)	Anastomotic Complications (n)
Carinal Resection with Neocarina	24	0	11	1
Left Carinal Pneumonectomy	10	1	5	4
Right Carinal Pneumonectomy	15	4	10	0
Carinal Resection plus lobar resection	1	0	1	1
Total	50	5	27	6

Conclusions: Despite advances in perioperative management, carinal resection poses challenges for both patient and surgeon. Preoperative radiation and cigarette smoking were associated with increased risk of complications in our study cohort. ECMO can be considered in select patients where oxygenation may be challenging. Hyperbaric oxygen can be considered for anastomotic healing issues. Patient selection and meticulous surgical technique contribute to morbidity and mortality.

3:30 pm – Coffee Break in the Exhibit Hall
4:00 pm

3:35 pm – 4:00 pm

**Deep Dive: The Addition of a Mobile App Technology
to a Post-Discharge Home Care Program Following
Thoracic Surgery Reduces the Rate of Emergency Room Visits**

AATS CT Theater I
Booth #134, Exhibit Hall
Not for Credit

See page 78 for details.



4:00 pm

General Thoracic Surgery

Room 25ABC, SDCC

Simultaneous Scientific Session (*continued*)

8 minute presentation, 10 minute discussion

Moderators: *Gail E. Darling and *Virginia R. Little

112. Resection of Tumors with Carinal Involvement After Induction Treatment

Domenico Galetta, Lorenzo Spaggiari

European Institute of Oncology, Milan, Italy

Invited Discussant:

Objective: Tumors involving the carina may be treated with resection of tracheo-bronchial bifurcation with or without lung resection. The role of induction therapy (IT) and its effects on morbidity and mortality of these patients are unclear. We evaluated surgical results and long-term outcomes of patients who underwent carina resection after IT.

Methods: From December 1998 to December 2016, 45 patients (35 men; median age, 62 years) underwent carinal resection for carcinoma involving carinal or tracheo-bronchial angle. Twenty-nine patients (64.4%) received IT (cisplatin based poli-chemotherapy): 24 chemotherapy and 5 chemo-radiation. Histology included 41 non-small cell lung cancers, 3 adenoid cystic carcinomas, 1 carcinoid. Carinal pneumonectomy was performed in 32 cases (all right sided, 3 completion pneumonectomy), carinal resection plus right upper lobectomy in 9, carinal resection plus upper bilobectomy in 1, and carinal resection without pulmonary resection in 3. Superior vena cava resection was combined with carinal resection in 22 cases (10 patients with graft interposition).

Results: Operative mortality was nil. Thirty-day mortality was 8.8% (n = 4). Major complications occurred in 9 patients (20%): 5 bronchopleural fistulas, 2 ARDS, 2 cardiac hernias. IT did not influence morbidity rate (p = .7371). Resection was complete in 42 patients. Pathological N status was N0 in 6 cases, N1 in 22, and N2 in 17. Follow-up was completed for all patients. Median survival was 16 months (range, 1 to 181 months). The overall 5-year and 10-year survival rates were 35.8%, respectively. Overall, 5-year and 10-year freedom from recurrence were 49.8% and 44.3%. Patients receiving IT had a poor survival (5- and 10-year, 22.6% versus 60%) but it was not statistically significant (p = .0596). Histology, extended resection, T and N status, did not influence survival.

Conclusions: Carinal resection is a feasible but technically challenging surgical procedure and provides acceptable results in terms of operative mortality and long-term outcomes. IT did not influence neither morbidity and mortality nor survival. In our experience, pathological nodal involvement did not impact on long-term survival.

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113. Neoadjuvant Versus Adjuvant Chemotherapy in Completely Resected cT2-4N0-1M0 Non-Small Cell Lung Cancer

Wanpu Yan, Whitney S. Brandt, Kay See Tan, *Manjit S. Bains, *Bernard J. Park, *Prasad S. Adusumilli, *James Huang, Matthew J. Bott, *Valerie W. Rusch, ♦Daniela Molena, James M. Isbell, Smita Sihag, Jamie E. Chافت, Mark G. Kris, *David R. Jones

Memorial Sloan-Kettering Cancer Center, New York, NY

Invited Discussant: *Jessica S. Donington

Objectives: Standard of care for patients with cT2-4N0-1M0 non-small cell lung cancer (NSCLC) is resection followed by adjuvant chemotherapy (AC). The role of neoadjuvant chemotherapy (NC) in this population is not well-established. The purpose of this study was to examine the short- and long-term outcomes of NC and AC in patients undergoing resection for cT2-4N0-1M0 NSCLC.

Methods: We performed a retrospective review of a prospectively maintained database to identify patients with cT2-4N0-1M0 NSCLC who underwent resection between 2000 and 2015. Staging was based on the 8th edition of the UICC/AJCC manual. Exclusion criteria included preoperative radiation, non-platinum-based chemotherapy, pre- or postoperative targeted therapy, intraoperative M1 disease, T4 by invasion and separate-nodule(s) criteria, wedge resection, and R1/R2 resection. The primary endpoint was disease-free survival (DFS). Secondary endpoints were overall survival (OS) and compliance with chemotherapy. Propensity scores were developed and matched using the 1:1 nearest neighbor algorithm. To assess balance between groups we used Absolute Standardized Mean Difference (ASMB). Survival was summarized by the Kaplan-Meier method and compared using the log-rank test, stratified by clinical stage. Hazard ratios (HR) were estimated from Cox models, adjusted for relevant clinicopathologic variables.

Results: 409 patients met inclusion criteria: 194 (47%) had NC, and 215 (53%) had AC. Thirty-day postoperative mortality was 0.5% ($n = 1$) for the NC group and 0% ($n = 0$) for the AC group; 90-day mortality was 2.6% ($n = 5$) and 0.9% ($n = 2$), respectively. Compared to the AC group, NC patients had larger cT size, higher tumor maximal standardized uptake value, higher clinical stage, more pneumonectomies, and a higher rate of PORT (all $p < 0.05$, see Table). RECIST criteria in the NC group showed a partial response in 77 (40%), stable disease in 105 (54%), and disease progression in 12 (6%). Histopathologic response in the NC group shows a major pathologic response in 23% (24/125) of cases with data available. After propensity-matching ($N = 101$ /group) the median follow-up was 3.3 years (1.9–6.3 yrs). NC patients had lower pT stage ($p < 0.001$) and were more likely to have pN0 disease ($p < 0.08$). NC patients had a higher rate of full dose (82% [$n = 80$] vs. 62% [$n = 63$], $p = 0.0013$) and full cycle (94% [$n = 92$] vs. 75% [$n = 76$], $p < 0.001$) of chemotherapy and a lower incidence of grade ≥ 3 adverse events from chemotherapy (18% [$n = 18$] vs. 40% [$n = 40$], $p < 0.001$). There was no difference in 5-year DFS (HR = 0.79, 95% CI: 0.54–1.15, $p = 0.2$) or OS (HR = 0.69, 95% CI: 0.45–1.06, $p = 0.086$) between AC and NC groups.

Conclusion: After propensity-matching, patients with larger tumors and cN1 disease have similar DFS and OS with either NC or AC. Patients receiving NC were significantly more likely to have full dose, full cycle chemotherapy with less toxicity compared to AC patients.

Table: Clinicopathologic Characteristics Stratified by Neoadjuvant vs. Adjuvant Chemotherapy (Unmatched/Matched)

	Unmatched				Propensity Matched			
	Neoadjuvant	Adjuvant	p	ASMD*	Neoadjuvant	Adjuvant	p	ASMD*
	(n = 194; 47%)	(n = 215; 53%)			(n = 101; 50%)	(n = 101; 50%)		
Age	65.0 (58.0, 73.0)	65.0 (58.0, 72.0)	0.98	0.003	65.0 (57.0, 74.0)	65.0 (58.0, 71.0)	0.57	0.083
Gender			0.3	0.102			0.57	0.079
Female	101 (52%)	101 (47%)			50 (50%)	46 (46%)		
Male	93 (48%)	114 (53%)			51 (50%)	55 (54%)		
Charlson Comorbidity Score			0.05	0.033			0.48	0.030
0	66 (34%)	89 (41%)			39 (39%)	43 (43%)		
1	75 (39%)	59 (28%)			38 (38%)	30 (30%)		
≥2	52 (27%)	67 (31%)			24 (23%)	28 (27%)		
Clinical Tumor Size (cm)	5.4 (4.4, 6.5)	4.3 (3.7, 5.2)	<0.001	NA	4.8 (4.0, 6.0)	4.8 (3.9, 6.0)	0.54	NA
Pre-treatment SUVmax	13.9 (10.5, 18.0)	10.9 (6.8, 14.6)	<0.001	0.516	12.8 (9.2, 17.2)	13.0 (8.7, 16.8)	0.93	0.020
cT			<0.001	0.623			0.98	0.046
2a	36 (18%)	87 (40%)			27 (27%)	28 (28%)		
2b	43 (22%)	59 (27%)			28 (28%)	26 (26%)		
3	77 (40%)	53 (25%)			33 (33%)	34 (34%)		
4	38 (20%)	16 (7%)			13 (13%)	13 (13%)		
cN			<0.001	0.482			0.57	0.101
0	111 (57%)	170 (79%)			57 (56%)	62 (61%)		
1	83 (43%)	45 (21%)			44 (44%)	39 (39%)		
Extent of Resection			0.01	0.305			0.33	0.061
Pneumonectomy	35 (18%)	17 (8%)			11 (11%)	13 (13%)		
Bilobectomy	13 (7%)	10 (5%)			7 (7%)	4 (4%)		
Lobectomy	141 (73%)	183 (85%)			79 (78%)	83 (82%)		
Segmentectomy	5 (3%)	5 (2%)			4 (4%)	1 (1%)		
Pathologic Tumor Size (cm)	4.0 (2.9, 5.7)	4.9 (3.8, 6.0)	<0.001	NA	3.9 (2.8, 5.4)	5.4 (4.0, 6.5)	<0.001	NA
(y) pT			<0.001	NA			<0.001	NA
0	12 (6%)	0 (0%)			1 (1%)	0 (0%)		
1	35 (18%)	10 (5%)			23 (23%)	3 (3%)		
2	80 (41%)	95 (44%)			40 (40%)	34 (34%)		
3	52 (27%)	79 (37%)			30 (30%)	45 (45%)		
4	15 (8%)	31 (14%)			7 (7%)	19 (19%)		
(y) pN			0.003	NA			0.079	NA

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	Unmatched				Propensity Matched			
	Neoadjuvant (n = 194; 47%)	Adjuvant (n = 215; 53%)	p	ASMD*	Neoadjuvant (n = 101; 50%)	Adjuvant (n = 101; 50%)	p	ASMD*
0	126 (65%)	104 (48%)			64 (63%)	49 (49%)		
1	45 (23%)	75 (35%)			25 (25%)	31 (31%)		
2	23 (12%)	36 (17%)			12 (12%)	21 (21%)		
Pathologic Response			NA	NA			NA	NA
<10% viable tumor	24 (23%)	0 (0%)			11 (18%)	0 (0%)		
10-50% viable tumor	24 (23%)	0 (0%)			12 (20%)	0 (0%)		
>50% viable tumor	57 (54%)	0 (0%)			38 (62%)	0 (0%)		
Full Dose of Chemotherapy			<0.001	NA			0.003	NA
No	33 (18%)	82 (38%)			18 (18%)	38 (38%)		
Yes	153 (82%)	131 (62%)			80 (82%)	63 (62%)		
Full Cycle of Chemotherapy			<0.001	NA			<0.001	NA
No	12 (7%)	46 (22%)			6 (6%)	25 (25%)		
Yes	174 (94%)	167 (78%)			92 (94%)	76 (75%)		
≥Grade 3 Chemotherapy Toxicity			<0.001	NA			0.001	NA
No	155 (83%)	126 (59%)			80 (82%)	61 (60%)		
Yes	31 (17%)	87 (41%)			18 (18%)	40 (40%)		
Postoperative Radiation			0.02	NA			0.21	NA
No	172 (89%)	204 (95%)			90 (89%)	95 (94%)		
Yes	22 (11%)	11 (5%)			11 (11%)	6 (6%)		

*ASMD, absolute standardized mean differences, ASMD ≤0.1 means the variable is balanced between the two groups



114. Prognostic Value of Neoadjuvant Treatment Response in Locally Advanced Esophageal Adenocarcinoma

Shawn S. Groth¹, ♦Bryan M. Burt¹, Farhood Farjah², Brandon G. Smaglo¹, Yvonne H. Sada¹, *David J. Sugarbaker¹, Nader N. Massarweh¹

¹Baylor College of Medicine, Houston, TX; ²University of Washington, Seattle, WA

Invited Discussant: ♦Siva Raja

Objective: To 1) determine the association between neoadjuvant chemotherapy vs. chemoradiation therapy on completeness of pathologic response and 2) to assess the relative impact of primary tumor vs. nodal response on survival for patients undergoing esophagectomy for esophageal adenocarcinoma. These associations have not been previously well characterized.

Methods: Retrospective cohort study of patients aged 18–80 years in the National Cancer Database (2006–2012) with clinically staged, locally advanced (cT2–4 or cN+) esophageal adenocarcinoma who underwent a margin-negative esophagectomy following neoadjuvant chemotherapy or chemoradiation therapy. Response rates were classified as: complete (ypT0N0), partial (cT3 downstaged to ypTis-1 or cT4 to ypTis-2 regardless of pathologic nodal status, cN+ to ypN0 with residual primary tumor, or ypN+ with a complete primary response), or no response (upstaged tumors or anything less than a partial response). Multivariable, multinomial regression was used to evaluate the association between neoadjuvant chemotherapy vs. chemoradiation and completeness of pathologic response. To assess the relative impact of primary vs. nodal treatment response and risk of death in a homogenous cohort, we used multivariate Cox proportional hazards regression models limited to patients treated with neoadjuvant chemoradiation.

Results: Of the 2870 patients in our study, 17.3% had a complete response and 34.5% had a partial response. Compared with neoadjuvant chemoradiation, neoadjuvant chemotherapy was associated with lower primary tumor (21.3% vs. 33.9%; $p < 0.001$) and nodal response rates (32.7% vs. 55.9%; $p < 0.001$) and was less likely to achieve a partial (relative risk ratio [RRR] 0.52 [95% confidence interval [CI]:0.40–0.68]) or complete response (RRR 0.26 [0.16–0.42]).

For patients treated with neoadjuvant chemoradiation, there was a significant association between completeness of response and overall risk of death: no response (reference), partial response (hazard ratio [HR] 0.81 [0.72–0.91]), and complete response (HR 0.55 [0.47–0.65]). Both a primary (HR 0.71 [0.63–0.79]) and nodal response (HR 0.60 [0.54–0.67]) were associated with a lower risk of death. However, among patients who had a primary but no nodal response, the survival benefit of the primary tumor response was mitigated (HR 0.88 [0.69–1.11]). In contrast, among patients who had a nodal but no primary response, the survival benefit of a nodal response was maintained (HR 0.66 [0.58–0.76]).

Conclusions: Nodal (rather than primary tumor) response to neoadjuvant therapy is the primary determinant of survival and suggests a need to optimize neoadjuvant strategies associated with more complete nodal response rates or to consider more aggressive adjuvant treatment for patients with residual nodal disease after a margin-negative esophagectomy.

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115. Development and External Validation of a Prediction Model of Pathological Lymph Node Metastasis in Lung Adenocarcinoma with Clinical Stage IA and Dominant Solid Part (JCOG0201A): Ancillary Analysis of Japan Clinical Oncology Groups Trial, JCOG0201

Keiju Aokage¹, ◆Kenji Suzuki², Masashi Wakabayashi³, Hisashi Saji⁴, Aritoshi Hattori², Hiroshige Yoshioka⁵, Yoshitaka Zenke⁶, Yasuhiro Tsutani⁷, Hiroyuki Ito⁸, Tadashi Aoki⁹, Kazuo Nakagawa¹⁰, Jiro Okami¹¹, Kazuya Takamochi², *Morihiro Okada⁷, Tomonori Mizutani³, Haruhiko Fukuda³, Shun-ichi Watanabe¹⁰

¹National Cancer Center Hospital East, Kashiwa, Japan; ²Juntendo University School of Medicine, Tokyo, Japan; ³JCOG Data Center/Operations Office, National Cancer Center, Tokyo, Japan; ⁴St. Marianna University, Kanagawa, Japan; ⁵Kansai Medical University Hospital, Osaka, Japan; ⁶Tokyo Metropolitan Cancer and Infectious Diseases Center Komagome Hospital, Tokyo, Japan; ⁷Hiroshima University Hospital, Hiroshima, Japan; ⁸Kanagawa Cancer Center, Kanagawa, Japan; ⁹Niigata Cancer Center Hospital, Niigata, Japan; ¹⁰National Cancer Center, Tokyo, Japan; ¹¹Osaka Cancer Institute, Osaka, Japan

Invited Discussant: *Prasad S. Adusumilli

Objective: Although lobectomy with lymph node dissection has been the standard surgery for even stage I lung cancer, pathological lymph node metastasis (PLNM) is rare in lung adenocarcinoma with dominant ground glass opacity (GGO) component. In this study we aimed to develop a prediction model of PLNM in lung adenocarcinoma with dominant solid part that is 3 cm or less in tumor diameter based on clinical factors and radiological findings on preoperative thin-sliced computed tomography (TSCT).

Methods: Among 811 patients (pts) who were enrolled in JCOG0201, which was prospective and multi-institutional study, 420 pts with clinical stage IA lung adenocarcinoma (TNM 5th) confined to dominant solid part were included in this study. Multivariable logistic regression with selection method was performed to develop the prediction model using the following preoperative clinical factors and radiological findings on TSCT; maximum tumor diameter including GGO component (continuous variable of centimeter), consolidation to tumor ratio (CTR, continuous variable), sex (man/woman), tumor location (RUL/RML/RLL/LUL/LLL), age (continuous variable), air bronchogram (presence/absence), pleural indentation (presence/absence), and density of solid part (obvious solid concentration and intermediate concentration between obvious solid concentration and GGO). The leave-one-out cross validation, as an internal validation, and the external validation using independent data of 221 pts were performed to assess predictive accuracy of the prediction model created. To indicate the discriminative ability, the concordance probability, the diagnostic sensitivity and specificity were calculated.



Results: PLNM was shown in 46 pts of total 420 pts (11.0%). A tumor diameter including GGO component, CTR and density of solid part were included in the prediction model. The concordance probability of this prediction model was 0.8041. The probability of PLNM positivity is 4.958% or more in condition of the maximum value of Youden's index (sensitivity + specificity – 1) under the condition with sensitivity of 95% or more. When the cutoff value and prediction of the risk of PLNM is set at 4.9%, the diagnostic sensitivity and specificity in predicting PLNM were 95.7% and 46.0%, respectively. The concordance probability by applying the external validation set to the predicting model was 0.7972, the diagnostic sensitivity and specificity in predicting PLNM were 95.4% and 40.5%.

Conclusions: This prediction model is a useful tool to predict PLNM in clinical stage IA lung adenocarcinoma and with dominant solid part on TSCT. A Probability of PLNM obtained by this prediction model might make us possible to apply a function-preserving surgery or a reduction of the extent of lymph node dissection.

116. Induction Chemoradiotherapy for Esophageal Cancer: Comparing CROSS Regimen with Cisplatin/5-FU

Abraham Geller, Ashok Muniappan, *Henning A. Gaissert, *Douglas J. Mathisen, Christopher Morse, *Cameron D. Wright, *Michael Lanuti
Massachusetts General Hospital, Boston, MA

Invited Discussant: *Arjun Pennathur

Objective: To investigate whether pathologic complete response (“path CR”) rates are different in esophageal cancer patients receiving preoperative chemoradiotherapy with cisplatin/5-FU (“CF”) versus carboplatin/paclitaxel (“CP”). We hypothesized that the CP induction regimen is associated with a reduced complete response rate and increased disease recurrence.

Methods: Patients were identified from a prospectively collected institutional database of esophagectomy cases between June 2002 and June 2017. Patients were excluded if they underwent esophagectomy for indications other than primary esophageal cancer, tumor histology other than adenocarcinoma (EAC) or squamous cell carcinoma (ESCC), or if they underwent redo esophagectomy or salvage esophagectomy. Oncology notes and pathology reports were reviewed to determine tumor response to treatment. The primary endpoint was path CR. Secondary endpoints were overall survival (OS) and disease-free survival (DFS). The association of chemotherapy regimen with tumor response was modeled using logistic regression. Kaplan – Meier curves were used to model survival differences, utilizing the log-rank test for significance of differences.

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Results: 961 patients underwent esophagectomy at our institution during the study period. 406 patients (42%) met inclusion criteria, and 322 patients (34%) had been treated with either CP or CF preoperatively in a concurrent chemoradiotherapy regimen. Median follow-up was 31 months in the CF group (range: 1–176 mo.) and 13 months in the CP group (range: 1–82 mo.) ($P < .001$ for difference). Patients with EAC who received neoadjuvant CF were more likely than patients receiving CP to achieve path CR (OR 2.14, 95% CI 1.19–3.83, $P = .011$) or complete/near-complete response (OR 3.26, 95% CI 1.87–5.68, $P < .001$). There was no difference in path CR rates for patients with ESCC receiving neoadjuvant CF or CP (OR .923, 95% CI .308–2.77, $P = .886$). There were no differences in OS or DFS between the treatment groups, though patients receiving CP had more early-stage cancers (2B or less) while those receiving CF had more advanced-stage cancers (3A or greater) ($P = .039$). Patients achieving path CR had significantly greater mean OS than those who did not (115 months vs. 67 months, $P < .001$).

Table: Logistic Regression Model of Path CR Rates Between CP and CF

	OR for Path CR	95% Confidence Interval	p Value	OR for Path CR or Near CR	95% Confidence Interval	p Value
Overall (n = 322)						
CP (n = 184)	1	Reference	Reference 1		Reference	Reference
CF (n = 138)	1.86	1.13–3.07	.015	3.11	1.92–5.03	<.001
Adenocarcinoma only (n = 271)						
CP (n = 159)	1	Reference	Reference 1		Reference	Reference
CF (n = 112)	2.14	1.19–3.83	.011	3.26	1.87–5.68	<.001
Squamous cell carcinoma only (n = 51)						
CP (n = 25)	1	Reference	Reference 1		Reference	Reference
CF (n = 26)	.923	.308–2.77	.886	2.51	.778–8.07	.124

Conclusion: Neoadjuvant cisplatin/5-FU was associated with greater likelihood of path CR than was carboplatin/paclitaxel in patients with esophageal adenocarcinoma. Path CR status confers a significant survival advantage over incomplete pathologic response. While we detected no differences in OS and DFS, CF patients tended to have more advanced cancers than CP patients. Prospective studies are warranted to investigate potential survival differences directly comparing cisplatin/5-FU to carboplatin/paclitaxel for the neoadjuvant treatment of esophageal adenocarcinoma.



117. Patterns and Risk of Recurrence in Esophageal Cancer Patients with a Pathological Complete Response After Neoadjuvant Chemoradiotherapy Followed by Surgery

Arianna Barbetta, Tamar Nobel, Meier Hsu, Key See Tan, *Manjit S. Bains, *Prasad S. Adusumilli, Matthew J. Bott, *James Huang, James M. Isbell, *Bernard J. Park, Valerie W. Rush, Smita Sihag, *David R. Jones, ♦Daniela Molena
Memorial Sloan Kettering Cancer Center, New York, NY

Invited Discussant:

Objective(s): A pathological complete response (pCR) in patients with locally advanced esophageal cancer after treatment with multimodality approach is associated with better overall and disease free survival. Nevertheless, approximately one-third of patients with pCR still recur. To date, no definitive factors have been associated with risk of recurrence in this subset of patients with ypT0N0 tumors. The aim of this study was to evaluate patterns and identify risk factors for recurrence in patients with a pCR following neoadjuvant chemoradiotherapy and surgery (CRT-S).

Methods: We performed a retrospective analysis of a prospective database for patients with clinical stage II and III esophageal cancer treated with CRT-S between 1997 and 2016 that achieved a pCR. Demographics, histologic features, stage, treatment and outcomes of pCR patients were collected. Follow-up included clinical examination and CT scan of the chest, abdomen, and pelvis. Endoscopy and brain scans were selectively performed for symptoms. Competing risk regression model was used to identify any factors associated with risk of recurrence. Multivariable analysis was performed on variables with $p < 0.2$ on univariable analysis including induction chemotherapy, chemotherapy regimen and radiation dose. Death without a recurrence was considered a competing risk event.

Results: We identified 233 patients with pCR. 171 (73.4%) patients were treated for adenocarcinoma and 62 (26.6%) for esophageal squamous cell carcinoma. 201 (86.3%) patients underwent Ivor Lewis esophagectomy, and the median number of lymph nodes retrieved was 20 (IQR 1–55). With a median follow-up of 40.7 months (IQR 0.4–213), disease recurrence was observed in 62 (27%) patients, with a 5-year cumulative incidence of recurrence of 30% (95% CI, 23%–36%). Among patients who recurred, 45 (73%) recurred at a distant site at a median of 0.97 years (IQR 0.5–1.75); 14 patients (22%) had a regional recurrence at a median of 1.46 years (IQR 0.76–2.28); 3 patients (5%) had a local recurrence at a median of 1.2 years (IQR 0.5–2.3). Poor differentiation was the only significant factor associated with risk of recurrence in multivariable analysis (HR 2.12 95% CI 1.10–4.11, $p = 0.03$; Table 1).

Conclusions: Although a finding of pCR may be suggestive of cure, the risk of recurrence for these patients remains substantial. The majority of patients recur at a distant site within the first year. Identification of patients with residual disease or at high risk of recurrence remains unsatisfying.

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Table1. Univariable and multivariable competing risk regression analysis for association with recurrence after pCR

			Univariable Analysis		Multivariable Analysis	
Characteristics	N at risk	N Recurred	HR (95% CI)	p-value	HR (95% CI)	p-value
Age	233	62	1.01 (0.98-1.03)	0.56		
Sex				0.767		
Male	184	49	1.10 (0.59-2.03)			
Race				0.368		
White	208	57	1.49 (0.62-3.59)			
Pulmonary comorbidity				0.389		
Yes	26	5	0.68 (0.28-1.65)			
Cardiac comorbidity				0.485		
Yes	116	34	1.19 (0.73-1.96)			
Diabetes				0.253		
Yes	24	8	1.51 (0.74-3.07)			
Tumor Location				0.628		
distal/GE Junction	201	52	1.00			
Middle	32	10	1.18 (0.61-2.29)			
Procedure Type				0.788		
3-hole	25	7	1.00			
Ivor Lewis	201	54	0.93 (0.41-2.12)			
Other	7	1	0.5 (0.07-3.69)			
Signet ring cells				0.78		
No	139	35	1.00			
Yes	29	9	1.29 (0.62-2.69)			
SCC histology	62	18	0.99 (0.57-1.73)			
Differentiation				0.052		0.026
Well/moderate	105	21	1.00			
Poor	111	36	1.70 (1.00-2.91)		2.12 (1.10 - 4.11)	
clinical Stage				0.467		
II	85	21	1.00			
III	148	41	1.21 (0.72-2.03)			
SUV max pre treatment	198	52	0.97 (0.94-1.01)	0.16	0.97 (0.92 - 1.02)	0.29
SUV max after CRT	158	41	0.94 (0.83-1.07)	0.35		
Tumor length (cm)	209	54	0.89 (0.75-1.06)	0.20	0.87 (0.68 - 1.10)	0.25
Total number of lymph nodes in specimen	233	62	1.00 (0.97-1.02)	0.88		
Distance to proximal margin (cm)	181	45	0.99 (0.9-1.09)	0.80		
Distance to distal margin (cm)	160	38	1.03 (0.94-1.14)	0.51		
Time from CRT to surgery (weeks)	216	59	1 (0.92-1.08)	0.92		
Chemotherapy Regimen				0.234		0.59
Platinum	139	39	1.00		1.00	
Carbo/Taxol	74	17	1.12 (0.63-1.99)		1.25 (0.58 - 2.67)	
S-FU	13	2	0.74 (0.17-3.21)		0.92 (0.19 - 4.35)	
Other	7	4	2.27 (1.01-5.11)		3.07 (1.25 - 7.56)	
Radiation Dose				0.242		
≤5040	31	5	1.00			
>5040	194	56	1.73 (0.69-4.36)		1.86 (0.61 - 5.68)	0.28
Pulmonary complication				0.826		
Yes	46	11	0.93 (0.48-1.81)			
Cardiac complication				0.48		
Yes	52	12	0.80 (0.43-1.49)			
Anastomotic leak				0.319		
Yes	31	11	1.39 (0.73-2.63)			

5:38 pm

Adjourn



2:00 pm –
3:30 pm

**What a Cardiac Surgeon In 2018
Should Know About Transcatheter Devices**

Ballroom 20A, SDCC

6 minute presentation, 9 minute discussion

Co-Chairs: *Lars G. Svensson, *Cleveland Clinic*
*Vinod H. Thourani, *MedStar Heart and Vascular Institute*

Panelists: *Isaac George, *New York Presbyterian Hospital*
Stephanie Mick, *Cleveland Clinic*
Jason H. Rogers, *University of California, Davis*

118. Causes of Death in Intermediate Risk Patients from the Randomized Surgical Replacement and Transcatheter Aortic Valve Implantation Trial

Hafid Amrane¹, *G. Michael Deeb², Jeffrey J. Popma³, Mubashir Mumtaz⁴,
Nicolas M. van Mieghem⁵, *Thomas G. Gleason⁶, *Michael J. Reardon⁷

¹*Medisch Centrum Leeuwarden, Leeuwarden, Netherlands;* ²*University of Michigan, Ann Arbor, MI;* ³*Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA;* ⁴*Pinnacle Health Harrisburg Hospital, Harrisburg, PA;* ⁵*Erasmus Medical Centre Rotterdam, Rotterdam, Netherlands;* ⁶*University of Pittsburgh, Pittsburgh, PA;* ⁷*Houston Methodist DeBakey Heart & Vascular Center, Houston, TX*

Invited Discussant: *Y. Joseph Woo

Objectives: Superior 1-year survival in high-risk patients treated with transcatheter aortic valve replacement (TAVR) vs. surgical AVR (SAVR) included significant differences in the timing and causes of death. In the Surgical Replacement and Transcatheter Aortic Valve Implantation (SURTAVI) Trial, TAVR was shown to be noninferior to SAVR for the primary endpoint of all-cause mortality or disabling stroke at 2 years. Although there were no differences in survival between TAVR and SAVR, we sought to examine the specific causes and timing of death in this intermediate-risk patient population.

Methods: Patients were randomized (1:1) to TAVR or SAVR and 1660 (864 TAVR; 796 SAVR) underwent attempted implantation. Cause of death was adjudicated by an independent Clinical Events Committee (CEC). To determine if these causes varied based on time since procedure, we evaluated baseline characteristics, serious adverse event rates and causes of death for patients who died during 3 time periods: post-procedure (0–30 days); mid-term (31–120 days); and long-term (121–365 days).

Results: There were significant differences in baseline demographics, clinical characteristics, medical history or frailty between TAVR and SAVR patients who died during any time period. There were more SAVR than TAVR patients who died post-procedure with a below-threshold grip strength (11/12 [91.7%] vs. 8/16 [50.0%], $p = 0.04$) and more SAVR than TAVR patients who died in the long-term period had ≥ 1 KATZ deficit (SAVR 4/23 [17.4%] vs. TAVR 0/28 [0.0%], $p = 0.02$). Mortality rates for TAVR vs. SAVR patients for the 3 time periods were; post-procedure (2.1% vs. 1.6%, $p = 0.50$); mid-term (1.2% vs. 2.1%, $p = 0.16$) and late-term (3.4 vs. 3.1%, $p = 0.75$). There was only 1 valve-related death (due to aortic valve re-intervention) in the SAVR group (mid-term) through 1 year. CEC causes are listed in the following Table.

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Table. Clinical Events Committee causes of death for each treatment arm for the 3 time periods.

No. (%)	0-30 Days		31-120 Days		121-365 Days	
	TAVR N=18	SAVR N=13	TAVR N=10	SAVR N=16	TAVR N=28	SAVR N=23
<i>Cardiovascular</i>	17 (94.4)	13 (100)	7 (70.0)	12 (75.0)	16 (57.1)	16 (69.6)
Valve-related	0 (0.0)	0 (0.0)	0 (0.0)	1 (6.3)*	0 (0.0)	0 (0.0)
Myocardial infarction	1 (5.6)	1 (7.7)	0 (0.0)	0 (0.0)	1 (3.6)	0 (0.0)
Cardiac tamponade	1 (5.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Worsening heart failure	0 (0.0)	0 (0.0)	1 (10.0)	2 (12.5)	3 (10.7)	1 (4.3)
Arrhythmia	0 (0.0)	1 (7.7)	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.3)
Non-coronary vascular Conditions	3 (16.7)	1 (7.7)	1 (10.0)	2 (12.5)	2 (7.1)	3 (13.0)
Neurological event	2 (11.1)	1 (7.7)	1 (10.0)	2 (12.5)	2 (7.1)	2 (8.7)
Other vascular disease	1 (5.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.3)
Sudden/unwitnessed	1 (5.6)	0 (0.0)	1 (10.0)	3 (18.8)	2 (7.1)	1 (4.3)
Complication of procedure	11 (61.1)	5 (38.5)	2 (20.0)	3 (18.8)	0 (0.0)	0 (0.0)
Treatment for complication of procedure	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Other	0 (0.0)	2 (15.4)	1 (10.0)	0 (0.0)	0 (0.0)	2 (8.7)
Unknown	0 (0.0)	3 (23.1)	1 (10.0)	1 (6.3)	8 (28.6)	8 (34.8)
<i>Non-cardiovascular</i>	1 (5.6)	0 (0.0)	3 (30.0)	4 (25.0)	12 (42.9)	7 (30.4)
Malignancy	0 (0.0)	0 (0.0)	0 (0.0)	2 (12.5)	0 (0.0)	1 (4.3)
Accidental	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (7.1)	0 (0.0)
Infection/sepsis	1 (5.6)	0 (0.0)	3 (30.0)	0 (0.0)	5 (17.9)	5 (21.7)
Renal disease	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (7.1)	0 (0.0)
COPD	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.3)
Other	0 (0.0)	0 (0.0)	0 (0.0)	2 (12.5)	3 (10.7)	0 (0.0)

*Aortic valve reintervention.

Conclusions: There were no significant differences in mortality rates between the TAVR and SAVR groups for any time period. The causes of death by time period will be presented.



119. Inter-Site Variability of Mortality and Stroke for Sites Performing Both Surgical and Transcatheter Aortic Valve Replacement for Aortic Valve Stenosis in Intermediate Risk Patients

*Kevin L. Greason¹, *Eugene Blackstone², Jeevanantham Rajeswaran²,
*Lars G. Svensson², Jeffrey W. Moses³, John Webb⁴, Murat E. Tuzcu²,
*Craig R. Smith³, *Michael Mack⁵, *Vinod H. Thourani⁶, Susheel Kodali³,
*D. Craig Miller⁷

¹Mayo Clinic, Rochester, MN; ²Cleveland Clinic, Cleveland, OH; ³Columbia University, New York, NY; ⁴University of British Columbia, Vancouver, BC; ⁵The Heart Hospital Baylor Plano, Denton, TX; ⁶Emory University, Atlanta, GA; ⁷Stanford University, Stanford, CA

Invited Discussant: *Michael J. Reardon

Objectives: A criticism and limitation of multi-site procedure-based randomized trials is that, unlike pharmaceutical trials, results are confounded by performance variability. Therefore, we quantified inter-site variability in mortality and stroke after both surgical (SAVR) and transcatheter (TAVR) aortic valve replacement in the PARTNER-2A randomized trial.

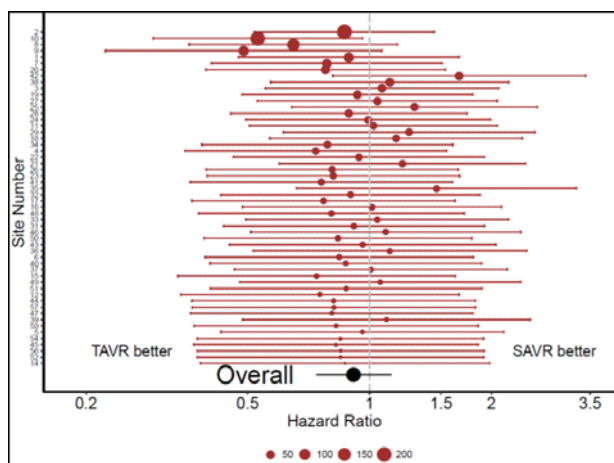
Methods: Patients at intermediate risk for SAVR were randomized to either SAVR (n = 1017) or TAVR (n = 1011) with a Sapien XT device at 54 sites performing both procedures. Patients were followed to 2 years. We used cluster-specific random-effects mixed-effect modeling to estimate inter-site variability in 2-year mortality and stroke. For mortality, we also estimated the hazard ratio of SAVR versus TAVR for each site and its 95% confidence interval.

Results: There were 336 deaths (SAVR 166, TAVR 170). Inter-site variability for mortality was greater for TAVR than SAVR, with 95% of hazard ratios for TAVR ranging from 0.61–1.49 (variance measure 0.13, 95% confidence interval 0.04–0.43) and 95% of hazard ratios for SAVR ranging from 0.71 to 1.33 (variance measure 0.11, 95% confidence interval 0.025–0.51; $P = .006$). Site-specific estimates of 2-year mortality hazard ratios demonstrated that, overall, TAVR was slightly better than SAVR, with all but 1 site's 95% confidence interval overlapping 1.0 (Figure), indicating few outliers. Lower site volume within the trial was associated with higher early risk of death after both procedures (SAVR $P = .07$; TAVR $P = .03$), but was not associated with late mortality (SAVR $P = .8$; TAVR $P = .5$). There were 192 strokes (SAVR 94, TAVR 98). Inter-site variability for stroke was greater after SAVR than TAVR, with 95% of hazard ratios for SAVR ranging from 0.76 to 1.44 (variance measure 0.17, 95% confidence interval 0.03–0.99; $P = .05$) compared with no detectable variation after TAVR ($P > .9$). Lower site volume within the trial was not associated with higher risk of stroke after SAVR or TAVR ($P \geq .1$).

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Conclusions: Inter-site variability for mortality after SAVR and TAVR was not large, and with rare exceptions, mortality was similar for SAVR and TAVR within a given site. Inter-site variability for stroke was greater for SAVR than for TAVR. Site volume within the trial was not correlated with either outcome. These findings support that participating sites demonstrated equal expertise in both procedures. Patient referrals for aortic valve replacement should be to centers of excellence that can perform either procedure with uniformly low risk.

Case Examples of the Heart Team at Work

See page 80 for details.

4:05 pm **Adult Cardiac Surgery** Ballroom 20A, SDCC
5:40 pm **Simultaneous Scientific Session**
 5 minute presentation, 9 minute discussion
Moderators: Nirav C. Patel and *John D. Puskas

120. Tissue Versus Mechanical Aortic Valve Replacement in Young Patients: A Multi-Center Experience

Alexander Iribarne¹, Gerald L. Sardella², Michael P. Robich³, Daniel J. Gelb¹,
 Yvon R. Baribeau⁴, *Bruce J. Leavitt⁵, Robert A. Clough⁶, Paul W. Weldner⁷,
 Anthony W. DiScipio¹

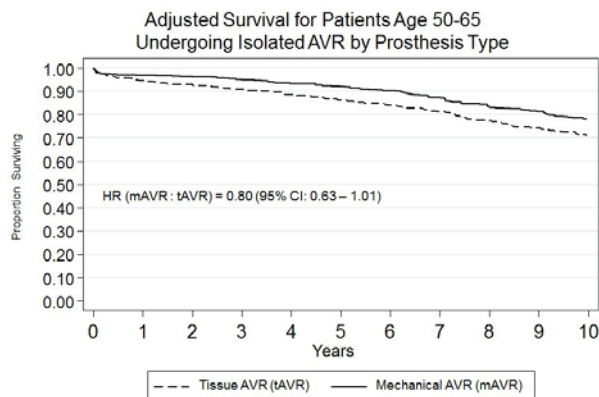
¹Dartmouth-Hitchcock Medical Center, Lebanon, NH; ²Concord Hospital, Concord, NH; ³Maine Medical Center, Portland, ME; ⁴Catholic Medical Center, Manchester, NH; ⁵University of Vermont, Burlington, VT; ⁶Eastern Maine Medical Center, Bangor, ME; ⁷Central Maine Medical Center, Lewiston, ME

Invited Discussant: *Joanna Chikwe

Objective: Tissue valves are increasingly being used in younger patients, and this trend toward greater use of tissue valves in patients between the ages of 50–65 has been further advanced by the ability for valve-in-valve transcatheter valve replacement. The goal of this study was to examine the long-term survival of patients between the ages of 50–65 undergoing tissue versus mechanical aortic valve replacement in a multi-center cohort.

Methods: A multi-center, retrospective analysis of all aortic valve replacement (AVR) patients ($n = 9,726$) from 1991–2015 among 7 medical centers reporting to a prospectively maintained clinical registry was conducted. Inclusion criteria were: age 50–65 years, elective case status, and isolated AVR. Exclusion criteria were: any prior valve surgery, emergent case status, and concomitant major cardiac procedures including CABG, other valve surgery, and aortic surgery. After applying inclusion/exclusion criteria, baseline co-morbidities were balanced using inverse probability weighting for a matched study cohort of 1,629 AVRs: 980 tissue AVR (tAVR) and 649 mechanical AVR (mAVR). The primary endpoint of the analysis was all-cause mortality. Secondary endpoints included rates of stroke, acute kidney injury, and 30-day mortality.

Results: Groups were successfully matched on age, gender, body surface area, major baseline co-morbidities, presence of atrial fibrillation, ejection fraction, priority (elective versus urgent), medical center, and study time period (1991–2002 vs. 2003–2015). During the study period there was a significant shift in the ratio of tAVR : mAVR operative procedures from 0.52 in the early time period (1991–2002) to 3.87 in the later time period (2003–2015) ($p < 0.001$). There was no significant difference in all-cause mortality between matched mAVR and tAVR groups (HR 0.80, 95% CI: 0.63–1.01, $p = 0.06$, Figure). There was also no difference between groups in 30-day mortality (mAVR 2.1% ($n = 14$), tAVR 1.8% ($n = 18$), $p = 0.81$); post-operative stroke (mAVR 0.87% ($n = 6$), tAVR 1.1% ($n = 10$), $p = 0.82$); or post-operative acute kidney injury by AKIN criteria (mAVR 25.4% ($n = 165$), tAVR 19.9% ($n = 195$), $p = 0.12$). Mean length of hospital admission was one day longer for mAVR patients (mAVR: 7.3 days, tAVR: 6.5 days, $p = 0.01$).



Conclusions: The 2014 AHA/ACC/AATS valve guidelines were modified in 2017 to note that uncertainty exists regarding the optimal aortic valve prosthesis type for patients aged 50–70, with conflicting data in the literature on the survival benefit between valve types in this age group. Our analysis demonstrates no significant difference in long term survival or in-hospital morbidity among patients undergoing mechanical versus tissue AVR. Therefore, either valve option is reasonable and valve choice should continue to be individualized, balancing the need for long term anticoagulation with need for re-intervention.

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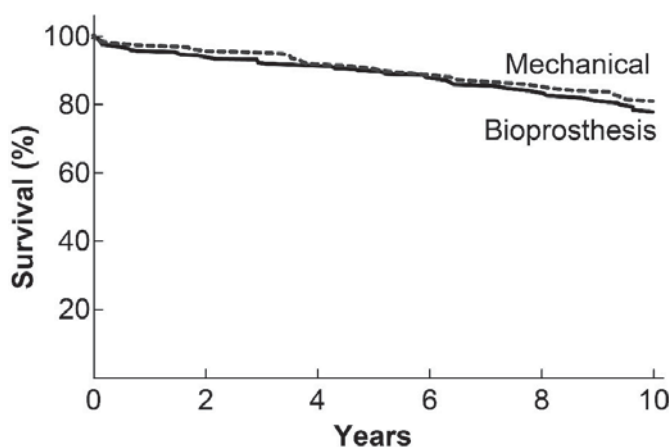
121. Equivalent Long-Term Survival After Isolated Bioprosthetic Versus Mechanical Aortic Valve Replacement: A Propensity Matched Analysis

Tamer Attia, *Faisal G. Bakaeen, *Edward G. Soltesz, *Eric E. Roselli, *Nicholas G. Smedira, *A. Marc Gillinov, *Lars G. Svensson, Andrew Toth, Jeevanantham Rajeswaran, *Eugene H. Blackstone, *Douglas R. Johnston
Cleveland Clinic, Cleveland, OH

Invited Discussant: *Ko Bando

Objectives: Patient preference to avoid anticoagulation and improved valve durability have led to increasing use of bioprostheses in younger patients despite higher need for reoperation, compared to mechanical valves. Our objectives were to compare in-hospital complications, need for reoperation, and survival in patients undergoing bioprosthetic and mechanical aortic valve replacement (AVR).

Methods: From 1/1990 to 1/2017, 5,836 patients underwent isolated AVR at a single institution. Of these, 714 (12%) received a mechanical valve and 5,122 (88%) received a bioprosthesis. Due to differences in patient characteristics between groups (e.g., mean age of mechanical valve patients was 52 ± 13 years vs. 69 ± 12 years for bioprosthesis patients), propensity matching based on preoperative patient characteristics was used to generate 497 well-matched pairs (70% of the mechanical prosthesis group). Mean age in the matched groups was 55 ± 12 years for mechanical valve patients vs. 54 ± 14 years for bioprosthesis patients ($P > .9$).



Survival in matched patients receiving an aortic valve bioprosthesis vs. a mechanical valve

Results: There was no difference between patients who received mechanical valve and bioprosthesis in the duration of cardiopulmonary bypass (76.8 ± 43.7 vs. 76.5 ± 39 minutes, respectively, $P = .29$) and crossclamp times (61.2 ± 20.1 vs. 61.3 ± 23.9 minutes, $P = .19$). There was no difference in major in-hospital complications including stroke, deep sternal wound infection and reoperation for bleeding. Patients receiving a mechanical valve had longer hospital stay than those receiving a bioprosthesis (15th/50th/85th percentiles, 5.4/7.3/13 vs. 4.4/6.4/13 days, respectively, $P < .0001$). In-hospital mortality



was similar (0.8% vs. 0.8%, 4 out of 497 in each group, $P > .9$). Ten-year survival was 81% in the mechanical group vs. 78% in the bioprosthetic group ($P = .2$). Twenty-four patients in the mechanical group (5.6% at 10 years) required reoperation vs. 117 (8.4% at 10 years) in the bioprosthesis group (P [log-rank] = .0002); however, there was no difference in 5-year survival in patients requiring reoperation (82% vs. 79%, respectively, $P = .14$).

Conclusion: Aortic valve bioprostheses are associated with excellent short-term outcomes and 10-year survival equivalent to that of mechanical valves. Reoperation after implantation of a bioprosthetic aortic valve does not adversely affect survival. These results suggest that risk for reoperation alone should not deter use of bioprostheses in younger patients.

122. Trans-Catheter Tricuspid Valve Therapy — First World Series of Native Annulus Implantation

*Jose L. Navia, Haytham Elgharably, Samir Kapadia, Amar Krishnaswamy
Cleveland Clinic, Cleveland Clinic, OH

Invited Discussant: *Hersh Maniar

123. Predicting 30-Day Readmission After CABG: An Accurate Bedside Assessment Tool

Joshua Michael Rosenblum, Rena C. Moon, Jose N. Binongo, Chadwick William Stouffer, Bradley Graham Leshnower, Jeffrey S. Miller, *Edward P. Chen, Omar M. Lattouf, *Robert A. Guyton, *Michael E. Halkos, William Brent Keeling

Emory University, Atlanta, GA

Invited Discussant: *Richard L. Prager

Objective: Readmission after coronary artery bypass grafting (CABG) occurs frequently and is coming under increasing scrutiny by payors and hospitals alike. The purpose of this study was to develop an accurate bedside scoring tool to predict post-CABG readmission.

Methods: A retrospective review of institutional STS database for patients who underwent primary, isolated CABG at a single U.S. academic institution from 1/2002 to 6/2016 was done. Patients were cohorted based on 30-day readmission status. Pre- and post-operative variables were used in constructing a multiple logistic regression model for readmission. Stepwise regression was used on a training subset of the dataset (70%, $n = 16,040$) to identify the strongest predictors of readmission. Predictors were confirmed on the validation subset and were used to develop a risk score model.

Results: Over the study period, 23,300 patients underwent primary, isolated CABG, with 355 (1.5%) deaths during index hospitalization, leaving 22,945 patients at risk for 30-day readmission. Of that study population, 2,162 (9.9%) had a same-institution 30-day readmission. In general, readmitted patients were sicker, with higher rates of urgent operation (33.3% vs. 41.5%, no readmission vs. readmission, $p < 0.0001$), severe COPD (3.7% vs. 5.3%, $p < 0.001$), diabetes (39.4% vs. 48.6%, $p < 0.0001$), and STS PROM

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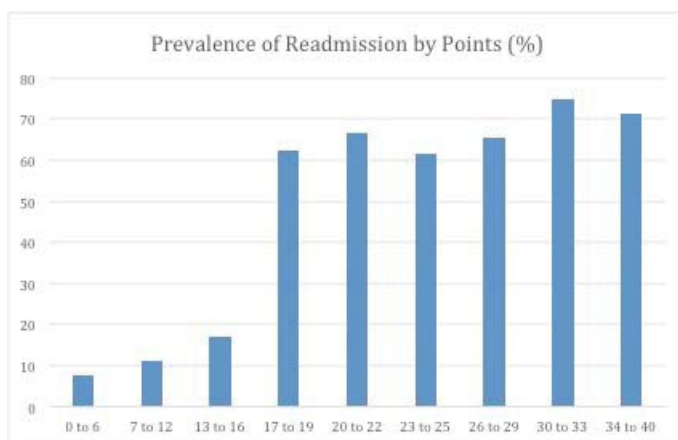


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scores (1.1 (IQR 0.6–2.3) vs. 1.5 (0.8–3.3), $p < 0.0001$). Insurance status was not different between groups ($p = 0.69$). Post-operative outcomes were similar between groups, with higher myocardial infarction rate in the readmitted group (6.2% vs. 0.32%, $p < 0.0001$). Fewer readmitted patients had been discharged to home on the index hospitalization (88.6% vs. 92.5%, $p < 0.0001$). Based on significant pre- and post-operative risk factors for readmission, a scoring tool was designed and validated, with cumulative score of 0–40 being incrementally predictive of readmission. On testing with the validation cohort, a dramatic increase in readmission prevalence was seen at 17 points (>60% readmission 17–19 points vs. 18% readmission 13–16 points, Figure).

Conclusion: Readmission following CABG is costly, and early intervention to prevent readmission requires accurate prediction of which patients are at highest risk. A scoring system using STS-collected pre- and post-operative variables accurately predicts readmission. Further studies are needed to validate this model in a prospective fashion in order to implement a readmission prevention protocol.



124. Multi-Vessel Versus Single-Vessel Robotic Totally Endoscopic Coronary Artery Bypass: Impact of a Beating Heart Approach with Anastomotic Connectors

Husam H. Balkhy, Sarah Nisivaco, Hiroto Kitahara, Brooke Patel, Mackenzie McCrorey
University of Chicago, Chicago, IL

Invited Discussant: Nirav C. Patel

Objective: The majority of robotic coronary artery bypass operations are single-vessel procedures. Very few centers perform totally endoscopic coronary bypass (TECAB). Even fewer perform multi-vessel grafting endoscopically. We hypothesized that a robotic beating heart approach using distal anastomotic connectors facilitates multi-vessel TECAB with the same safety and efficacy as single-vessel TECAB.

Methods: We reviewed all patients undergoing robotic TECAB at our institution between 7/2013 and 9/2017, (total 311 patients). Patients were divided into two groups based on the number of distal anastomoses performed: multi-vessel TECAB (Group 1), and single-vessel TECAB (Group 2). Our database of prospectively collected data was interrogated retrospectively for pre-operative characteristics, intra-operative details and postoperative outcomes. Statistical analysis was performed to compare the two groups.

Results: There were no differences in STS risk between the two groups. Patients in Group 1 were older, had longer operative times, and had more 3 vessel disease. In Group 1, 86% had TECAB x2 and 14% had TECAB x3. Incidence of bilateral internal mammary artery grafting was 89% in Group 1. Hospital and ICU length of stay, mortality, morbidity, and mid term angiographic patency (in hybrid patients undergoing angiography) were similar between the 2 groups (Table 1).

Table. Outcomes in multi-vessel vs single-vessel TECAB

Variables	Multi-Vessel (N = 180)	Single-Vessel (N = 131)	P value
STS score, mean	1.79 ± 2.5	2.15 ± 3.7	0.302
Age, years	67 ± 9.5	63 ± 11.3	0.000
Triple Vessel Disease, n (%)	126 (70)	27 (21)	0.000
Robotic Operative Time, min	295 ± 57	176 ± 68	0.000
Blood Transfusion, n (%)	32 (18)	26 (20)	0.220
Conversion to <u>Sternotomy</u> , n (%)	0 (0)	1 (0.8)	0.241
Conversion to CPB, n (%)	3 (1.7)	1 (0.8)	0.461
Postoperative Complications			
Myocardial infarction, n (%)	1 (0.6)	0 (0)	0.319
Stroke or TIA, n (%)	0 (0)	0 (0)	-
Re-exploration for bleeding, n (%)	2 (1.1)	1 (0.8)	0.751
Hospital Length of Stay, days	3.15 ± 1.2	2.93 ± 1.4	0.181
Mortality, n (%)	4 (2.2)	1 (0.8)	0.277
Mid-term Graft Patency, n (%)	128/134 (95.5)	32/33 (97.0)	0.402

Numerical data are expressed as mean ± standard deviation.

Conclusion: Multi-vessel grafting is feasible during robotic beating heart connector TECAB with excellent outcomes. We found no significant difference in perioperative mortality, hospital length of stay and midterm graft patency when compared to single-vessel TECAB. Further studies are warranted to evaluate longer-term outcomes.

5:15 pm

Adjourn

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TUESDAY AFTERNOON, MAY 1, 2018

4:05 pm MCS/Transplant Session Room 23BC, SDCC

5:40 pm 5 minute presentation, 7 minute discussion

Moderators: *Nader Moazami and Scott C. Silvestry

125. Optimal Timing for Heart Transplantation in Patients Bridged with Left Ventricular Assist Devices: Is Timing of the Essence?

Chase Robert Brown, Fabliha Khurshan, J. Eduardo Rame, Zehang Chen,

*Michael Acker, Fenton McCarthy, Peter Groeneveld, *Nimesh Desai

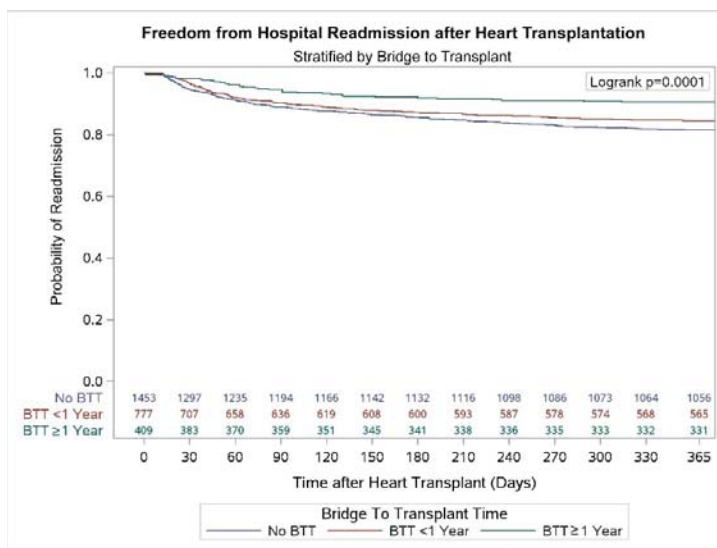
University of Pennsylvania, Philadelphia, PA

Invited Discussant: *Manuel J. Antunes

Objective: Patients being bridged to transplantation (BTT) with a left ventricular assist device (LVAD) comprise about 50% of all patients undergoing heart transplantation (HTx) and are being supported for longer periods prior to transplant. The objective of this study is to determine the effect of BTT timing on post-operative heart transplant outcomes.

Methods: From 2008 to 2014, all fee-for-service Medicare patients that underwent a HTx were included. We identified 2,639 patients that underwent HTx with 1,186 (45%) patients bridged to transplant with an LVAD. The LVAD patients were stratified into BTT < 1 year (777, 66%) and BTT ≥ 1 year (408, 34%) and compared to 1453 Non-BTT patients. Primary endpoint was all-cause mortality. Secondary endpoints were cardiovascular (CV) related hospital admissions within one year pre and post-HTx, major bleeding episodes one year prior to HTx, and incidence of ECMO within 30-days post-transplant. Hospital admission rates and pre-transplant major bleeding were calculated with a cumulative incidence function for competing risks using proportional hazards regression model. Kaplan-Meier curve and the log-rank test were used for survival analysis. Median follow up was 2.69 years.

Results: Average BTT time was 6.1 ± 3.2 months in BTT < 1 year and 21.4 ± 9.5 months in the BTT ≥ 1 year groups. All-cause mortality among BTT and Non-BTT patients was similar ($p = 0.16$). Survival was also similar among BTT ≥ 1 year and BTT < 1 year as compared to Non-BTT patients [30-days: Non-BTT = 94.3%; BTT ≥ 1: 94.8%; BTT < 1 94.1%; 1 year: Non-BTT = 88.5%; BTT ≥ 1: 88.6%; BTT < 1 84.7%; 3-years: Non-BTT = 81.9%; BTT ≥ 1: 80.8%; BTT < 1 78.3%, ($p = 0.34$). One-year CV related hospital readmissions post-HTx was significantly lower in the BTT ≥ 1 year group (HR = 0.53, $p < 0.005$) (BTT ≥ 1 year: 8.8%; BTT < 1 year: 14.2%; Non-BTT: 17.2%, $p < 0.001$) [Figure]. Likewise, patients in BTT ≥ 1 year (HR = 0.36, $p = 0.001$) had the lowest rate of hospital admissions one year before HTx (BTT ≥ 1: 30.1%; BTT < 1: 61.1%; non-BTT: 66.5%). The risk for bleeding one year prior to HTx was higher in the BTT groups (BTT ≥ 1: 56.5%; BTT < 1 67.3%; Non-BTT: 30.3%; $p < 0.001$). No differences were detected for ECMO post-HTx (BTT ≥ 1: 4.7%; BTT < 1: 4.0%; non-BTT: 4.5%, $p = 0.83$).



Conclusions: In patients undergoing HTx, survival was not impacted by BTT with an LVAD. Patients who were BTT ≥ 1 year with an LVAD had the lowest rates of hospital admissions pre and post-HTx. Future studies should elucidate if the patients who survive more than one-year post LVAD are favorably selected for heart transplantation or if reversal of heart failure with LVAD therapy can protect against adverse events after transplantation—a paramount goal given the shortage of donor hearts.

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126. Outcomes of Bridge to Cardiac Re-Transplantation in the Contemporary Mechanical Circulatory Support Era: An Analysis of the UNOS Database

Koji Takeda, Joseph Sanchez, Masahiko Ando, Marisa Cevasco, *Hiroo Takayama, *Yoshifumi Naka

Columbia University, New York, NY

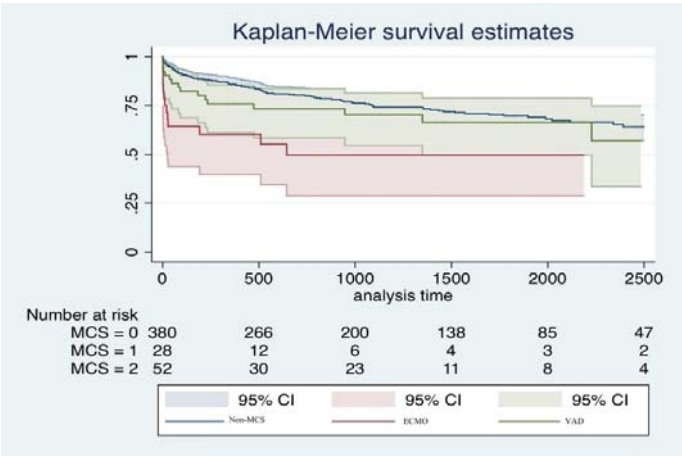
Invited Discussant: Fardad Esmailian

Objective: There have been marked improvements in the outcomes of patients bridged to heart transplant on contemporary continuous-flow ventricular assist devices (VAD) over the past decade. Here, we evaluated the efficacy of mechanical circulatory support (MCS) as a means to bridge patients to cardiac re-transplantation.

Methods: We retrospectively reviewed 464 patients who underwent cardiac re-transplant from the United Network for Organ Sharing (UNOS) database between January 2006 and November 2015. Baseline characteristics, pre-transplant device support, listing indication, and mortality information were collected and compared between patients bridged to re-transplant with MCS (n = 81) and those without MCS (n = 383).

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Results: The mean ages for the MCS and Non-MCS cohorts were 41.2 and 42.1, respectively ($p = \text{NS}$). Patients bridged with MCS were placed on either left VAD (28.4%), Total Artificial Heart (17.3%), biventricular VAD (14.8%), right VAD (4.9%), extracorporeal membrane oxygenation (ECMO) (35.8%), or other (1.2%). Twelve (14.8%) were placed on a second device prior to re-transplant. Thirty-two percent of the MCS group were indicated for listing due to primary graft dysfunction or acute rejection versus 6% of the Non-MCS group ($p < 0.01$). Similarly, 30% of the MCS group were listed for cardiac allograft vasculopathy compared to the 59% of the Non-MCS group ($p < 0.01$). Waitlist duration for the MCS group was significantly shorter compared with the Non-MCS group (134 vs. 226, days; $p = 0.04$); and the median durations between primary and re-transplantation were significant between MCS and Non-MCS patients (2.0 vs. 10.7, years; $p < 0.01$). 30-day mortality was significantly higher in MCS group (17.8% vs. 4.8%, $p < 0.01$). Kaplan Meier analysis showed comparable 5-year survival rate between groups (66.4% in MCS vs. 69.6% in non-MCS, $p = 0.72$). Patients who bridged with ECMO had significantly worse outcomes compared to non-MCS group and those bridged with VAD (Figure).



Conclusions: Patients who require MCS bridge to re-transplant are high risk cohort. However, comparable long-term outcome to non-MCS cohort can be expected when patients' condition allows to be bridged with VAD.



127. To Repair or Not to Repair: Continuous Flow Left Ventricular Assist Device with Uncorrected MR Has Little Adverse Impact on Survival, RV Function and Pulmonary Artery Pressure

Muhammad F. Masood, Irene Fischer, Gregory A. Ewald, *Ralph J. Damiano, Jr.,
*Marc R. Moon, Keki R. Balsara, Akinobu Itoh

Washington University, Saint Louis, MO

Invited Discussant: *Walter P. Dembitsky

Objective: Severity of secondary mitral regurgitation (MR) related to end-stage heart failure may alter the outcome after LVAD implant, such as RV failure which demands RVAD implant, reduction in pulmonary artery pressure, and overall survival: however, continuous LV venting by LVAD may mitigate the adverse effect of MR without concomitant mitral valve repair at the time of LVAD implant. Moreover, little is known about alterations in RV function, severity of MR, pulmonary artery pressure in mid term post LVAD implant.

Methods: From 2007 to 2017, 567 continuous flow LVAD implants were performed, of which, HeartMate II (HM2) or HeartWare VAD (HVAD) implant without mitral valve repair as bridge to transplant or destination therapy were included. Patients enrolled into HeartMate 3 study were excluded. Based on pre-operative transthoracic echocardiogram (TTE), MR severity was determined and patients were divided into two groups: S-MR (moderate to severe MR) and M-MR group (mild or less MR). Demographics, pre-operative RV function (pulmonary artery pulsatility index (PAPI) and right ventricular stroke work index (RVSWI)), follow-up TTE (immediate post-op and latest follow-up with pulmonary artery systolic pressure (PASP)) and survival were analyzed.

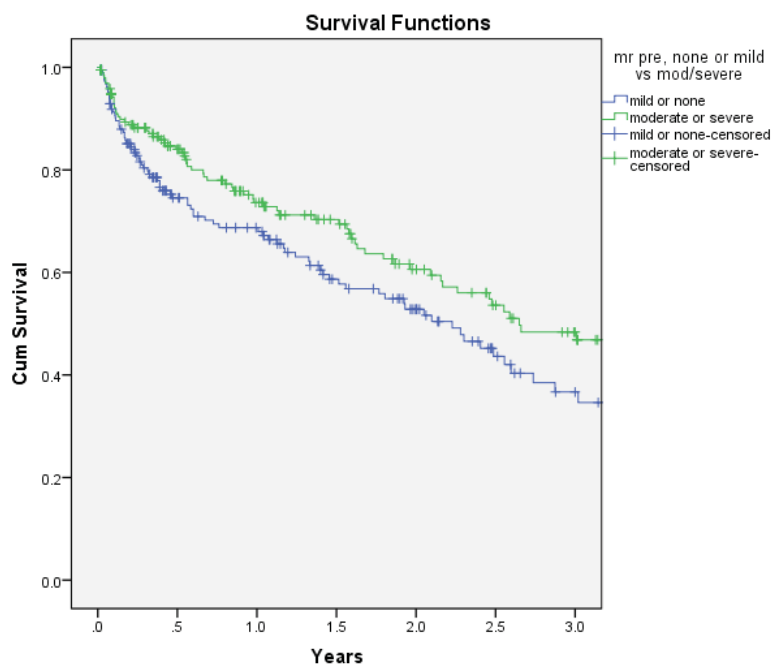
Results: The S-MR group included a total of 207: 177 (86%) HM2 and 30 (14%) HVAD, while M-MR had a total of 199: 167 (84%) HM2 and 32 (16%) HVAD. Average follow-up period by TTE was 14 months (2–78, median 13.7, IQR 21). Gender distributions, ages or INTERMACS level were similar in both groups. Pre-operative PAPI and RVSWI were similar in both groups, and post-operative RVAD requirements were similar. Overall survival during the LVAD support was 3.2 years in S-MR and 2.5 years in M-MR ($p = .06$). Heart transplants were performed in 23 (66%) in S-MR and 12 (34%) in M-MR, and results were similar. By analyzing immediate postoperative TTE MR degree improved in 90% patients in S-MR group and 48% in M-MR group which was sustained in the late follow up. PASP by TTE were similar in both groups. These outcomes were similar when patients with severe MR were compared to mild or less MR.

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Conclusion: This study demonstrated that LVAD implant without moderate to severe MR correction had no adverse outcome compared to less MR patients in short and mid term. Despite differences in MR severity, once patients are supported by LVAD, RV function, PA pressure and mid-term survival may become irrelevant, which further question the necessity for surgical correction of MR at the time of LVAD implant.

Invited Speaker:

Reducing the Burden of Adverse Events with MCS: Is Better Technology the Answer?

**Ashish S. Shah, Vanderbilt University*



128. Extended Duration Counterpulsation with a Minimally Invasive Circulatory Assist Device: Initial Clinical Experience

*Valluvan Jeevanandam, Tae Song, David Onsager, Takeoshi Ota, Colleen Jurisek, Thomas Lammy, Nir Uriel

University of Chicago, Chicago, IL

Invited Discussant: *Ahmet Kilic

Objective: The NuPulseCV iVAS is a novel counterpulsation heart assist system delivered via the subclavian artery and powered by a portable driver. It is designed for recovery, bridge to transplantation (BTT), or for prolonging medical therapy. We report the initial clinical experience with this minimally invasive and non-obligatory device.

Methods: We reviewed data from the completed First in Human (FIH) and the ongoing Feasibility prospective, non-randomized single arm, FDA-approved trials. The FIH trial consisted of UNOS 1a or 1b listed patients. The Feasibility trial enrolled listed as well as potential transplant candidates. The primary endpoint was to assess survival to transplant or stroke-free survival at 30 days.

Results: Twenty-three (23) patients were enrolled and 22 (95.6%) were treated with iVAS. The average age was 58.2 ± 6.8 years; 82% were male; 43% had ischemic cardiomyopathy; 6 were INTERMACS (IM) 2, 14 were IM 3 and 3 were IM 4. The mean LVEF was 24.1%, LVIDD was 7.5 mm and 72% had moderate or severe MR. There were no intraoperative complications. ICU stay after implant was 5.3 ± 5.9 days. Twenty one out of 22 patients successfully meet study endpoint. One patient required escalation of mechanical support prior to successful transplant. There were no deaths or thromboembolic events; post-implant complications included temporary neuropathy (n = 2) and reoperation for device adjustment (n = 3). No intra-operative blood transfusions were required. Seven patients were discharged home.

Conclusions: This study demonstrates a high rate of successful outcomes with an excellent risk to benefit profile. This initial clinical experience reveals that the iVAS can be successfully inserted in a minimally invasive approach, provide hemodynamic support, can be interrupted for short periods, and allows for home discharge. A multicenter trial to investigate effectiveness and safety is underway.

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129. Management of Severe Mitral Regurgitation During Left Ventricular Assist Device Implantation — Repair or Not Repair?

Amit Pawale, Shinobu Itagaki, Aditya Parikh, Sean Pinney, *David H. Adams,

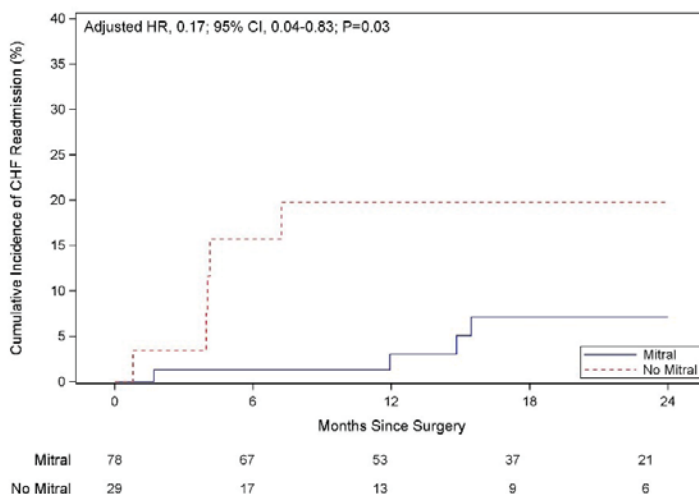
*Anelechi C. Anyanwu

Mount Sinai Medical Center, New York, NY

Invited Discussant:

Background: Traditionally, severe mitral regurgitation (MR) is not treated surgically during left ventricular assist device (LVAD) implantation on the assumption that unloading the left ventricle makes MR inconsequential. We adopted an alternative approach of systematic repair of severe MR at the time of LVAD implantation and report our experience.

Methods: We performed Mitral Valve Repair (MVR) on 78 consecutive patients with severe MR undergoing LVAD at our institution. We compared outcomes of these patients to 28 historical controls with severe MR from the immediate preceding period where the MR was not treated. For the entire cohort, mean age was 58 y, 83% male and 37% were in INTERMACS Class I or II. Mitral valve repair was done either with ring annuloplasty, using a beating heart, transeptal approach (n = 62), or with edge-to-edge technique done transapically via the ventriculotomy (n = 16). Median follow-up time was 18 months with censoring at transplantation or time of analysis.



Results: Patients who underwent MVR were younger than non-MVR group (55 vs. 63 years, $P = 0.001$), but otherwise had similar preoperative demographics and hemodynamics. Notably, both groups had significant pulmonary hypertension (Pulmonary Vascular Resistance (PVR) 4.1 vs. 3.5 Units $P = 0.37$). Tricuspid valve repair used more in the MVR group (87.2 vs. 67.9%, $P < 0.001$) and mean cardiopulmonary bypass time was longer (142 vs. 97 minutes, $P < 0.001$) compared to controls. The incidence of early major adverse events was similar in MVR compared to non-MVR patients, including 30 day mortality (2.6 vs. 3.6%, $P = 0.78$), stroke (2.6 vs. 3.6%, $P = 0.78$), and reoperations



for bleeding (6.4 vs. 7.1%, $P = 0.89$). No RVAD was used in either group. Pre-discharge transthoracic echocardiography confirmed absence of greater than mild MR in all MVr patients. Cardiac catheterization done within 3 to 6 months of surgery showed a tendency to greater reduction in pulmonary artery systolic pressure in MVr group compared to non-MVr (37 vs. 43 mmHg; baseline 56 Vs 57 mmHg, $P = 0.05$). The cumulative incidence of readmission due to congestive heart failure at 2 years were 7.1% (95% CI, 6.9–37.3%) in mitral group and 19.7% (95% CI, 2.2 to 16.0%) in non-mitral group (adjusted hazard ratio 0.17, $P = 0.03$). The survival at 2 years were 90.2% (95% CI, 78.3–95.7%) in mitral group and 79.7% (95% CI, 57.2–91.2) in non-mitral group (adjusted hazard ratio 0.50, $P = 0.29$).

Conclusion: Concurrent MVr at the time of LVAD implantation can be done safely without increase in perioperative adverse events. Our data suggest MVr may have potential benefit in terms of superior reversal of pulmonary hypertension and reduction in right heart failure. Surgical treatment of MR at time of LVAD warrants further investigation, and may be worth particular consideration in patients with high PVR and in those expected to be supported with the LVAD for prolonged time period.

130. Minimally Invasive Left Ventricular Assist Device Implantation May Be Associated with Improved Survival in High-Risk Patients

Chetan Pasrija¹, Mariem Sawan¹, Erik Sorensen¹, Hannah Voorhees¹, Van-Khue Ton¹, Erica Feller¹, David J. Kaczorowski¹, *Bartley P. Griffith¹, *Si M. Pham², Zachary N. Kon¹
¹University of Maryland, Baltimore, MD; ²Mayo Clinic, Jacksonville, FL

Invited Discussant: ♦Edwin McGee

Objectives: Despite substantial improvement in overall outcomes after left ventricular assist device (LVAD) implantation over the past 2 decades, high-risk recipients are still associated with a high rate of morbidity and mortality. We hypothesized that a minimally invasive approach to centrifugal continuous-flow LVAD implantation would be associated with improved survival compared to a conventional approach in this high-risk cohort.

Methods: All consecutive high-risk LVAD recipients (2013–2017) that underwent centrifugal continuous-flow LVAD implantation (HeartWare, Framingham, MA) at a single center were retrospectively reviewed. Patients were considered high-risk if they were classified as INTERMACS 1, or required a preoperative temporary VAD/ veno-arterial extracorporeal membrane oxygenation (VA-ECMO). The presence of an intra-aortic balloon pump alone was not sufficient to categorize a recipient as high-risk. Patients were stratified by surgical approach: conventional sternotomy (CS) and minimally invasive left thoracotomy with hemi-sternotomy (LTHS). The primary outcome was 1-year survival, assessed by the Kaplan-Meier method. Secondary outcomes included incidence of severe RV failure and temporary RVAD implantation.

Results: 23 patients (CS: 12, LTHS: 11) were identified, with a median age of 55 years. 5/12 (42%) patients in the CS cohort were INTERMACS 1, with 9/12 (75%) requiring preoperative temporary VAD or VA-ECMO support. All patients in the LTHS cohort were INTERMACS 1, with 4/11 (36%) requiring preoperative VAD or VA-ECMO support. Overall, the median preoperative Kormos score and HeartMate II mortality score were

TUESDAY, MAY 1

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2.3 (IQR: 1.8–4.8) and 1.8 (IQR: 1.2–2.5), respectively, with no significant difference between the 2 groups. Preoperative end-organ dysfunction was also similar between the 2 groups. While operative time was not significantly different (CS: 5.8 vs. LTHS: 4.9 hours, $p = \text{NS}$), cardiopulmonary bypass time was significantly shorter in the LTHS group (126 vs. 64 minutes, $p = 0.002$). The median days on inotropes were similar between the 2 groups. However, there was a trend towards decreased intensive care unit length of stay (LOS) (15 vs. 7, $p = 0.08$), ventilator time (140 vs. 40 hours, $p = 0.12$), and hospital LOS (28 vs. 27, $p = 0.21$) in the LTHS group. Moreover, there was a nominal, but non-statistically significant, increase severe, postoperative right ventricular dysfunction (67% vs. 36%, $p = 0.22$) and a significant increase in temporary RVAD support in the CS group (50%, vs. 0%, $p = 0.01$). Kaplan-Meier 1-year estimated survival was significantly higher in the LTHS group (41% vs. 91%, $p = 0.04$).

Conclusions: In this cohort, minimally invasive VAD implantation appears to be associated with improved survival compared to conventional VAD implantation. Future, prospective analyses further investigating the benefits of this approach may be warranted.

5:36 pm **Adjourn**

TUESDAY EVENING, MAY 1, 2018

5:40 pm –
7:10 pm

AATS Surgical Cinema: Adult Cardiac

Ballroom 20A, SDCC

See page 85 for description.

5:40 pm –
7:30 pm

AATS Surgical Cinema: Congenital

Room 24ABC, SDCC

See page 85 for description.

5:40 pm –
7:10 pm

AATS Surgical Cinema: General Thoracic

Room 24ABC, SDCC

See page 86 for description.