AATS *Centennial* 1917-2017

Reflecting on the Past.

Building our Future.

Always Learning.

AMERICAN ASSOCIATION
FOR THORACIC SURGERY
A Century of Modeling Excellence

SATURDAY AND SUNDAY SYMPOSIA

April 29 – May 3, 2017

Boston Hynes Convention Center
Boston, MA, USA

PRESIDENT & ANNUAL MEETING CHAIR
Thoralf M. Sundt, III

ANNUAL MEETING CO-CHAIRS
Robert D. Jaquiss & Bryan F. Meyers

In Collaboration With

AMERICAN SOCIETY OF EXTRACORPOREAL TECHNOLOGY
Lead - Collaborate - Educate - Care

55th International Conference

www.aats.org
www.amsect.org

Welcome to the AATS 2017
Saturday Courses and Sunday Symposia
In Collabarotion with the
American Society of Extracorporeal Technology

SATURDAY COURSES | APRIL 29

Your Saturday all-access registration grants you admittance to all of the sessions taking place on Saturday from 8:00 AM to 3:30 PM in the Hynes Convention Center.

Adult Cardiac Skills	**Ballroom ABC, Level 3, Hynes**
Congenital Skills	**Room 311, Level 3, Hynes**
General Thoracic Skills	**Room 312, Level 3, Hynes**
Optimal Therapies for End-Stage Thoracic Organ Failure	**Room 302/304, Level 3, Hynes**
Surgical Ethics Course	**Room 306, Level 3, Hynes**
Survival Guide for the Cardiothoracic Surgical Team	**Rooms 308, 309, 310, Level 3, Hynes**

Hands-On Sessions | 4:00 PM – 6:00 PM

Hands-On sessions require a separate registration from the Saturday all-access registration. If you registered for one of the Hands-On courses you will see either an "AHOA, AHOM, AHOP, AHOT, AHOV, CHO, THO, GHOE, GHOP" printed on the top right-hand corner of your badge. Those who do not have the code printed but would like to attend, should visit the registration area located on Level 2 outside of Exhibit Hall C at the Boston Hynes Convention Center

Adult Cardiac Hands-On	**Grand Ballroom, Sheraton Hotel**	*Not for Credit*
Congenital Hands-On	**Constitution A, Sheraton Hotel**	*Not for Credit*
General Thoracic Hands-On	**Back Bay A and B, Sheraton Hotel**	*Not for Credit*
Optimal Therapies for End-Stage Thoracic Organ Failure Hands-On	**Back Bay C, Sheraton Hotel**	*Not for Credit*

SUNDAY AATS/STS POSTGRADUATE SYMPOSIA | APRIL 30

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

AATS/STS Adult Cardiac Surgery Symposium	**Ballroom ABC, Level 3, Hynes**
AATS/STS Congenital Heart Disease Symposium	**Room 312, Level 3, Hynes**
AATS/STS General Thoracic Surgery Symposium	**Room 302/304, Level 3, Hynes**
Interprofessional Cardiothoracic Team Symposium	**Room 306, Level 3, Hynes**

AATS/AmSECT Welcome Reception | 5:00 PM – 7:00 PM in the AATS Exhibit Hall, Level 2, Hynes

Join us as we officially celebrate the opening of this year's AATS Centennial and AmSECT 55th International Conference. Visit with our valued exhibitors and supporters in the AATS Exhibit Hall where you will learn cutting edge techniques and discover groundbreaking new products while networking with other attendees.

The AATS 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 2017 Mitral Conclave and 2016 Aortic Symposium
- AATS Resident Poster Competition
- AATS Perioperative & Team-Based Care Poster Competition

AATS/AmSECT Planning Committee

*Robert D. Jaquiss, *Co-Chair*
*Bryan F. Meyers, *Co-Chair*
*David H. Adams
+Ron Angona
*Matthew Bacchetta
David Bichell
*Duke E. Cameron
+William J. DeBois
*Volkmar Falk
+David Fitzgerald
*Seth D. Force
Steven Gottesfeld
Katherine J. Hoercher
*Shaf Keshavjee
*Moishe Liberman
*Virginia R. Litle
*Bohdan Maruszewski
*Carmelo A. Milano
*Michael E. Mitchell
*Marc R. Moon
*Hitoshi Ogino
*Giovanni Stellin
*Vinod H. Thourani
+Rich Walczak
*Glenn J. Whitman
Kazuhiro Yasufuku
*Kenton J. Zehr

*AATS Member **AATS New Member +AmSECT Member

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 educational support:

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

Platinum Level
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Corporate Support
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Biostage
Getinge
Gore & Associates
Johnson & Johnson Medical Devices Companies
LSI Solutions
Teleflex
Terumo
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 **31.5** ***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 13.75 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 estimated that this educational activity will be designated for 45 Category 1 CEUs. *Please go to AmSECT.org for a final CEU count.*

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

Saturday, April 29, 2017 – up to 6.25 hours (CME, AAPA, ABCP)
Adult Cardiac Skills, up to 6.5 hours
Congenital Skills, up to 6 hours
General Thoracic Skills, up to 6 hours
Cardiothoracic Transplant and Mechanical Circulatory Support of Heart and Lung Failure, up to 6.25 hours
Surgical Ethics Course, up to 6 hours
Survival Guide: Your First Night on Call, not for credit

Sunday, April 30, 2017 – up to 7.5 hours (CME, AAPA, ABCP)
Adult Cardiac Surgery, up to 7.5 hours
Congenital Heart Disease, up to 7 hours
General Thoracic Surgery, up to 7.25 hours
Interprofessional Cardiothoracic Team Symposium, up to 7 hours

Monday, May 1, 2017 – up to 7 hours (CME, ABCP)
Plenary Scientific Session, Presidential Address,
up to 2.75 hours
Honored Guest Lecture, not for credit
Ethics Forum Luncheon, up to 1.5 hours
C. Walton Lillehei Resident Forum, not for credit
Adult Cardiac Surgery Simultaneous Session, up to 2.75 hours
Controversies in CABG 2017, up to 2.75 hours
Congenital Heart Disease Simultaneous Session, up to 2.5 hours
General Thoracic Surgery Simultaneous Session, up to 2.5 hours
Perioperative Care Simultaneous Session, up to 2.5 hours

Tuesday, May 2, 2017 – up to 6.75 hours (CME, ABCP)
Cardiac Surgery Forum, up to 1.25 hours
General Thoracic Surgery Forum, up to 1.25 hours
Adult Cardiac Emerging Technologies and Techniques / Video Session, up to 1.25 hours
Congenital Emerging Technologies and Techniques / Video Session, up to 1.25 hours
General Thoracic Emerging Technologies and Techniques / Video Session, up to 1.75 hours
Plenary Scientific Session, Basic Science Lecture, up to 2.5 hours
Transcatheter Valve Therapies, up to 1.5 hours
Adult Cardiac Surgery Simultaneous Session, up to 1.5 hours
MCS/Transplant Session, up to 1.5 hours
ELSO at AATS, up to 1.5 hours
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

*AATS Member **AATS New Member +AmSECT Member

Wednesday, May 3, 2017 – up to 4 hours (CME, ABCP)
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 2.25 hours
Adult Cardiac Masters of Surgery Video Session, up to 1.75 hour
Congenital Masters of Surgery Video Session, up to 1.75 hours
General Thoracic Masters of Surgery Video Session, 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 2 outside of Exhibit Hall C at the Boston Hynes 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/aat171/.

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 (AATS) that any individual who is in a position to control or influence the content of an educational activity to disclose all relevant financial relationships or affiliations. All identified conflicts of interest must be resolved and the educational content thoroughly vetted by AATS for fair balance, scientific objectivity, and appropriateness of patient care recommendations. 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 commercial support. The following faculty members do not plan on discussing unlabeled/investigational uses of a commercial product.

*Matthew Bacchetta
*David Bichell
*Duke E. Cameron
*Volkmar Falk
*Seth D. Force
Steven Gottesfeld
Katherine J. Hoercher
*Robert D. Jaquiss
*Virginia R. Litle
*Bohdan Maruszewski
*Hitoshi Ogino
*Giovanni Stellin
*Kenton J. Zehr

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

*David H. Adams	The Icahn School of Medicine at Mount Sinai receives royaltie from Edwards Lifesciences and Medtronic; National Co-PI with Medtronic and NeoChord
*Shaf Keshavjee	Consultant with Lung Bioengineering Inc.; Shareholder with Perfusix Canada Inc., XOR Labs Toronto; Research Support Recipient from United Therapeutics, XVIVO Perfusion Inc.
*Moishe Liberman	Research Support from Ethicon, Medtronic, Boston Scientific, Cook Medical
*Bryan F. Meyers, *Co-Chair*	Consultant with Varian Medican Systems; Research Support from Ethicon
*Carmelo A. Milano	Consultant with HeartWare, Inc.
*Michael E. Mitchell	Co-Founder of Ariosa Diagnostics, TAI Diagnostics, MDInterative

*Marc R. Moon	Speaker with Edwards Lifesciences
*Thoralf M. Sundt, III	Advisor with Thrasos Therapeutics
*Vinod H. Thourani	Advisor with Edwards Lifesciences, Abbott Medical
*Glenn J. Whitman	Research Support from Abbott Nutrition
Kazuhiro Yasufuku	Consultant with Olympus Corporation, Olympus American, Inc, Intuitive Surgical, Inc.; Research Support from Siemens, Veran Medical

Faculty

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

*Michael Acker
Anil K. Agarwal
Cara Agerstrand
Hakan Akinturk
+Cory Altwardt
+Ron Angona
*Anelechi Anyanwu
+Dana Apsel
*Abbas Ardehali
*Rakesh C. Arora
*Carl L. Backer
*Vinay Badhwar
+Rob Baker
*David Barron
David Barron
*David P. Bichell
Emma Birks
*Shanda H. Blackmon
*Daniel J. Boffa
Mary Beth Brady
*John W. Brown
*Raphael Bueno
*Harold M. Burkhart
*Duke E. Cameron
*Andrew C. Chang
*Edward P. Chen
+Michael Colligan
*Gail E. Darling
*Tirone E. David
Ryan R. Davies
*Joseph A. Dearani
+William J. DeBois
*Pedro J. del Nido
Eva Maria Delmo Walter
*Frank C. Detterbeck
Roberto Di Bartolomeo
Melanie A. Edwards
+Susan Englert
John W. Entwistle
Kathleen Fenton
*Felix G. Fernandez
+David Fitzgerald
*Raja M. Flores
*Charles D. Fraser
*Richard K. Freeman
*Stephen E. Fremes
*J. William Gaynor
*Sebastien Gilbert
Don Goldmann
Steven M. Gottesfeld
*Bartly P. Griffith
*Frank L. Hanley
Alex B. Haynes
Mark Hazekamp
+Ashley Hodge
Katherine J. Hoercher
*Wayne L. Hofstetter
*Viktor Hraska
*Tain-Yen Hsia
*Michel N. Ilbawi
*Michael T. Jaklitsch
*Robert D. Jaquiss
*Douglas Johnston
David S. Jones
Mark R. Katlic
+Tom M. Klein
Damien J. LaPar
Stephen R. Large
*Harold L. Lazar
*Virginia R. Litle
Gabriel Loor
+Kimberly Madigan
Katsuhide Maeda
Audrey C. Marshall
Gerald Marx
+Greg Matte
*John E. Mayer
*Martin F. McKneally
+Craig McRobb
Justin Miller
*Susan D. Moffatt-Bruce
+Greg Mork
Christopher R. Morse
*Sudish C. Murthy
Patrick T. O'Gara
*Hitoshi Ogino
*Richard G. Ohye
*Mark B. Orringer
Harold C. Ott
*Francis D. Pagani
+Altaf Panjwani
+Theron A. Paugh
*Alberto Pochettino
Peter Provonost
*Varun Puri
*John D. Puskas
+Jim Reagor
*V. Mohan Reddy
*Hermann Reichenspurner
+Brian Reinbold
*David C. Rice
+Jeffery B. Riley
+Alex Robertson
Joseph Rogers
+Tami Rosenthal
Jens C. Rückert
*Robert M. Sade
*Hans-Joachim Schaefers
*Hartzell V. Schaff
Paul H. Schoof
+Lucas A. Schroedl
*Matthew J. Schuchert
*Ashish S. Shah
David M. Shahian
+Kenneth Shann
+Colin J. Shaughnessy
+Mark Shepard
Timothy C. Slesnick
*Nicholas G. Smedira
*Craig R. Smith
*Joshua R. Sonett
+Kyle Spear
*Thomas L. Spray
Sandra Starnes
Matt Steliga
*Giovanni Stellin
*James Tatoulis
Betty C. Tong
*Dirk E. Van Raemdonck
+Craig Vocelka
+Rich Walczak
*Garrett L. Walsh
*Tom J. Watson
Judson Williams
*Cameron D. Wright
*Kenton J. Zehr
*Joseph B. Zwischenberger

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

+Desiree Bonadonna	*Off-label/unapproved use discussion* - off label use of medical devices for ECMO
*Christopher A. Caldarone	*Off-label/unapproved use discussion* - losartan
*Yolonda L. Colson	*Off-label/unapproved use discussion* - ICG for lymphatic mapping
*Kirk R. Kanter	*Off-label/unapproved use discussion* - Gore-tex bifurcated aortoiliac bypassgraft
*Brian E. Kogon	*Off-label/unapproved use discussion* - Gore-tex bifurcated aortoiliac bypassgraft
+Tami R. Rosenthal	*Off-label/unapproved use discussion* - Gore-tex bifurcated aortoiliac bypassgraft
Marc Sussman	*Off-label/unapproved use discussion* - I will discuss the use of drugs in resuscitation that may be unlabeled uses

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

*David H. Adams	The Icahn School of Medicine at Mount Sinai receives royaltie from Edwards Lifesciences and Medtronic; National Co-PI with Medtronic and NeoChord
*Gorav Ailawadi	Consultant with Abbott Vascular, St. Jude Medical, Cephea, Medtronic, Atricure
*Nasser K. Altorki	Stock Shareholder with Angiocrine Bioscience; Research Support from Astra Zeneca PLC, Roche
*Matthew Bacchetta	Consultant with Breethe
*Michael Borger	Speaker with Edwards Lifesciences, Medtronic, St Jude Medical. Consultant with Edwards Lifesciences, Medtronic, Cyrolife.
*Christian Brizard	Consultant and Stock Shareholder with Admedus Australia
Charles H. Brown	Consultant with Medtronic
Daniel Burkhoff	Consultant with HeartWare division of Medtronic, Cardiac Implants LLC, IMPULSE Dynamics, Sensible Medical
*Joseph S. Coselli	Speaker with Maquet Getinge Group; Consultant with WL Gore & Associates, Medtronic Inc., Vascutek Terumo; Grant/Research Support from Vascutek Terumo, Edwards Lifesciences, Medtronic Inc, WL Gore & Associates, Bolton Medical, Cytosorbents, Baxter Healthca
*Marcelo Cypel	Consultant with United Therapeutics; Shareholder with Perfusix Canada, XOR Labs; Research Support from Xvivo Perfusion
*Thomas A. D'Amico	Consultant with Scanlan
Mani A. Daneshmand	Speaker with Maquet
James E. Davies	Consultant with Edwards Lifesciences. Advisor with Medtronic.
*Steven R. DeMeester	Speaker with Bard/Davol, Novadaq, Gore; Consultant with C2 Therapeutics, Bard/Davol; Stock Shareholder with Novadaq; Research Support from Bard/Davol, C2 Therapeutics, Gore
*Gilles D. Dreyfus	Speaker with Edwards Lifesciences, Medtronic

Michael I. Ebright	Consultant with Medtronic
*Mark K. Ferguson	Royalties from and Co-Editor with STS, Elsevier, Springer, CTSNet
*Hiran C. Fernando	Consultant with CSA Medical; Research Support from CSA Medical; Medical Monitor with Galil Medical
*Michael E. Halkos	Advisor with Medtronic Inc
*James Huang	Research Support from Bristol Myers Squibb
*Valluvan Jeevanandam	Advisor with Thoratec St. Jude
*Shaf Keshavjee	Consultant with Lung Bioengineering Inc.; Shareholder with Perfusix Canada, Inc., XOR Labs Toronto; Research Support from Uniter Therapeutics, XVIVO Perfusion Inc
*Michael J. Mack	Co-PI with Edward Lifesciences and Abbott Vascular
*Carmelo A. Milano	Consultant with HeartWare, Inc.
*D. Craig Miller	Consultant with Medtronic; Co-PI with Abbott Vascular; PI with Edwards Lifesciences, Medronic
Daniela Molena	Speaker with Novadaq Inc
*Marc R. Moon	Speaker with Edwards Lifesciences
*Yoshifumi Naka	Consultant with St. Jude Medical/Abbot
*Patrick Perier	Speaker with Edwards Lifesciences
*Gaetano Rocco	Speaker with Baxter, Medtronic, Ethicon; Consultant with Scanlan; Research Support from Baxter, Medtronic
*Mark Ruel	Research Support from Medtronic, Inc; Proctor with Medtronic, St. Jude Medical
*Edward G. Soltesz	Speaker with St. Jude Medical, Abiomed, Atricure; Recieves Royalties from Jace Medical
*Brendon M. Stiles	Stock Shareholder with Pfizer GEP
*Thoralf M. Sundt, III	Advisor with Thrasos Therapeutics
*Rakesh M. Suri	Research Support from Sorin, Edwards Lifesciences, Abbott, St. Jude; Co-PI and Clinical Steering Committee Member with Abbott; Steering Committee Member with St. Jude Medical; National PI with Sorin
*Wilson Y. Szeto	Consultant with Microinterventional Devices; Research Support from Edwards Lifesciences, Medtronic, Bolton Medical, Boston Scientific
*Vinod H. Thourani	Advisor with Edwards Lifesciences, Abbott Medical
*James S. Tweddell	Advisor with CorMatrix
Frank Van Praet	Consultant with Teaching, Proctoring
*Michael J. Weyant	Consultant with Covidien Inc.; Grant/Research Support from XVIVO Inc.
*Glenn J. Whitman	Research Support from Abbott Nutrition

*Kazuhiro Yasufuku	Consultant with Olympus America Inc, Johnson and Johnson, Covidien; Research Support from Olympus Corporation, Siemens, Veran Medical Systems

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

Andrea Colli	Travel Grants from NeoChord Inc; *Off-label/unapproved use discussion* - Neochord, Harpoon
Farouc A. Jaffer	Consultant with Abbott Vascular, Boston Scientific; Research Support from Siemens, Canon; *Off-label/unapproved use discussion* - Coronary Stents for PCI - some indications made not be labeled
Patrick McConnell	Speaker with Admedus; Consultant with ClearFlow Inc.; *Off-label/unapproved use discussion* - Cormatrix ECM
Edwin McGee	Consultant with HeartWare/Medtronic; *Off-label/unapproved use discussion* - Alternate implant techniques for HVAD
Nahush A. Mokadam	Consultant with HeartWare and St Jude; Research Support from HeartWare, St Jude, SynCardia; *Off-label/unapproved use discussion* - IABP, temporary VAD, ECMO
*Gert D. Victor Pretorius	Speaker with Medtronic and Saint Jude Medical; *Off-label/unapproved use discussion* - Use of HVAD system as Right ventricular support
*Eric E. Roselli	Speaker with Vascutek, Cook, LivaNova, St Jude; Consultant with Gore, Bolton, Medtronic, Cryolife; Advisor with Medtronic; Research Support from Gore; *Off-label/unapproved use discussion* - Off label uses of devices for aortic valve replacement and off label and investigation use of devices for aortic arch repair.

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 Lauren Kelly Coughlin, Charlotte LeTourneau, Lauren Ruggiero, Cindy VerColen

Adult Cardiac Skills: *100 Years of Training - More Skills Still Needed!* **Ballroom ABC, Hynes**
Saturday, April 29, 2017 | 8:00 AM - 3:30 PM
**Course Chair: ***Kenton J. Zehr, *Johns Hopkins Hospital*
**Course Co-Chair: ***Volkmar Falk, *Deutsches Herzzentrum Berlin*
Course Co-Chair: +David Fitzgerald, *Medical Center of South Carolina*

8:00 AM - 8:10 AM	**Welcome and Introduction**
	Controversies in Mitral Valve Surgery
8:10 AM - 8:25 AM	**Two Leaflets are No Problem - Bileaflet Mitral Valve Repair** *Patrick Perier, *Herz und Gefass Klinik*
8:25 AM - 8:40 AM	**Small Cut No Pain - Endoscopic Mitral Valve Repair** Frank Van Praet, *Onze Lieve Vrouw Ziekenhuis*
8:40 AM - 8:55 AM	**Right Perfusion Management makes Mitral Surgery Easy!** +Michael Colligan, *Baylor St. Luke's Medical Center*
8:55 AM - 9:10 AM	**Let It Beat - Transapical Artificial Chordae Implantation** Andrea Colli, *University of Padova*
9:10 AM - 9:25 AM	**Panel Discussion**
9:25 AM - 9:40 AM	**Coffee Break**
9:40 AM - 9:55 AM	**The Surgical Tool Box for Aortic Dissection** *Alberto Pochettino, *Mayo Clinic*
9:55 AM - 10:10 AM	**The Perfusionist's Tool Box for Aortic Dissection** +David Fitzgerald, *Medical Center of South Carolina*
10:10 AM - 10:25 AM	**You Do Not Need Three Leaflets for an Aortic Valve Repair - AVR in Bicuspid Aortic Valve** *Hans-Joachim Schaefers, *Saarland University*
10:25 AM - 10:40 AM	**Aortic Arch Reconstruction - No Longer a Mystery** *Thoralf M. Sundt, *Massachusetts General Hospital* +Kenneth Shann, *Massachusetts General Hospital*
10:40 AM - 10:55 AM	**Panel Discussion**
	Imaging in Cardiac Surgery
10:55 AM - 11:10 AM	**Image Guidance in TEVAR - How to make Aortic Stenting easy** *Eric E. Roselli, *Cleveland Clinic*
11:10 AM - 11:25 AM	**Transfemoral TAVR - A case for the surgeon** *Wilson Y. Szeto, *University of Pennsylvania*
11:25 AM - 11:40 AM	**TEE: The Eye of the Repair for the Surgeon** Mary Beth Brady, *Johns Hopkins University*
11:40 AM - 11:55 AM	**Panel Discussion**
12:00 PM - 1:00 PM	**Combined Luncheon Speaker** **Remain in Ballroom ABC, Hynes** *W. Gerald Austen, *Massachusetts General Hospital*

Coronary Surgery

1:00 PM - 1:15 PM **There are many ways to Rome – Internal Thoracic Artery Graft Configurations**
*Kenton J. Zehr, *Johns Hopkins Hospital*

1:15 PM - 1:30 PM **The Graft with Difficult Reputation - The News on Radial Arteries**
*James Tatoulis, *Royal Melbourne Hospital*

1:30 PM - 1:45 PM **Best of Both Worlds - Hybrid Revascularization (MIDCAB+PCI)**
*John D. Puskas, *Mount Sinai Beth Isreal*

1:45 PM - 2:00 PM **The Modernist Way - Minimal Access OPCAB**
*Mark Ruel, *University of Ottawa Heart Institute*

2:00 PM - 2:15 PM **Panel Discussion**

Complex Case Presentations

2:15 PM - 2:30 PM **The Second Fix - Redo Mitral Valve Repair**
*David H. Adams, *Mount Sinai Medical Center*

2:30 PM - 2:45 PM **When Everthing Falls Apart - The Infected Aortic Root**
*Tirone E. David, *Toronto General Hospital*

2:45 PM - 3:00 PM **Post Stent Disaster - Complex TAA repair after TEVAR**
*Joseph S. Coselli, *Baylor College of Medicine*

3:00 PM - 3:15 PM **Beyond a simple TAVR - Complex Transcatheter Valve Therapies**
*Vinod H. Thourani, *Emory University*

3:15 PM - 3:30 PM **The Ultimate AF Fix - Cox-Maze IV or Cut-and-Sew Cox Maze III**
*Marc R. Moon, *Washington University*
*Hartzell V. Schaff, *Mayo Clinic*

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Congenital Skills: *Mastery of Common and Uncommon Challenges* **Room 311, Hynes**
Saturday, April 29, 2017 | 8:00 AM - 3:30 PM
**Course Chair: ***David Bichell, *Vanderbilt University/Children's Hospital*
**Course Co-Chair: ***Bohdan Maruszewski, *Children's Memorial Health Institute*
Course Co-Chair: +Ron Angona, *University of Oklahoma Health Sciences Center*

7:55 AM - 8:00 AM **Welcome and Introduction**

8:00 AM - 8:15 AM **Fix the Valve: Delaminate and Rehabilitate the Dysplastic Pulmonary Valve**
*Giovanni Stellin, *University of Padova*

8:15 AM - 8:30 AM **Build a Valve: Monocusp Pulmonary Valve Construction**
*John W. Brown, *Indiana University*

8:30 AM - 8:45 AM **Build a Valve: A Freehand Valved Conduit Construction**
Patrick McConnell, *Nationwide Children's Hospital*

8:45 AM - 9:00 AM **Forget the Valve: Conduit-free Repair for Truncus Arteriosus**
David Barron, *Birmingham Children's Hospital*

9:00 AM - 9:15 AM **Deploy a Valve: Hybrid Pulmonary Valve Implantation**
*Joseph A. Dearani, *Mayo Clinic*

9:15 AM - 9:30 AM **Optimize Recovery: Simplified Modified Ultrafiltration at Boston Children's Hospital**
+Greg Matte, *Boston Children's Hospital*

9:30 AM - 10:00 AM **Coffee Break**

Part A: Optimizing Fontan Design and Construction, Minimizing the Insult of Surgery

10:00 AM - 10:15 AM **Set up the Fontan: Hemifontan as the Second Stage**
*Thomas L. Spray, *Children's Hospital of Philadelphia*

10:15 AM - 10:30 AM **Improve the Fontan: The "Y" Graft**
*Kirk R. Kanter, *Emory University*

10:30 AM - 10:45 AM **Redo the Fontan: Fontan Conversion**
*Carl L. Backer, *Lurie Children's Hospital of Chicago*

Part B: Optimizing Perfusion

10:45 AM - 11:00 AM **Reduce the Physiologic Insult: Circuit Miniaturization**
+Ron Angona, *University of Oklahoma Health Sciences Center*

11:00 AM - 11:15 AM **When Less is More: Nationwide Children's Hospital Approach to Bloodless Congenital Cardiac Surgery**
+Ashley Hodge, *Nationwide Children's Hospital*

Part C: How it Should Look: Imaging to Plan an Optimal Repair

11:15 AM - 11:30 AM **Plan your Fontan: Patient Specific, Image Based Computational Models to Plan an Optimal Fontan**
Timothy C. Slesnick, *Emory University*

11:30 AM - 11:45 AM **Plan your Arch: Computational Modeling of the Optimal Arch**
**Tain-Yen Hsia, *Great Ormond Street Hospital*

11:45 AM - 12:00 PM **Plan your Valvuloplasty: 3D Echo in Planning Atrioventricular Valve Repair**
Gerald Marx, *Boston Children's Hospital*

12:00 PM - 1:00 PM **Combined Luncheon Speaker** **Ballroom ABC, Hynes**
*W. Gerald Austen, *Massachusetts General Hospital*

Part A: Aortic Arch Reconstruction- Integrating Perfusion and Surcical Strategies

1:00 PM - 1:15 PM **Arch Reconstruction Strategy: The CHOP Approach**
*Thomas L. Spray, *Children's Hospital of Philadelphia*
+Tami Rosenthal, *Children's Hospital of Philadelphia*

1:15 PM - 1:30 PM **Arch Reconstruction Strategy: The Cincinnati Approach**
*James S. Tweddell, *Cincinnati Children's Hospital Medical Center*
+Jim Reagor, *Cincinnati Children's Hospital Medical Center*

1:30 PM - 1:45 PM **Arch Reconstruction Strategy: The Vanderbilt Approach**
*David P. Bichell, *Vanderbilt University/Children's Hospital*
+Tom M. Klein, *Vanderbilt University/Children's Hospital*

1:45 PM - 2:00 PM **The Redo Arch**
*Harold M. Burkhart, *University of Oklahoma*

2:00 PM - 2:15 PM **The Late-Presenting Arch**
*Robert D. Jaquiss, *Duke University*

2:15 PM - 2:30 PM **Connective Tissue Disorders: Special Considerations in Aortic Arch Reconstruction**
*Duke E. Cameron, *Johns Hopkins Hospital*

*AATS Member **AATS New Member +AmSECT Member

Part B: Atrioventricular Valve Repair Methods

2:30 PM - 2:45 PM **Ebstein's Tricuspid Repair: The Cone Repair Technique**
*Joseph A. Dearani, *Mayo Clinic*

2:45 PM - 3:00 PM **Techniques for Atrioventricular ValveRepair for the Single Ventricle Patient**
*Richard G. Ohye, *University of Michigan*

3:00 PM - 3:15 PM **Reoperative Valve Repair for Atrioventricular Septal Defect**
*Pedro J. del Nido, *Children's Hospital*

3:15 PM - 3:30 PM **Beyond Repair: Cylinder Replacement of the Mitral Valve in Infants**
Patrick McConnell, *Nationwide Children's Hospital*

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General Thoracic Clinical Decision Making and Skills: *Management of Thoracic Tumors in 2017* **Room 312, Hynes**
Saturday, April 29, 2017 | 8:00 AM - 3:30 PM
Course Chair: *Virginia R. Litle, *Boston University*
Course Co-Chair: Kazuhiro Yasufuku, *University of Toronto*

8:00 AM - 8:05 AM **Welcome and Introduction**
*Virginia R. Litle, *Boston University*

8:05 AM - 8:15 AM **Social Media and Your Cancer Patient: Are There Boundaries?**
*Brendon M. Stiles, *New York Presbyterian Hospital/Columbia University Medical Center*

Challenges in Pre-operative Cancer Management

8:15 AM - 8:35 AM **Enrollment of Patients in Clinical Trials: Shared Decision Making**
*Nasser K. Altorki, *New York Hospital-Cornell University*

8:35 AM - 8:50 AM **Smoking Cessation: How to Get Patients to Stop**
Matt Steliga, *University of Arkansas*

8:50 AM - 9:05 AM **Pre-habilitation of the Thoracic Patient**
*Michael T. Jaklitsch, *Brigham & Women's Hospital*

9:05 AM - 9:15 AM **From 3D to 5D Planning: Indications in Clinical Practice**
*Shanda H. Blackmon, *Mayo Clinic*

9:15 AM - 9:30 AM **Panel Discussion**

9:30 AM - 9:50 AM **Coffee Break**

9:50 AM - 10:10 AM **Sentinel Node Mapping in NSCLC: How I Do It**
*Yolonda L. Colson, *Brigham & Women's Hospital*

10:10 AM - 10:30 AM **Uniportal VATS**
*Gaetano Rocco, *NCI, Pascale Foundation*

10:30 AM - 10:50 AM **Prone Versus Lateral Minimally Invasive Esophagectomy**
Anil K. Agarwal, *Agrasen Hospital*

10:50 AM - 11:05 AM **Creative Esophageal Replacement: When the Stomach Won't Work**
*Wayne L. Hofstetter, *M.D. Anderson Cancer Center*

11:05 AM - 11:30 AM **Complex minimally Invasive Segmental Lung Resections**
*David C. Rice, *M.D. Anderson Cancer Center*

11:30 AM - 12:00 PM **Panel Discussion**

12:00 PM - 1:00 PM **Combined Luncheon Speaker** **Ballroom ABC, Hynes**
*W. Gerald Austen, *Massachusetts General Hospital*

Imaging in Thoracic Surgery

1:00 PM - 1:15 PM **Optimal Imaging after RFA and SBRT**
*Hiran C. Fernando, *Boston Medical Center*

1:15 PM - 1:30 PM **Image-based Therapy for GGO: Use of the Hybrid Operating Room to Localize**
*Raphael Bueno, *Brigham & Women's Hospital*

1:30 PM - 1:45 PM **Navigational Bronchoscopy**
Michael I. Ebright, *New York Presbyterian Hospital/Columbia University Medical Center*

1:45 PM - 2:00 PM **Spy for Imaging the Gastric Conduit**
Daniela Molena, *Memorial Sloan Kettering Cancer Center*

Rescue Strategies in Thoracic Surgery

2:00 PM - 2:15 PM **Airway Injury during Esophagectomy**
**Sebastien Gilbert, *The Ottawa Hospital*

2:15 PM - 2:30 PM **Vascular Injuries during VATS, RATS and Laps**
Melanie A. Edwards, *St. Louis University*

2:30 PM - 2:45 PM **Creating the Best Cervical Esophagostomy: Length and Location**
*Steven R. DeMeester, *Oregon Clinic*

2:45 PM - 3:00 PM **Endobronchial Valves and Postoperative Air Leaks**
*Varun Puri, *Washington University*

3:00 PM - 3:15 PM **Conduit Revision after MIE: The Difficult Conduit**
*Matthew J. Schuchert, *University of Pittsburgh*

3:15 PM - 3:30 PM **Panel Discussion**

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Cardiothoracic Transplant and Mechanical Circulatory Support of Heart and Lung Failure: **Room 302/304, Hynes**
Mastery of the Management of End Stage Heart and Lung Disease
Saturday, April 29, 2017 | 8:00 AM - 3:30 PM
Course Co-Chairs *Matthew Bacchetta, *Columbia University*
*Carmelo A. Milano, *Duke University*
+Rich Walczak, *Duke University*

8:00 AM - 8:15 AM **Welcome and Introduction**

Heart Transplant

Moderators: *Matthew Bacchetta, *Columbia University*
*Carmelo A. Milano, *Duke University*
+Rich Walczak, *Duke University*

Panelists:
*Abbas Ardehali, *University of California Los Angeles*
Stephen R. Large, *Papworth Hospital*
*Francis D. Pagani, *University of Michigan*
Joseph Rogers, *Duke University*
+Colin J. Shaughnessy, *Massachusetts General Hospital*

8:15 AM - 8:30 AM **Heart Transplantation Utilizing DCD Organs**
Stephen R. Large, *Papworth Hospital*

8:30 AM - 8:45 AM **Perfusion Storage for Cardiac Transplantation**
*Abbas Ardehali, *University of California Los Angeles*

8:45 AM - 9:00 AM **Ex-Vivo Heart – Maintaining a Near Physiologic State**
+Colin J. Shaughnessy, *Massachusetts General Hospital*

9:00 AM - 9:15 AM **Primary Graft Dysfunction: Incidence, Prevention and Management**
*Francis D. Pagani, *University of Michigan*

9:15 AM - 9:30 AM **New UNOS Heart Allocation System**
Jospeh Rogers, *Duke University*

9:30 AM - 9:45 AM **Clinical Experience with the Newest Durable Centrifugal LVAD**
*Yoshifumi Naka, *Columbia University*

9:45 AM – 10:00 AM **Review of ENDURANCE II Trial Results**
*Carmelo A. Milano, *Duke University*

10:00 AM - 10:30 AM **Coffee Break**

Lung Transplant
Moderators: *Matthew Bacchetta, *New York Presbyterian Hospital/Columbia University Medical Center*
*Carmelo A. Milano, *Duke University*
+Desiree Bonadonna, *Duke University*

Panelists:
*Marcelo Cypel, *Toronto General Hospital*
Mani A. Daneshmand, *Duke University*
Harold C. Ott, *Massachusetts General Hospital*
*Hermann Reichenspurner, *University Hospital Eppendorf*

10:30 AM - 10:45 AM **Update on DCD Lung Transplantation: Outcomes and Utilization**
*Marcelo Cypel, *Toronto General Hospital*

10:45 AM - 11:00 AM **Technical Considerations and Results of Lung Transplantation for Pulmonary Hypertension**
*Hermann Reichenspurner, *University Hospital Eppendorf*

11:00 AM - 11:15 AM **Primary Graft Dysfunction: How to Manage It**
Mani A. Daneshmand, *Duke University*

11:15 AM - 11:30 AM **Bioengineered Lungs**
Harold C. Ott, *Massachusetts General Hospital*

11:30 AM - 12:00 PM **Discussion**

12:00 PM - 1:00 PM **Combined Luncheon Speaker** **Ballroom ABC, Hynes**
*W. Gerald Austen, *Massachusetts General Hospital*

Mechanical Circulatory Support
Moderators: *Matthew Bacchetta, *New York Presbyterian Hospital/Columbia University Medical Center*
*Carmelo A. Milano, *Duke University*
+Rich Walczak, *Duke University*

Panelists:
*Anelechi Anyanwu, *Mount Sinai*
Emma Birks, *University of Louisville*
Edwin McGee, *Loyola University*
*Yoshifumi Naka, *Columbia University*
*Gert D. Victor Pretorius, *University of California, San Diego*
+Lucas A. Schroedl, *Mayo Clinic Arizona*
*Nicholas G. Smedira, *Cleveland Clinic*

1:00 PM - 1:12 PM **LV Recovery with LVAD Support**
Emma Birks, *University of Louisville*

1:12 PM - 1:24 PM **Non-Sternotomy LVAD Insertion**
Edwin McGee, *Loyola University*

1:24 PM - 1:36 PM **BiVAD Support with Two Intracorporeal Centrifugal Pumps**
*Gert D. Victor Pretorius, *University of California, San Diego*

1: 36 PM - 1: 48 PM **Pump Thrombosis – How to Avoid and How to Treat**
*Nicholas G. Smedira, *Cleveland Clinic*

1:48 PM - 2:00 PM **Tips and Tricks for Troubleshooting Implantable Devices**
+Lucas A. Schroedl, *Mayo Clinic Arizona*

2:00 PM - 2:12 PM **LVAD Implantation with Concurrent Valve Procedures**
*Anelechi Anyanwu, *Mount Sinai*

ECMO for Bridge to Transplant, Recovery and Beyond
Moderators: *Matthew Bacchetta, *New York Presbyterian Hospital/Columbia University Medical Center*
*Carmelo A. Milano, *Duke University*
+Rich Walczak, *Duke University*

Panelists:
Cara Agerstrand, *New York Presbyterian Hospital/Columbia University Medical Center*

+Desiree Bonadonna, *Duke University*
Daniel Burkhoff, *New York Presbyterian Hospital/Columbia University Medical Center*
*Bartly P. Griffith, *University of Maryland*
*Shaf Keshavjee, *Toronto General Hospital*
+Brian Reinbold, *University of Minnesota*
*Michael J. Weyant, *University of Colorado*

2:12 PM - 2:24 PM **Simulation Modeling for Optimal ECMO Configuration Choice and Device Design**
Daniel Burkhoff, *Columbia University*

2:24 PM - 2:36 PM **ECMO BTT to Lung Transplantation: Cannulation and Configuration (Understanding the How and Why)**
*Matthew Bacchetta, *New York Presbyterian Hospital/Columbia University Medical Center*

2:36 PM - 2:48 PM **Artificial Lung Development: Current Status and Future Development**
*Bartly P. Griffith, *University of Maryland*

2:48 PM - 3:00 PM **Management of Ambulation on ECMO: How to Do It**
Cara Agerstrand, *New York Presbyterian Hospital/Columbia University Medical Center*
+Dana Apsel, *New York Presbyterian Hospital/Columbia University Medical Center*

3:00 PM - 3:12 PM **EVLP: Is the Challenge Worth the Trouble?**
*Michael Weyant, *University of Colorado*

3:12 PM - 3:24 PM **ECMO Transport: "How We Do It"**
+Desiree Bonadonna, *Duke University*

3:24 PM - 3:36 PM **Management of the Lung Transplant Patient with a High PRA**
*Shaf Keshavjee, *Toronto General Hospital*

3:36 PM - 3:48 PM **Ex Vivo Lung – Maintaining a Near Physiologic State**
+Brian Reinbold, *University of Minnesota*

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Surgical Ethics Course: ***Interdisciplinary Approaches to Ethical Problems in CT Surgery*** **Room 306, Hynes**

Saturday, April 29, 2017 | 8:00 AM - 3:30 PM

Course Co-Chairs:

+William J. DeBois, *New York Presbyterian Hospital/Columbia University Medical Center*
*Martin F. McKneally, *University of Toronto*
*Robert M. Sade, *Medical University of South Carolina*

8:00 AM - 8:15 AM	**Welcome and Introduction** *Martin F. McKneally, *University of Toronto* *Robert M. Sade, *Medical University of South Carolina*
8:15 AM - 9:15 AM	**Keynote Address: Surgical Innovation and Ambition: Ethical Dilemmas in the Development of Heart Surgery** David S. Jones, *Harvard University*
9:15 AM - 9:30 AM	**Ethical Implications of Measuring Waning Surgical Competence** Mark R. Katlic, *Sinai Hospital of Baltimore*
9:30 AM - 9:45 AM	**Is It Ethically Mandatory to Report Errors of Other Surgeons to Patients and Families?** Judson B. Williams, *Duke University*
9:45 AM - 10:15 AM	**Panel Discussion** **Moderator:** Sandra Starnes, *University of Cincinnati*
10:15 AM - 10:45 AM	**Coffee Break**
10:45 AM - 11:00 AM	**Perfusionist Responsibility in Case of Surgeon Error** +William J. DeBois, *New York Presbyterian Hospital/Columbia University Medical Center*
11:00 AM - 11:15 AM	**Public Reporting of Surgical Outcomes: Has Risk Adjustment Matured Enough?** *Susan D. Moffatt-Bruce, *Ohio State University*
11:15 AM - 11:45 AM	**Panel Discussion** **Moderator:** Kathleen Fenton, *William Novick Global Cardiac Alliance*
12:00 PM - 1:00 PM	**Combined Luncheon Speaker** **Ballroom ABC, Hynes** *W. Gerald Austen, *Massachusetts General Hospital*
1:00 PM - 1:15 PM	**Ethical Considerations for Termination of ECMO** +Craig Vocelka, *University of Washington*
1:15 AM - 1:30 PM	N**otes on the Ethics of the Learning Curve** *John Mayer Jr., *Harvard University*
1:30 PM - 2:00 PM	**Panel Discussion** **Moderator:** John W. Entwistle, *Thomas Jefferson University*
2:00 PM - 2:15 PM	**Should Complex CT Operations Be Regionalized?** *Mark B. Orringer, *University of Michigan*
2:15 PM - 2:30 PM	**Organ Transplantation in the Setting of Physician-Assisted Dying** *****Dirk van Raemdonck, University *Hospitals, Leuven, Belgium*
2:30 PM - 2:45 PM	**Can a Surgeon Ever Justifiably Schedule Concurrent Operations?** *****Joseph Zwischenberger, University *of Kentucky*
2:45 PM - 3:30 PM	**Panel Discussion** **Moderator:** *Thomas A. D'Amico, *Duke University*

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Survival Guide: Your First Night on Call *Not for Credit*

Saturday, April 29, 2017 | 11:45 am - 4:00 pm

Course Chairs: *Edward Chen, *Emory University* & *Malcolm M. DeCamp, Jr., *Northwestern Memorial Hospital*

Introduction with Box Lunch	**Room 308, Hynes**
Stations 1-4	**Room 309, Hynes**
Stations 5-8	**Room 310, Hynes**

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.

11:45 AM – 12:00 PM **Introduction with Box Lunch**

12:00 PM – 2:00 PM **Groups 1-4 will rotate through Stations 1, 3, 5, 7**

2:00 PM – 4:00 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
+Ed Darling, *Upstate Medical University*
+Uriah J. Dudgeon, *Massachusetts General Hospital*

Station 6: Thoracic
*Malcolm M. DeCamp, Jr., *Northwestern Memorial Hospital*

Station 7: Pacemaker
*Glenn J. Whitman, *Johns Hopkins Hospital*

Station 8: Low Cardiac Output
*Michael Halkos, *Emory University*

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AATS/STS Adult Cardiac Surgery Symposium: *Excellence Through Knowledge* **Ballroom ABC, Hynes**
Sunday, April 30, 2017 | 8:00 AM - 5:00 PM
Course Chair: *Vinod H. Thourani, *Emory University*
Course Co-Chair: *Hitoshi Ogino, *Tokyo Medical University*
Course Co-Chair: +David Fitzgerald, *Medical Center of South Carolina*

8:00 AM - 8:05 AM **Welcome and Introduction**
*Vinod H. Thourani, *Emory University*

Session 1: Short-Term Circulatory Support and Cardiopulmonary Support Gone Bad

Moderators:
+Cory Alwardt, *Mayo Clinic*
*Ashish S. Shah, *Vanderbilt University*
*Nicholas G. Smedira, *Cleveland Clinic*
*Vinod H. Thourani, *Emory University*

Panelists:
*Valluvan Jeevanandam, *University of Chicago*
Nahush A. Mokadam, *University of Washington*
+Jeffrey B. Riley, *University Hospital Case Medical Center*
*Edward G. Soltesz, *Cleveland Clinic Foundation*

8:05 AM - 8:10 AM **Case Presentation: CPB Gone Bad During a Case**
+Cory Alwardt, *Mayo Clinic*

8:10 AM - 8:25 AM **Choice of Temporary Mechanical Support and Weaning Parameters for Post-Cardiotomy Support**
*Valluvan Jeevanandam, *University of Chicago*

8:25 AM - 8:40 AM **Choice of Temporary Mechanical Support and Weaning Parameters for Cardiogenic Shock for Bridge or Recovery**
Nahush A. Mokadam, *University of Washington*

8:40 AM - 8:55 AM **Optimizing the Anti-Coagulation during Mechanical Support and ECMO**
+Jeffrey B. Riley, *University Hospital Case Medical Center*

8:55 AM - 9:10 AM **New Surgical and Transcatheter Therapies for Right Ventricular Failure**
*Edward G, Soltesz, *Cleveland Clinic Foundation*

9:10 AM - 9:30 AM **Discussion and Recap of the Case Presentation**

9:30 AM - 9:50 AM **Coffee Break**

Session 2: Controversies in Aortic Valve Disease
Moderators:
+Rob Baker, *Flinders University*
*Craig R. Smith, *New York Presbyterian Hospital/Columbia University Medical Center*
*Vinod H. Thourani, *Emory University*

Panelists:
*Michael Borger, *New York Presbyterian Hospital/Columbia University Medical Center*
James E. Davies, *University of Alabama*
*D. Craig Miller, *Stanford University*
Patrick T. O'Gara, *Brigham & Women's Hospital*
*Hartzell V. Schaff, *Mayo Clinic*

9:50 AM - 10:05 PM **ACC/AHA Guidelines for the Aortic Valve**
Patrick T. O'Gara, *Brigham & Women's Hospital*

10:05 AM - 10:15 AM	**Case Presentation: Management of the Small Aortic Root** James E. Davies, *University of Alabama*	
10:15 AM - 10:30 AM	**Strategies for Managing the Small Aortic Root** *Hartzell V. Schaff, *Mayo Clinic*	
10:30 AM - 10:45 AM	**Minimally Invasive AVR: How and Why You Should Incorporate This in Your Practice** *Michael Borger, *New York Presbyterian Hospital/Columbia University Medical Center*	
10:45 AM - 11:00 AM	**Goal-Directed Perfusion Management in Cardiopulmonary Bypass** +Rob Baker, *Flinders University*	
11:00 AM - 11:15 AM	**TAVR for the Treatment of Aortic Stenosis: Here Comes the Tsunami!!!** *Michael J. Mack, *Baylor Health Care System*	
11:15 AM - 11:30 AM	**Hold Your Horses, Let's Look at the Data for TAVR** *D. Craig Miller, *Stanford University*	
11:30 AM - 12:00 PM	**Discussion and Aortic Case Wrap-Up**	
12:00 PM - 1:00 PM	**Legends Luncheon** *Sir Magdi Yacoub, *The Magdi Yacoub Institute*	**Remain in Ballroom ABC, Hynes** *Not for Credit*

Session 3: Controversies in Mitral Valve Surgery

Moderators:

*Patrick Perier, *Herz und Gefass Klinik*
*Rakesh M. Suri, *Cleveland Clinic*
*Vinod H. Thourani, *Emory University*

Panelists:

*Michael Acker, *University of Pennsylvania*
*Gorav Ailawadi, *University of Virginia*
*Vinay Badhwar, *West Virginia University*
*Gilles D. Dreyfus, *Centre of Monaco*

1:00 PM - 1:15 PM	**ACC/AHA Guidelines for the Mitral Valve** Patrick T. O'Gara, *Brigham & Women's Hospital*
1:15 PM - 1:27 PM	**Determinants for MV Repair or Replacement in Secondary MR** *Michael Acker, *University of Pennsylvania*
1:27 PM - 1:39 PM	**Indications for the Use of Percutaneous Mitral Valve Repair** *Gorav Ailawadi, *University of Virginia*
1:39 PM - 1:51 PM	**Indications for Concomitant Tricuspid Valve Repair** *Gilles D. Dreyfus, *Centre of Monaco*
1:51 PM - 2:03 PM	**Atrial Fibrillation in the Setting of Mitral Valve Disease: Which Lesions are Optimal and Which Patients Benefit the Most** *Vinay Badhwar, *West Virginia University*
2:03 PM - 2:18 PM	**Discussion and Case Wrap-Up**

Session 4: Coronary Artery Disease
Moderators:
Farouc A. Jaffer, *Massachusetts General Hospital*
+Theron A. Paugh, *University of Michigan*
*Vinod H. Thourani, *Emory University*
*Kenton J. Zehr, *Johns Hopkins Hospital*

Panelists:
*Stephen E. Fremes, *Sunnybrook Health Sciences Center*
*Michael E. Halkos, *Emory University*

2:18 PM - 2:28 PM	**Case Presentation: Hybrid Coronary Revascularization** *Michael E. Halkos, *Emory University*
2:28 PM - 2:40 PM	**Making the The Heat Team a Reality in Choosing Between CABG and PCI** Farouc A. Jaffer, *Massachusetts General Hospital*
2:40 PM - 2:52 PM	**Value of and Choice of a Second Arterial Graft** *Stephen E. Fremes, *Sunnybrook Health Sciences Center*
2:52 PM - 3:04 PM	**Can Perfusion Outcome Registries Improve our Understanding of Myocardial Protection?** +Theron A. Paugh, *University of Michigan*
3:04 PM - 3:20 PM	**Discussion and Case Wrap-Up**
3:20 PM - 3:30 PM	**Coffee Break**

Session 5: Aortic Surgery
Moderators:
*Joseph S. Coselli, *Baylor College of Medicine*
*Hitoshi Ogino, *Tokyo Medical University*
*Eric E. Roselli, *Cleveland Clinic*
*Vinod H. Thourani, *Emory University*

Panelists:
*Edward P. Chen, *Emory University*
*Tirone E. David, *Toronto General Hospital*
**Roberto Di Bartolomeo, *University of Bologna*
+Altaf Panjwani, *Emory University*

3:30 PM - 3:45 PM	**Composite Root Replacement versus Valve Sparing Root is the Standard for Routine Aortic Root Replacement** **Roberto Di Bartolomeo, *University of Bologna*
3:45 PM - 4:00 PM	**Root Aneurysm with Bicuspid Aortic Valve: Spare or Replace** *Tirone E. David, *Toronto General Hospital*
4:00 PM - 4:15 PM	**Arch Replacement in 2017: When to Add a Frozen Elephant Trunk** *Edward P. Chen, *Emory University*
4:15 PM - 4:25 PM	**Cannulation Strategies & Myocardial Protection for Circulatory Arrest** +Altaf Panjwani, *Emory University*
4:25 PM - 4:40 PM	**Management of Type B Aortic Dissection: Medical Therapy or TEVAR** *Eric E. Roselli, *Cleveland Clinic*
4:40 PM - 4:58 PM	**Discussion and Case Wrap-Up**
4:58 PM - 5:00 PM	**Closing Remarks** *Vinod H. Thourani, *Emory University*

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*AATS Member **AATS New Member +AmSECT Member

AATS/STS Congenital Heart Disease Symposium: **Room 312, Hynes**

Innovations and Controversies in the Surgical Management of Congenital Heart Disease

Sunday, April 30, 2017 | 8:00 AM - 5:00 PM

**Course Chair: ***Michael E. Mitchell, *Children's Hospital of Wisconsin*

**Course Co-Chair: ***Giovanni Stellin, *University of Padova*

Course Co-Chair: +Ron Angona, *University of Oklahoma Health Sciences Center*

7:55 AM - 8:00 AM	**Welcome and Introduction**
8:00 AM - 8:15 AM	**Device Innovations and Options for Biventrical Mechanical Circulatory Support** +Mark Shepard, *St. Louis Children's Hospital*
8:15 AM - 8:30 AM	**Support for the Single Ventricle/Failing Fontan** *J. William Gaynor, *Children's Hospital of Philadelphia*
8:30 AM - 8:45 AM	**Support of the Neonate and Infant** Katsuhide Maeda, *Stanford University*
8:45 AM - 9:00 AM	**UNOS Status Update- New Donor Allocation Scheme** Ryan R. Davies, *A.I. duPont Hospital for Children*
9:00 AM - 9:15 AM	**Mistakes in Timing and Listing for Transplant** *James S. Tweddell, *Cincinnati Children's Hospital Medical Center*
9:15 AM - 9:30 AM	**The Difficult Recipient: Complex Transplantation in Congenital Heart Disease** +Tami R. Rosenthal, *Children's Hospital of Philadelphia*
9:30 AM - 10:00 AM	**Coffee Break**
10:00 AM - 10:15 AM	**Arch Reconstruction at Stage II** Hakan Akinturk, *Justus Liebig University*
10:15 AM - 10:30 AM	**The "Tweener" Arch - Front vs. Side** *Charles D. Fraser, *Texas Children's Hospital*
10:30 AM - 10:45 AM	**Fetal Intervention - Ready for Prime Time?** Audrey C. Marshall, *Boston Children's Hospital*
10:45 AM - 11:00 AM	**Congenital AS - The Case for Surgical Valvotomy** *Viktor Hraska, *Children's Hospital of Wisconsin*
11:00 AM - 11:15 AM	**Aortic Valve Repair for Insufficiency** *Michel N. Ilbawi, *Hope Children's Hospital*
11:15 AM - 11:30 AM	**Repair for Mitral Stenosis** Eva Maria Delmo Walter, *Cardio Centrum Berlin*
11:30 AM - 11:45 AM	**Repair Techniques for Mitral Valve Insufficiency in Children** *Giovanni Stellin, *University of Padova*
11:45 AM - 12:00 PM	**Mitral Valve Replacement Techniques in Children** *Pedro J. del Nido, *Children's Hospital*
12:00 PM - 1:00 PM	**Legends Luncheon** **Remain in Room 312, Hynes** *William I. Norwood *Not for Credit*

1:00 PM - 1:15 PM	**Result of the National Perfusion Survey** +Ashley Hodge, *Nationwide Children's Hospital*
1:15 PM - 1:30 PM	**Management of Perfusion in HLHS - DHCA vs. Warm Antegrade and Distal Perfusion** *Thomas L. Spray, *Children's Hospital of Philadelphia* *David P. Bichell, *Vanderbilt University/Children's Hospital*
1:30 PM - 1:45 PM	**To MUF or Not to MUF: Are We Making America Great Again?** +Rich Walczak, *Duke University* +Craig McRobb, *Children's Hospital Colorado*
1:45 PM - 2:00 PM	**Management of MAPCAs in Repair TOF - Unifocalize or Not** *Frank L. Hanley, *Stanford University* **Christian Brizard, *Royal Children's Hospital*
2:00 PM - 2:15 PM	**Surgical/Perfusion Mistake** **Tain-Yen Hsia, *Great Ormond Street Hospital* +Alex Robertson, *Great Ormond Street Hospital*
2:15 PM - 2:30 PM	**Surgical/Perfusion Mistake** *James S. Tweddell, *Cincinnati Children's Hospital* +Jim Reagor, *Cincinnati Children's Hospital*
2:30 PM - 2:45 PM	**Surgical/Perfusion Mistake** *Charles D. Fraser, *Texas Children's Hospital* +Kimberly Madigan, *Texas Children's Hospital*
3:00 PM - 3:30 PM	**Coffee Break**
3:30 PM - 3:45 PM	**Nikaidoh vs. Rastelli** Mark Hazekamp, *Leiden University*
3:45 PM - 4:00 PM	**AAOCA** *V. Mohan Reddy, *Stanford University*
4:00 PM - 4:15 PM	**Surgical Innovations with the Fontan** *Brian E. Kogon, *Emory University*
4:15 PM - 4:30 PM	**Surgical Techniques for TAPVR** *Christopher A. Caldarone, *Hopsital for Sick Children*
4:30 PM - 4:45 PM	**Approaches to TOF with MAPCAs** David Barron, *Birmingham Children's Hospital*
4:45 PM - 5:00 PM	**Neonatal ROSS** Paul H. Schoof, *University Medical Center Utrecht*

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AATS/STS General Thoracic Surgery Symposium: ***Thoracic Surgery 2017 - State of the Art*** **Room 302/304, Hynes**
Sunday, April 30, 2017 | 8:00 AM - 5:00 PM
Course Chair: *Seth D. Force, *Emory University*
Course Co-Chair: *Moishe Liberman, *Centre Hospitalier de l'Université de Montréal*

8:00 AM - 8:10 AM	**Welcome and Introduction**
	Lung Cancer: Solitary Pulmonary Nodule and Screening
8:10 AM - 8:25 AM	**Setting up a Lung Cancer Screening Program - Team coordination & Financial Aspects** Betty C. Tong, *Duke University*
8:25 AM - 8:40 AM	**Lung Cancer Screening: Who Gets Followed, Who Does the Following and For How Long?** *Michael T. Jaklitsch, *Brigham & Women's Hospital*
8:40 AM - 8:55 AM	**Management of Screen-Detected Lesions: GGO, Sub-Solid, Part-Solid** *Frank C. Detterbeck, *Yale Unversity*
8:55 AM - 9:10 AM	**Diagnostic Modality Options for Suspicious Lesions** *Kazuhiro Yasufuku, *University of Toronto*
9:10 AM - 9:25 AM	**When are EBUS or Mediastinoscopy Needed? What Is the Data for Their Use?** *Felix G. Fernandez, *Emory University*
9:25 AM - 9:45 AM	**Panel Discussion**
9:45 AM - 10:05 AM	**Coffee Break**
	Lung Cancer: Controversial and High Risk Patients with Lung Cancer
10:05 AM - 10:20 AM	**How do we Define "Physiological High Risk", Regardless of Stage?** *Mark K. Ferguson, *University of Chicago*
10:20 AM - 10:35 AM	**Evidence supported Use of Sublobar Resection, MITS, Brachytherapy** *Nasser K. Altorki, *New York Hospital-Cornell University*
10:35 AM - 10:50 AM	**Where is the State of Tthe Science for: SBRT Versus Resection In Clinical Stage I?** *Hiran C. Fernando, *Boston Medical Center*
10:50 AM - 11:05 AM	**What is the Surgeons Role in SBRT and Where are the Gaps in Practice?** *Daniel J. Boffa, *Yale Unversity*
11:05 AM - 11:20 AM	**Surgery is Never Indicated for Patients with N2 Disease: Con** *Gail E. Darling, *Toronto General Hospital*
11:20 AM - 11:40 AM	**Surgery is Never Indicated for Patients with N2 Disease: Pro** *Garrett L. Walsh, *M.D. Anderson Cancer Center*
11:40 AM - 12:00 PM	**Panel Discussion**
12:00 PM - 1:00 PM	**Legends Luncheon** **Remain in Room 302/304, Hynes** *Valerie W. Rusch, *Memorial Sloan-Kettering Cancer Center* *Not for Credit*
	Mediastinum and Pleura
1:00 PM - 1:15 PM	**Surgery in "Exceptional" Myasthenia Patients: Elderly, Obese, Ocular-Only, Etc.** Jens C. Rückert, *Chirurgische Klinik CCM*
1:15 PM - 1:30 PM	**Evidence Based Claims for "Best Thymectomy" for Myasthenia Gravis** *Joshua R. Sonett, *New York Presbyterian Hospital/Columbia University Medical Center*
1:30 PM - 1:45 PM	**Evolved Management of the Anterior Mediastinal Mass: Best Practices** *James Huang, *Memorial Sloan Kettering Cancer Center*

1:45 PM - 2:00 PM **Surgery, Plus… in "Exceptional" Thymoma Patients: Neoadjuvant, Adjuvant, Stage IV**
*Cameron D. Wright, *Massachusetts General Hospital*

2:00 PM - 2:15 PM **Evidence Review of Best Strategy for Classic Presentation of Malignant Mesothelioma**
*Raja M. Flores, *Mount Sinai Medical Center*

2:15 PM - 2:30 PM **Best Intervention Algorithm for Malignant Pleural Effusion**
*Richard K. Freeman, *St. Vincent Hospital Indianapolis*

2:30 PM - 2:50 PM **Panel Discussion**

2:50 PM - 3:10 PM **Coffee Break**

Esophagus

3:10 PM - 3:25 PM **Exploring the Limits of Esophageal-Sparing Therapy for HGD and T1a Adenocarcinoma**
*Tom J. Watson, *MedStar Washington*

3:25 PM - 3:40 PM **Evidence Supporting the Decision to Use Induction Therapy: When and Which Strategy?**
*Andrew C. Chang, *University of Michigan*

3:40 PM - 3:55 PM **Stage III Cancer: Who Is and Who Is Not a Candidate for Trimodality Therapy**
*Wayne L. Hofstetter, *M.D. Anderson Cancer Center*

3:55 PM - 4:10 PM **Best Surgical Approach: MIE vs THE vs Ivor Lewis**
*Sudish C. Murthy, *Cleveland Clinic*

4:10 PM - 4:25 PM **Achalasia Primer: High Res Manometry, Endo-FLIP, POEM**
*Steven R. DeMeester, *Oregon Clinic*

4:25 PM - 4:40 PM **Surgery for Complex Patients with Achalasia: Recurrent symptoms, Megaesophagus, Obese Patient, Elderly Patient**
Christpher R. Morse, *Massachusetts General Hospital*

4:40 PM - 5:00 PM **Panel Discussion**

- -

Interprofessional Cardiothoracic Team Symposium: *Improving Systems of Care, Quality and Safety* **Room 306, Hynes**
Sunday, April 30, 2017 | 8:00 AM - 5:00 PM
Course Co-Chairs:
Katherine J. Hoercher, *Clevland Clinic Foundation*
Steven Gottesfeld, *Sharp Memorial Hospital*
+Greg Mork, *Rush University*
*Glenn J. Whitman, *Johns Hopkins Hospital*

8:00 AM - 8:10 AM **Welcome and Introduction**
*Glenn J. Whitman, *Johns Hopkins Hospital*

Moderators:
Katherine J. Hoercher, *Clevland Clinic Foundation*
*Glenn J. Whitman, *Johns Hopkins Hospital*

8:10 AM - 8:30 AM **Enhanced Recovery Pathways: Prehabilitation to Reduce Morbidity and Mortality**
Charles H. Brown, IV, *Johns Hopkins Hospital*

8:30 AM - 9:00 AM **Preoperative Optimization: Exercising Control Where It Makes a Difference**
*Glenn J. Whitman, *Johns Hopkins Hospital*

9:00 AM - 9:20 AM **Assessing Patient and Surrogate Capacity to Consent to Treatment: Who Decides?**
*Thomas A. D'Amico, *Duke University*

9:20 AM - 9:35 AM **Discussion**

9:35 AM - 10:00 AM **Coffee Break**

Moderators:
+Greg Mork, *Rush University*
+Susan Englert, *Perfusion Services LLC*

10:00 AM - 10:15 AM **Minimizing Transfusions – The Team Approach: Pre- Admission Use of Epoetin: Indications and Outcomes**
Justin Miller, *National Heart, Lung, and Blood Institute*

10:15 AM - 10:30 AM **Minimizing Transfusions – The Team Approach: Pre-operative Evaluation and Intraop Management**
+Susan Englert, *Perfusion Services LLC*

10:30 AM - 10:45 AM **Minimizing Transfusions – The Team Approach: Peri-operative Management of Blood Preservation**
+Kyle Spear, *Harvard University*

10:45 AM - 11:00 AM **Minimizing Transfusions – The Team Approach: Risks, Recognition and Management of Post CPB Hemorrhage**
Gabriel Loor, *Baylor St. Lukes Medical Center*

11:00 AM - 11:15 AM **Goal Directed Resuscitation and Its Impact on Outcomes and LOS**
Steven M. Gottesfeld, *Sharp Memorial Hospital*

11:15 AM - 11:30 AM **Running a Code in the ICU: The Hopkins Experience**
Marc Sussman, *Johns Hopkins Hospital*

11:30 AM - 11:45 AM **The Ethics of ECMO Withdrawal**
*Susan D. Moffatt-Bruce, *Ohio State University*

11:45 AM - 12:00 PM **Discussion**

12:00 PM - 1:00 PM **Legends Luncheons**

*William I. Norwood	*Taking place in Room 312, Hynes*
*Valerie W. Rusch	*Taking place in Room 302/304, Hynes*
*Sir Magdi Yacoub	*Taking place in Ballroom ABC, Hynes*

Moderators:
Steven Gottesfeld, *Sharp Memorial Hospital*
*Glenn J. Whitman, *Johns Hopkins Hospital*

1:00 PM - 1:15 PM **Glycemic Control in Cardiac Surgery: Where Are We Now?**
*Harold L. Lazar, *Boston Medical Center*

1:15 PM - 1:30 PM **Risk Factors, Recognition and Management of Peri-operative MI**
*John Puskas, *Mount Sinai Medical Center*

1:30 PM - 1:45 PM **Management of Peri-Operative CVA**
Damien J. LaPar, *Boston Children's Hospital*

1:45 PM - 2:00 PM **Prolonged Intensive Care Unit Stay in Cardiac Surgery: Risk Factors and Long-Term-Survival**
*Rakesh C. Arora, *St. Boniface General Hospital*

2:00 PM - 2:15 PM **Discussion**

2:15 PM - 2:45 PM **Coffee Break**

Moderators:
Katherine J. Hoercher, *Clevland Clinic Foundation*
*Glenn J. Whitman, *Johns Hopkins Hospital*

2:45 PM – 3:00 PM	**What Surgical Teams Can Learn from Fighter Pilots, Special Ops Forces and Other Elite Performers** *Douglas R. Johnston, *Clevland Clinic*
3:00 PM - 3:30 PM	**Organizational Structure and Process Factors for Improving Cardiac Surgery Quality and Safety** Peter Provonost, *Johns Hopkins University*
3:30 PM - 3:55 PM	**The Science of Improvement: Why Cardiothoracic Surgeons Should Care** Don Goldmann, *Institute for Healthcare Improvement*
3:55 PM - 4:15 PM	**Surgical Checklists: Have They Decreased Morbidity and Mortality?** Alex B. Haynes, *Massachusetts General Hospital*
4:15 PM - 4:35 PM	**Meaningful Outcome Measures in Cardiac Surgery: The STS Database and Public Reporting** David M. Shahian, *Harvard Medical School*
4:35 PM - 5:00 PM	**Discussion**

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AATS 98TH ANNUAL MEETING 2018

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AATS – PROMOTING SCHOLARSHIP IN THORACIC AND CARDIOVASCULAR SURGERY

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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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.

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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 13.75 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 estimated that this educational activity will be designated for 45 Category 1 CEUs. *Please go to AmSECT.org for a final CEU count.*

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

Saturday, April 29, 2017 – up to 6.25 hours (CME, AAPA, ABCP)

Adult Cardiac Skills, up to 6.5 hours
Congenital Skills, up to 6 hours
General Thoracic Skills, up to 6 hours
Cardiothoracic Transplant and Mechanical Circulatory Support of Heart and Lung Failure, up to 6.25 hours
Surgical Ethics Course, up to 6 hours
Survival Guide: Your First Night on Call, not for credit

Sunday, April 30, 2017 – up to 7.5 hours (CME, AAPA, ABCP)

Adult Cardiac Surgery, up to 7.5 hours
Congenital Heart Disease, up to 7 hours
General Thoracic Surgery, up to 7.25 hours
Interprofessional Cardiothoracic Team Symposium, up to 7 hours

Monday, May 1, 2017 – up to 7 hours (CME, ABCP)

Plenary Scientific Session, Presidential Address, up to 2.75 hours
Honored Guest Lecture, not for credit
Ethics Forum Luncheon, up to 1.5 hours
C. Walton Lillehei Resident Forum, not for credit
Adult Cardiac Surgery Simultaneous Session, up to 2.75 hours
Controversies in CABG 2017, up to 2.75 hours
Congenital Heart Disease Simultaneous Session, up to 2.5 hours
General Thoracic Surgery Simultaneous Session, up to 2.5 hours
Perioperative Care Simultaneous Session, up to 2.5 hours

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Tuesday, May 2, 2017 – up to 6.75 hours (CME, ABCP)
Cardiac Surgery Forum, up to 1.25 hours
General Thoracic Surgery Forum, up to 1.25 hours
Adult Cardiac Emerging Technologies and Techniques/Video Session, up to 1.25 hours
Congenital Emerging Technologies and Techniques/Video Session, up to 1.25 hours
General Thoracic Emerging Technologies and Techniques/Video Session, up to 1.75 hours
Plenary Scientific Session, Basic Science Lecture, up to 2.5 hours
Transcatheter Valve Therapies, up to 1.5 hours
Adult Cardiac Surgery Simultaneous Session, up to 1.5 hours
MCS/Transplant Session, up to 1.5 hours
ELSO at AATS, up to 1.5 hours
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

Wednesday, May 3, 2017 – up to 4 hours (CME, ABCP)
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 2.25 hours
Adult Cardiac Masters of Surgery Video Session, up to 1.75 hour
Congenital Masters of Surgery Video Session, up to 1.75 hours
General Thoracic Masters of Surgery Video Session, 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 2 outside of Exhibit Hall C at the Boston Hynes 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/aat171/.

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 (AATS) that any individual who is in a position to control or influence the content of an educational activity to disclose all relevant financial relationships or affiliations. All identified conflicts of interest must be resolved and the educational content thoroughly vetted by AATS for fair balance, scientific objectivity, and appropriateness of patient care recommendations. 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.

Committee Disclosures

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

*Prasad S. Adusumilli
*Shahab Akhter
*George Alfieris
*Anelechi C. Anyanwu
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*Niv Ad	Advisor with AtriCure, Nido Surgical; Co-owner of Left Atrial Appendage Occluder, LLC; Consultant with Medtronic; Speakers Bureau with ArtiCure, LivaNova
*David H. Adams	The Icahn School of Medicine at Mount Sinai Receives Royalties from Edwards Lifesciences and Medtronic; National Co-PI with Medtronic and NeoChord
*Gorav Ailawadi	Consultant with Abbott, AtriCure, Edwards Lifesciences, Medtronic, St. Jude
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*Ahmet Kilic	Consultant with St. Jude Medical; Travel Grants from HeartWare; Speaker with Baxter International
*S. Chris Malaisrie	Consultant with Abbott, Edwards Lifesciences, Medtronic; Speaker with Bolton
*M. Blair Marshall	Advisor with ClincialKey; Consultant with Ethicon; Research Support from MedStar
*Bryan F. Meyers	Consultant with Varian Medical Systems; Research Support from Ethicon
*Yoshifumi Naka	Consultant with St. Jude Medical, Zimmer-Biomet
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AUTHOR INDEX

A

Key

C = Controversies in CABG 2017
F = Laboratory Research Forum
L = C. Walton Lillehei Resident Forum
LB = Late Breaking Clinical Trial
P = Moderated Poster Competition
T = Emerging Technologies and Techniques | Case Video Forum
TCT = Transcatheter Valve Therapies

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SUNDAY, APRIL 30, 2017

5:00 pm – 7:00 pm	**AATS/AMSECT Welcome Reception**	Exhibit Hall
	AATS Cardiothoracic Resident Poster Competition	*Not for Credit*
	AATS Perioperative and Team-Based Care Poster Competition	*Not for Credit*
	AATS Summer Intern Scholarship Poster Session	*Not for Credit*

5:05 pm – 6:00 pm
Work Life Balance in Cardiothoracic Surgery
AATS CT Theater I
Booth #106, Exhibit Hall
Not for Credit

Panelists: *Marc R. Moon, *Washington University*
Miguel Sousa Uva, *Hospital Cruz Vermelha*

Introduction: *Malakh Shrestha, *Hannover Medical School*

My Husband Is a Trauma Surgeon and I Just had Twins – The Perfect Time to Start CT Residency
Lindsey Saint, *Washington University*

CT Surgical Training in Modern Times: European Resident's View Point
Constanze Merz, *Hannover Medical School*

European Working Guidelines
*A. Pieter Kappetein, *Erasmus Medical Centre*

USA Working Guidelines
*Thoralf M. Sundt, III, *Massachusetts General Hospital*

Panel Discussion

MONDAY, MAY 1, 2017

6:30 am **Update on Maintenance of Certification for the American Board of Thoracic Surgery** Room 312, Hynes *Not for Credit*

Presenter: *Yolonda L. Colson, Brigham *and Women's Hospital, Boston, MA*

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 year 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 ABTS Directors.

7:20 am **Business Session,** *AATS Members Only* Ballroom ABC, Hynes

7:30 am – 11:05 am **Plenary Scientific Session** Ballroom ABC, Hynes
8 minute presentation, 12 minute discussion

Moderators: *Thoralf M. Sundt, III and *Marc R. Moon

1. Comparative Effectiveness of CABG Versus PCI in a Real World STICH Population
Alexander Iribarne[1], Anthony W. DiScipio[1], *Bruce J. Leavitt[2], Yvon R. Baribeau[3], Paul W. Weldner[4], Yi-Ling Huang[1], Michael P. Robich[5], Robert A. Clough[6], Gerald L. Sardella[7], Elaine M. Olmstead[1], David J. Malenka[1]
[1]Dartmouth-Hitchcock Medical Center, Lebanon, NH; [2]University of Vermont, Burlington, VT; [3]Catholic Medical School, Manchester, NH; [4]Central Maine Medical Center, Lewiston, ME; [5]Maine Medical Center, Portland, ME; [6]Eastern Maine Medical Center, Bangor, ME; [7]Concord Hospital, Concord, NH

Invited Discussant: *John D. Puskas

2. A Comparison of the Belsey Mark IV and Laparoscopic Nissen Fundoplication in Patients with Large Paraesopahgeal Hernia
Danuel Laan, John Agzarian, William S. Harmsen, K. Robert Shen, *Shanda H. Blackmon, *Francis C. Nichols, III, *Stephen D. Cassivi, *Dennis A. Wigle, *Mark S. Allen
Mayo Clinic, Rochester, MN

Invited Discussant: *James D. Luketich

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3. Outcomes of Surgical Intervention for Anomalous Aortic Origin of a Coronary Artery: A Large Contemporary Prospective Cohort Study

Carlos M. Mery[1], Luis E. De León[1], Silvana M. Molossi[1], S. Kristen Sexson-Tejtel[1], Hitesh Agrawal[1], Rajesh Krishnamurthy[2], Prakash M. Masand[1], E. Dean McKenzie[1], *Charles D. Fraser, Jr.[1]

[1]Texas Children's Hospital, Houston, TX; [2]Nationwide Children's Hospital, Columbus, OH

Invited Discussant: *Pedro J. del Nido

8:35 am **In the Words of the Presidents: A Video Celebration of the AATS Centennial**

8:50 am **Award Presentations**

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

9:05 am – 9:35 am
Social Media in Cardiothoracic Surgery

AATS CT Theater II
Booth #1828, Exhibit Hall
Not for Credit

Moderator: Nikki Stamp, *Sydney, Australia*

Abstract Presenter: Tamara Ni Hici, *Cardiff University Hospital, Cardiff, United Kingdom*

Panelists: *Mara B. Antonoff, *UT MD Anderson Cancer Center, Houston, TX*
*Thomas K. Varghese Jr., *University of Utah, Salt Lake City, UT*

Current Engagement of Cardiac and Thoracic Surgical Societies with Social Media: Supernova or Black Hole?

Tamara Ni Hici[1], Farah Bhatti[2]

[1]Cardiff University Hospital, Cardiff, United Kingdom; [2]Abertawe Bro Morgannwg University Health Board, Morrison Hospital, Swansea, United Kingdom

9:40 am **Honored Guest Lecture**
Team of Teams – Rules of Engagement for a Complex World
General Stanley A. McChrystal, *McChrystal Group*

10:20 am **Plenary Scientific Session**

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

4. Safety and Feasibility of Lobectomy Following Concurrent Chemotherapy and High Dose Radiation for Stage IIIA NSCLC: Pooled Surgical Results of NRG Oncology RTOG 0229 and 0839

*Jessica S. Donington[1], Rebecca Paulus[2], Martin Edelman[3], *Mark Krasna[4], Quynh Le[5], Mohan Suntharalingam[6], Billy Loo[5], Steven Feigenberg[6], Elizabeth Gore[7], Vita McCabe[8], Cliff Robinson[9], Gregory Videtic[10], Nathaniel Evans[11], Paul Thurmes[12], Maximilian Diehn[5], Mark Smith[13], Roy Decker[14], Jeffery Bradley[15]

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Invited Discussant: *David R. Jones

5. 10 Year Clinical Experience of Humanitarian Cardiothoracic Surgery: Building a Platform for Ultimate Sustainability in a Resource-Limited Setting

Ralph Morton Bolman, III[1], JaBaris D. Swain[2], Colleen Sinnott[3], Suellen Breakey[4], Rian Hasson Charles[5], Gita Mody[2], Naphthal Nyirimanzi[6], Gabriel Toma[7], Egidia Rugwizangoga[2], Ceeya Patton-Bolman[8], Patricia Come[8], Gapira Ganza[9], Emmanuel Rusingiza[10], Nathan Ruhamya[11], Joseph Mucumbitsi[11], Jorge Chiquie Borges[12], Martin Zammert[12], Jochen D. Muehlschlegel[12], Robert Oakes[13], *Bruce Leavitt[1]

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Invited Discussants: *A. Pieter Kappetein and *David A. Fullerton

11:05 am **New Member Induction** Ballroom ABC, Hynes

11:25 am **Presidential Address** Ballroom ABC, Hynes

Ancora Imparo: Always Learning

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

12:30 pm **Adjourn for Lunch in the Exhibit Hall**

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12:45 pm – 2:00 pm **Ethics Forum Lunch** Room 310, Hynes

Separate Registration Required

Final Exit with Medical Help: Should State Law Legitimize Physician-Assisted Suicide?

Moderator: *Robert M. Sade, *Medical University of South Carolina, Charleston, SC*

Pro: Haider J. Warraich, *Duke University Medical Center, Durham NC*

Con: Robert Sewell, *Master Center of North Texas, Southlake, TX*

12:45 pm – 2:00 pm **20th Annual C. Walton Lillehei Resident Forum** AATS CT Theater I

6 minute presentation, 4 minute discussion Booth #106, Exhibit Hall

Not for Credit

Chairs: *Fredrick Y. Chen and *Dao M. Nguyen

L1. Mutations in ROBO4 Lead to the Development of Bicuspid Aortic Valve and Ascending Aortic Aneurysm

Hamza Aziz[1], Russell Gould[2], Courtney Wood[2], Ajay Kumar[3], Christoph Preuss[4], Hua Ling[2], Nara Sobreira[2], Christopher Bennett[5], Asad Shah[6], G. Chad Hughes[1], Salah A. Mohamed[7], Anders Franco-Cereceda[8], Per Eriksson[8], Gregor Andelfinger[4], Lut Van Laer[3], Bart Loeys[3], Andy McCallion[2], Harry C. Dietz[2]

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Invited Discussant:

L2. Targeted Near-Infrared Intraoperative Molecular Imaging Can Identify Residual Disease During Pulmonary Resection

Jarrod D. Predina, Jane Keating, Andrew Newton, *Sunil Singhal

University of Pennsylvania, Philadelphia, PA

Invited Discussant:

L3. Delivery of Endothelial Progenitor Cells with Injectable Shear-Thinning Hydrogels Maintains Ventricular Geometry andNormalizes Dynamic Strain to Stabilize Cardiac Function Following Ischemic Injury

Ann C. Gaffey, Minna H. Chen, Alen Trubelja, Chantel M. Venkataraman, Carol W. Chen, Susan Schultz, *Robert Gorman, Chandra M. Sehgal, Jason A. Burdick, *Pavan Atluri

University of Pennsylvania, Philadelphia, PA

Invited Discussant:

L4. Targeted Cell Replacement in Human Lung Bioengineering

Brandon A. Guenthart, John D. O'Neill, Jinho Kim, Gordana Vunjak-Novakovic, *Matthew Bacchetta

Columbia University, New York, NY

Invited Discussant: *Marcelo Cypel

L5. Donor-Derived Non-Classical Monocytes Mediate Primary Lung Allograft Dysfunction by Recruiting Recipient Neutrophils via Toll Like Receptor-Dependent Production of MIP-2

Stephen Chiu[1], Zhikun Zheng[1], Mahzad Akbarpour[1], Ramiro Fernandez[1], Alexandra McQuattie-Pimentel[1], *Daniel Kreisel[2], Harris Perlman[1], G.R. Scott Budinger[1], Alexander Misharin[1], Ankit Bharat[1]

[1]Northwestern University, Chicago, IL; [2]Washington University, St. Louis, MO

Invited Discussant: *Christine L. Lau

L6. *In Vivo* Lung Perfusion Rehabilitates Sepsis-Induced Lung Injury

J. Hunter Mehaffey, Eric J. Charles, Sarah A. Schubert, Ashish K. Sharma, Dustin Money, *Curtis G. Tribble, Victor E. Laubach, Mark E. Roeser, *Irving L. Kron

University of Virginia, Charlottesville, VA

Invited Discussant: *Jules Lin

MONDAY AFTERNOON, MAY 1, 2017

2:00 pm – 5:30 pm **Adult Cardiac Surgery Controversies** Ballroom ABC, Hynes
Simultaneous Scientific Sessions

2:00 pm **Adult Cardiac Surgery Controversies 1: Myocardial Protection**
5 minute presentation, no discussion

Moderator: *Anelechi Anyanwu

Panelists: Jennifer S. Lawton, *Ralph J. Damiano, Jr., *Thierry-Pierre Carrel, *Clifford W. Barlow

The Science Behind Cardioplegia

*Frank W. Sellke, *Brown Medical School, Providence, RI*

6. The Use of del Nido Cardioplegia in Surgery: A Prospective Randomized Trial

*Niv Ad[1], Sari D. Holmes[2], Paul S. Massimiano[3], Anthony J. Rongione[3], Lisa M. Fornaresio[2], David Fitzgerald[4]

[1]West Virginia University, Morgantown, WV; [2]Inova Heart and Vascular Institute, Falls Church, VA; [3]Adventist HealthCare, Takoma Park, MD; [4]Medical University of South Carolina, Charleston, SC

7. A Normokalemic Long Acting Blood Cardioplegia

Amber Malhotra, Vivek Wadhawa, Jaydip Ramani, Pankaj Garg, Arvind Kumar Bishnoi, Pranav Sharma, Manish Hinduja, Himani Pandya

U.N. Mehta Institute of Cardiology and Research Center, Ahmedabad, India

8. Single Dose Cardioplegia Protects Myocardium As Well As Traditional Repetitive Dosing: A Randomized Study

Alessandro Vivacqua, Nicholas A. Tepe, Jeffrey M. Altshuler, Francis L. Shannon, Marc P. Sakwa

Beaumont Health, Royal Oak, MI

Panel Discussion

2:50 pm **Adult Cardiac Surgery Controversies 2: Tricuspid Valve Repair**
5 minute presentation, 5 minute discussion

Moderator: *Rakesh M. Suri

Panelists: *David H. Adams, *Frank C. Wells, *Patrick M. McCarthy, *Gebrine El Khoury

9. Tricuspid Annulus Diameter Does Not Predict the Development of Tricuspid Regurgitation After Mitral Valve Repair for Mitral Regurgitation Due to Degenerative Diseases

*Tirone E. David, Carolyn David, Cedric Manlhiot

Toronto General Hospital, Toronto, ON, Canada

10. Outcome of Tricuspid Annuloplasty Following Current Guidelines

Filip Dulguerov[1], Clara Alexandrescu[1], Cecilia Marcacci[1], Franck Levy[1], Shelley Rahman[2], Elie Dan Schouver[1], *Gilles Daniel Dreyfus[1]

[1]Cardiothoracic Center of Monaco, Monte Carlo, Monaco; [2]Royal Brompton and Harefield NHS Foundation Trust, London, United Kingdom

11. Long Term Effect of Concomitant Tricuspid Repair

Sarah Ward, Meghan Baker, *Steven Bolling

University of Michigan, Ann Arbor, MI

Panel Discussion

3:40 pm – 4:10 pm **Coffee Break in the Exhibit Hall**

4:10 pm **Adult Cardiac Surgery Controversies 3: Aortic Valve Replacement**
6 minute presentation, 8 minute discussion

Moderators: *Niv Ad and *J. Michael DiMaio

Innovation in Valve Design

*James L. Cox, *Washington University, St. Louis, MO*

Late-Breaking Clincial Trial

LB1. One-Year Outcomes Associated with a Novel Bovine Pericardial Stented Aortic Bioprosthesis: PERIGON Pivotal Trial

*Joseph F. Sabik, III[1], Vivek Rao[2], *Rüdiger Lange[3], *A. Pieter Kappetein[4], *Francois Dagenais[5], Louis Labrousse[6], Vinayak Bapat[7], Michael Moront[8], Neil J. Weissman[9], *Himanshu Patel[10], *Michael J. Reardon[11], Federico M. Asch[9], Robert J.M. Klautz[12]

[1]University Hospitals Cleveland Medical Center, Cleveland, OH; [2]Toronto General Hospital, Toronto, ON, Canada; [3]German Heart Centre of the Technical University, Munich, Germany; [4]Erasmus Medical Centre, Rotterdam, Netherlands; [5]Quebec Heart and Lung Institute, Quebec City, QC, Canada; [6]University Hospital of Bordeaux, Pessac Cedex, France; [7]St. Thomas' Hospital, London, United Kingdom; [8]ProMedica Toledo Hospital, Toledo, OH; [9]MedStar Health Research Institute, Hyattsville, MD; [10]University of Michigan, Ann Arbor, MI; [11]Houston Methodist DeBakey Heart & Vascular Center, Houston, TX; [12]Leiden University Medical Center, Leiden, Netherlands

Invited Discussant: *W. Randolph Chitwood, Jr.

12. Repeat Conventional Biological Valve Replacement over 20 Years: Surgical Benchmarks Should Guide Patient Selection for Transcatheter Valve-in-Valve Therapy

*John M. Stulak, Vakhtang Tchantchaleishvili, *Richard C. Daly, Mackram Eleid, *Kevin L. Greason, *Joseph A. Dearani, David L. Joyce, *Lyle D. Joyce, *Alberto Pochettino, Sameh M. Said, *Hartzell V. Schaff, *Simon Maltais

Mayo Clinic, Rochester, MN

Invited Discussant: *Vinod H. Thourani

13. Aortic Root Enlargement Does Not Increase the Operative Risk of Aortic Valve Replacement

Rodolfo V. Rocha, Cedric Manlhiot, *Christopher M. Feindel, *Terrence M. Yau, *Tirone E. David, Maral Ouzounian

University of Toronto, Toronto, ON, Canada

Invited Discussant: *Edward G. Soltesz

14. Bioprosthetic Aortic Valve Replacement: Revisiting Prosthesis Choice in Patients Younger than 50 Years of Age

Nana Toyoda, *Joanna Chikwe, Samuel R. Schnittman, Shinobu Itagaki, Natalia N. Egorova, *David H. Adams

Mount Sinai Medical Center and Stony Brook University Hospital, New York, NY

Invited Discussant: *Thierry G. Mesana

5:30 pm **Adjourn**

MONDAY AFTERNOON, MAY 1, 2017

2:00 pm – 5:15 pm **Controversies in CABG 2017** Room 311, Hynes
Course Co-Chairs: *John D. Puskas and *David P. Taggart
Expert Panel: *Bruce W. Lytle, *Joseph F. Sabik, Miguel Sousa Uva

2:05 pm **Controversies in CABG 2017**
*John D. Puskas, *Mount Sinai Saint Luke's*

2:15 pm **C1. Priorities in CABG: Is Long-Term Survival More Dependent on Completeness of Revascularization or Multiple Arterial Graft?**
Joshua M. Rosenblum, William B. Keeling, John Hunting, Jose Binongo, Bradley G. Leshnower, *Edward P. Chen, Jeffrey S. Miller, Steven Macheers, Omar M. Lattouf, *Robert A. Guyton, *Vinod H. Thourani, *Michael E. Halkos
Emory University, Atlanta, GA

2:22 pm **Discussion: Priorities in CABG**
*Bruce W. Lytle, *The Heart Hospital at Baylor Plano*

2:30 pm **C2. Saphenous Vein Versus Right Internal Thoracic Artery As a Y-Composite Graft: 5-Year Angiography and Midterm Clinical Follow-Up of the SAVE RITA Trial**
Min-Seok Kim, Ho Young Hwang, Jun Sung Kim, Se Jin Oh, Seokyung Hahn, *Ki-Bong Kim
Seoul National University Hospital, Seoul, Republic of Korea

2:37 pm **Discussion: Conduits in CABG**
*Joseph F. Sabik, *University Hospitals Cleveland Medical Center*

2:45 pm **C3. Minimally Invasive CABG with Bilateral Internal Thoracic Arteries: Will This Be the Future?**
Pradeep Nambiar
Moolchand Hospitals, Gurgaon, India

2:52 pm **Discussion: BITA/ART Trial**
*David P. Taggart, *University of Oxford*

3:00 pm **C4. Hybrid Coronary Revasculrization Versus Percutaneous Strategies for Left Main Stenosis: A Propensity Match Study**
Alberto Repossini[1], Lorenzo Di Bacco[1], Laura Giroletti[1], Maurizio Tespili[2], Antonio Saino[2], Claudio Gentilini[3], Davide Personeni[2], Alfonso Lelasi[2], *Claudio Muneretto[1]
[1]University of Brescia, Brescia, Italy; [2]Ospedale Bolognini di Seriate, Seriate, Italy; [3]Ospedale di Chiari, Brescia, Italy

3:07 pm **Discussion: The Role of HCR**
*John D. Puskas, *Mount Saint Luke's*

3:15 pm **C5. Off-Pump Coronary Artery Bypass Grafting Provides More Clinical Benefit in Patients with Preoperative Renal Failure**
Chikara Ueki[1], Hiroaki Miyata[2], *Noboru Motomura[2], Ryuzo Sakata[2], Genichi Sakaguchi[1], Takehide Akimoto[1], *Shinichi Takamoto[2]
[1]Shizuoka General Hospital, Shizuoka, Japan; [2]Japan Cardiovascular Surgery Database Organization, Bunkyo-ku, Japan

3:22 pm **Discussion: OPCAB in 2017**
*David P. Taggart, *University of Oxford*

3:30 pm **Comparison of European and North American Guidelines for Surgical Myocardial Revascularization**
Miguel Sousa Uva, *Hospital Cruz Vermelha*

3:40 pm – 4:10 pm **Coffee Break in the Exhibit Hall**

4:10 pm **Avoiding Stroke in CABG**
*Joseph Sabik, *University Hospitals Cleveland Medical Center*

Late-Breaking Clincial Trial

LB11. Comparable Mid- and Long-Term Patency Rates for Skeletonized and Non-Skeletonized Internal Thoracic Artery Grafts: A Prospective Randomized Trial
Mats Dreifaldt[1], David Taggart[2], Lennart Bodin[3], Håkan Geijer[1], Mats Lidén[1], Domingos Souza[1]
[1]Örebro University, Örebro, Sweden; [2]Oxford University, Oxford, United Kingdom; [3]Karolinska institute, Solna, Sweden

4:30 pm **C6. Lack of a Heart Team in Stand-Alone Interventional Cardiology Units Impacts the Rate of Percutaneous Coronary Intervention in Patients with Multi-Vessel Disease**
Eilon Ram, Yigal Kassif, Amit Segev, Jacob Lavee, Ronny Ben-Avi, Ilan Goldenberg, Nir Shlomo, *Ehud Raanani
Sheba Tel Hashomer Medical Center, Ramat Gan, Israel

4:38 pm **Discussion with Expert Panel: What Are the Barriers to a Real Heart Team at Our Institution(s) and How Are We Working to Overcome Them?**

4:47 pm **C7. Programmatic and Surgeon Specialization in Coronary Surgery Improves Morbidity and Mortality Following Isolated Coronary Bypass Grafting**
A. Claire Watkins, Mehrdad Ghoreishi, Nathan L. Maassel, Brody Wehman, *Bartley P. Griffith, *James S. Gammie, Bradley S. Taylor
University of Maryland, Baltimore, MD

4:54 pm **Discussion with Expert Panel: Is It Time for a Subspecialty in Surgical Coronary Revascularization? Why? How? What Are the Obstacles?**

5:04 pm **Question and Answer with Expert Panel**

5:15 pm **Adjourn**

MONDAY AFTERNOON, MAY 1, 2017

2:00 pm – 5:15 pm **Congenital Heart Disease** Room 312, Hynes
Simultaneous Scientific Sessions
8 minute presentation, 10 minute discussion

Moderators: *Robert D. Jaquiss and *Andrew J. Lodge

15. Long Term Outcomes of the Expanded Polytetrafluoroethylene Conduit with Bulging Sinuses and a Fan Shaped Valve in the Right Ventricular Outflow Tract Reconstruction

Takako Miyazaki, Masaaki Yamagishi, Yoshinobu Maeda, Satoshi Taniguchi, Shuhei Fujita, Hisayuki Hongu, Haruka Fu, ◆Hitoshi Yaku
Kyoto Prefectural University of Medicine, Kyoto, Japan

Invited Discussant: *John W. Brown

16. Valve-Sparing Repair with Intraoperative Balloon Dilation in Tetralogy of Fallot: Mid-Term Results and Therapeutic Implications

Sophie C. Hofferberth, Meena Nathan, Lynn A. Sleeper, Audrey C. Marshall, Christopher W. Baird, *Pedro J. del Nido, ◆Sitaram M. Emani
Boston Children's Hospital, Harvard Medical School, Boston, MA

Invited Discussant: *Giovanni Stellin

Deep Dive Session with Paper 16. *Valve-Sparing Repair with Intraoperative Balloon Dilation in Tetralogy of Fallot: Mid-Term Results and Therapeutic Implications*

Panelists: ◆SItaram Emani, Sophie C. Hofferberth, *Giovanni Stellin

3:20 pm – 3:55 pm **Coffee Break in the Exhibit Hall**

17. Bicuspid Valved Polytetrafluoroethylene Conduits Versus Homograft Conduits for Right Ventricular Outflow Tract Reconstruction in Neonates, Infants and Young Children: An Institutional Experience

Christopher W. Mercer, Shawn C. West, Mahesh S. Sharma, *Victor O. Morell
Children's Hospital of Pittsburgh of UPMC, Pittsburgh, PA

Invited Discussant: *James A. Quintessenza

18. Transcatheter Pulmonary Valve Replacement for Treatment of Dysfunctional Surgical Bioprostheses: A Multicenter Study

Allison K. Cabalka[1], Jeremy D. Asnes[2], David T. Balzer[3], John P. Cheatham[4], Matthew J. Gillespie[5], Thomas K. Jones[6], Henri Justino[7], Dennis W. Kim[8], Te-Hsin Lung[9], Daniel R. Turner[10], Doff B. McElhinney[11]

[1]Mayo Clinic, Rochester, MN; [2]Yale University, New Haven, CT; [3]Washington University, St. Louis, MO; [4]Nationwide Children's Hospital, Columbus, OH; [5]Children's Hospital of Pennsylvania, Philadelphia, PA; [6]Seattle Children's Hospital, Seattle, WA; [7]Texas Children's Hospital, Houston, TX; [8]Children's Healthcare of Atlanta/Emory University, Atlanta, GA; [9]Medtronic, Santa Rosa, CA; [10]Children's Hospital of Michigan, Detroit, MI; [11]Lucille Packard Children's Hospital, Stanford University, Palo Alto, CA

Invited Discussant: *John E. Mayer

19. Modified Repair of Type I and II Truncus Arteriosus Limits Early Right Ventricular Outflow Tract Re-Operation

Clauden Louis, Michael F. Swartz, Jill M. Cholette, Francisco Gensini, ◆George M. Alfieris

University of Rochester, Rochester, NY

Invited Discussant: *Jonathan M. Chen

20. Impact of Truncal Valve Insufficiency on the Outcomes of Truncus Arteriosus Repair

Phillip Naimo, Tyson Fricke, *Yves d'Udekem, Robert Weintraub, Johann Brink, *Christian Brizard, *Igor Konstantinov

Royal Children's Hospital, Melbourne, Australia

Invited Discussant: *Carl L. Backer

5:15 pm **Adjourn**

MONDAY AFTERNOON, MAY 1, 2017

2:00 pm – 5:15 pm **General Thoracic Surgery** Room 302/304, Hynes
Simultaneous Scientific Session:
Management of Early Stage Lung Cancer
8 minute presentation, 10 minute discussion

Moderators: *Scott J. Swanson and *Michael Lanuti

21. Comparison of Morbidity of Pulmonary Segmentectomy and Lobectomy: Initial Results of a Phase III Randomized Trial of Lobectomy Versus Segmentectomy for Small (2 cm or Less) Peripheral Non-Small Cell Lung Cancer (JCOG0802/WJOG4607L)

Kenji Suzuki[1], Hisashi Saji[2], Shunichi Watanabe[3], *Morihito Okada[4], Junki Mizusawa[3], Ryu Nakajima[5], Masahiro Tsuboi[3], Shinichiro Nakamura[6], Kenichi Nakamura[3], Tetsuya Mitsudomi[7], Hisao Asamura[8]

[1]Juntendo University Hospital, Tokyo, Japan; [2]St. Marianna University, Kanagawa, Japan; [3]National Cancer Center Hospital, Tokyo, Japan; [4]Hiroshima University, Hiroshima, Japan; [5]Osaka City General Medical Center, Osaka, Japan[6]West Japan Oncology Group, Osaka, Japan; [7]Kinki University Faculty of Medicine, Osaka, Japan; [8]Keio University School of Medicine, Tokyo, Japan

Invited Discussant: *Nasser K. Altorki

22. Variability in Surgical Quality in Patients with Early Stage Non-Small Cell Lung Cancer Undergoing Wedge Resection Impacts Overall Survival When Compared to Stereotactic Body Radiation Therapy

Gaurav Ajmani[1], Chi-Hsiung Wang[1], Ki Wan Kim[1], *John A. Howington[2], Seth B. Krantz[1]

[1]NorthShore University Health System, Evanston, IL; [2]Saint Thomas Healthcare, Nashville, TN

Invited Discussant: *Benjamin D. Kozower

23. Endosonographic Mediastinal Lymph Node Staging in Positron Emission Tomography and Computed Tomography Negative Non-Small Cell Lung Cancer

Pravachan Hegde[1], Vicky Thiffault[1], Adeline Jouquan[1], Vipul Jain[2], Akshatha Gowda[2], *Pasquale Ferraro[1], *Moishe Liberman[1]

[1]University of Montreal, Montreal, QC, Canada; [2]University of California, San Francisco, CA

Invited Discussant: *Kazuhiro Yasufuku

24. Declining Use of Surgical Therapy for Early Stage Non-Small Cell Lung Cancer in the United States

Kathryn E. Engelhardt, Joseph M. Feinglass, *Malcolm M. DeCamp, Karl Y. Bilimoria, David D. Odell

Northwestern University, Chicago, IL

Invited Discussant: *Keith S. Naunheim

3:20 pm – 3:55 pm Coffee Break in the Exhibit Hall

Moderators: *Malcolm M. DeCamp, Jr. and *Joseph B. Shrager

25. Predictors of Distant Recurrence Following R0 Lobectomy for pN0 Lung Adenocarcinoma

Ilies Bouadallah, Whitney Brandt, Kay See Tan, *Bernard J. Park, *Prasad S. Adusumilli, *Valerie W. Rusch, Daniela Molena, *Manjit S. Bains, *James Huang, *Robert J. Downey, James M. Isbell, Matthew Bott, *David R. Jones

Memorial Sloan Kettering Cancer Center, New York, NY

Invited Discussant: *Michael Lanuti

26. Differential Impact of Operative Complications on Survival Following Surgery for Primary Lung Cancer

*Felix G. Fernandez[1], Andrzej S. Kosinski[2], *Anthony P. Furnary[3], *Mark Onaitis[4], Sunghee Kim[5], Robert H. Habib[6], Betty C. Tong[2], Patricia Cowper[5], *Daniel Boffa[7], *Jeffrey P. Jacobs[8], *Cameron D. Wright[9], *Joe B. Putnam[10]

[1]Emory University, Atlanta, GA; [2]Duke University, Durham, NC; [3]Starr-Wood Cardiothoracic Group, Portland, OR; [4]University of California, San Diego, CA; [5]Duke Clinical Research Institute, Durham, NC; [6]Society of Thoracic Surgeons Research Center, Chicago, IL; [7]Yale University, New Haven, CT; [8]Johns Hopkins All Children's Hospital, St. Petersburg, FL; [9]Massachusetts General Hospital, Boston, MA; [10]Baptist MD Anderson Cancer Center, Jacksonville, FL

Invited Discussant: *Sudish C. Murthy

27. Genetic Variants in Cytokine Signaling Pathways Are Associated with Survival in Surgically Resectable Non-Small Cell Lung Cancer

Boris Sepesi, Yuanquing Ye, Liren Zhang, Jianchun Gu, Lin Ji, Mara Antonoff, *Wayne L. Hofstetter, *David Rice, *Reza Mehran, *Garrett L. Walsh, *Ara A. Vaporciyan, *Stephen G. Swisher, *Jack A. Roth, Wu Xifeng

MD Anderson Cancer Center, Houston, TX

Invited Discussant: Bryan M. Burt

28. Long-Term Outcomes from a Phase I Near-Infrared Sentinel Lymph Node Mapping Trial in Non-Small Cell Lung Cancer

*Christopher S. Digesu[1], Krista J. Hachey[1], Denis M. Gilmore[2], Onkar V. Khullar[3], *Michael T. Jaklitsch[1], *Yolonda L. Colson[1] [1]Brigham and Women's Hospital, Boston, MA; [2]Vanderbilt University, Nashville, TN; [3]Emory University, Atlanta, GA*

Invited Discussant:

5:15 pm **Adjourn**

MONDAY AFTERNOON, MAY 1, 2017

2:00 pm – 5:30 pm **Perioperative Care** Room 306, Hynes
Simultaneous Scientific Session
6 minute presentation, 8 minute discussion

Moderators: Katherine J. Hoercher and *Glenn J. Whitman

29. Early Predictors of Permanent Pacemaker Implantation After Surgical Aortic Valve Replacement in High Risk Patients

Alejandro Suarez-Pierre, Todd C. Crawford, Mohammad F. Usmani, J. Trent Magruder, Thomas S. Metkus, *Jennifer S. Lawton, *Duke E. Cameron, *John V. Conte, *Glenn J. Whitman

Johns Hopkins University, Baltimore, MD

Invited Discussant: *Ourania Preventza

30. Predicting Readmission After Cardiac Surgery: Insights from a State-Level Analysis

J. Trent Magruder, Arman Kilic, Todd C. Crawford, Joshua C. Grimm, Sharon G. Owens, Maryhelen Miller, Lynn Desrosiers, *Glenn J. Whitman

Johns Hopkins University, Baltimore, MD

Invited Discussant: Domenico Pagano

31. A Novel Risk Score to Predict New Atrial Fibrillation After Isolated Coronary Artery Bypass Grafting

Sophie Lin, Todd C. Crawford, Alejandro Suarez-Pierre, J. Trent Magruder, Joshua C. Grimm, *Jennifer S. Lawton, *Glenn J. Whitman, *Duke E. Cameron, *William A. Baumgartner, Kaushik Mandal

Johns Hopkins University, Baltimore, MD

Invited Discussant: *Filip P. Casselman

32. Preoperative Left Ventricular Diastolic Dysfunction Predicts Postoperative Atrial Fibrillation After Aortic Valve Replacement for Aortic Valve Stenosis

Yoshihisa Morimoro, Takaki Sugimoto, Keigo Fukase, Fumiya Haba, Mari Hamaguchi

Awaji Medical Center, Hyogo, Sumoto, Japan

Invited Discussant: *Michael Argenziano

33. Utilizing Observed to Expected 30-Day Mortality As a Benchmark for Transcatheter Aortic Valve Replacement Programs: Outliers and Potential Implications for Reimbursement

Matthew C. Henn[1], Alan Zajarias[1], Nishath Quader[1], Marc Sintek[1], Brian R. Lindman[1], John M. Lasala[1], Kelly Koogler[1], Marci S. Damiano[1], Puja Kachroo[1], D. Craig Miller[2], Spencer J. Melby[1], *Marc R. Moon[1], *Ralph J. Damiano, Jr.[1], *Hersh S. Maniar[1]

[1]Washington University, Barnes-Jewish Hospital, St Louis, MO; [2]Stanford University Medical School, Palo Alto, CA

Invited Discussant: *Michael E. Halkos

Late-Breaking Clincial Trial

LB2. Use of a Novel Hemoadsorption Technology to Reduce Plasma Free Hemoglobin During Complex Cardiac Surgery: Results from the Randomized Controlled Safety and Feasibility REFRESH I Trial

*Joseph Zwishenberger[1], *Thomas Gleason[2], *Michael Argenziano[3], *Joseph Bavaria[4], Lauren Kane[5], *Joseph Coselli[6], *Richard Engelman[7], Kenichi Tanaka[8], Ahmed Awad[9], Michael Sekela[1]

[1]University of Kentucky, Lexington, KY; [2]University of Pittsburgh, Pittsburgh, PA; [3]Columbia University, New York, NY; [4]University of Pennsylvania, Philadelphia, PA; [5]University Texas Children's Hospital, Houston, TX; [6]Texas Heart Institute, Houston, TX; [7]Basystate Medical Center, Springfield, MA; [8]Univeristy of Maryland, Baltimore, KY; [9]Cooper University Hospital, Camden, NJ

Invited Discussant: *Frank W. Sellke

3:30 pm – 4:05 pm Coffee Break in the Exhibit Hall

34. Propensity and Impact of Autologous Platelet Rich Plasma Utilization in Acute Type A Dissection

Harleen K. Sandhu, Shruti N. Dahotre, Kristofer M. Charlton-ouw, Charles C. Miller, III, Roy K. Sheinbaum, *Hazim J. Safi, *Anthony L. Estrera, Shao Feng Zhou

McGovern Medical School, UTHealth at Houston, Houston, TX

Invited Discussant: *Himanshu J. Patel

35. Partial Thromboplastin Time Is More Predictive of Bleeding than Heparin Levels in Heparinized Pediatric Patients Following Cardiac Surgery

Olubunmi Oladunjoye, Asha Nair, Lynn Sleeper, Christina VanderPluym, John Kheir, ◆Sitaram Emani

Boston Children's Hospital, Boston, MA

Invited Discussant: *David M. McMullan

36. Estimation of Achievable Oxygen Consumption Following Transfusion with Rejuvenated Red Blood Cells

Amudan J. Srinivasan[1], Kyle Kausch[2], Collin Inglut[2], Alan Gray[2], Matthew Landrigan[2], Ian J. Welsby[1]

[1]Duke University, Durham, NC; [2]Zimmer Biomet, Warsaw, IN

Invited Discussant: *Richard D. Weisel

37. The Impact of Prolonged Intensive Care Stay on Quality of Life, Recovery and Clinical Outcomes: A Prospective Study

Mohammad S. Diab[1], Rajdeep Bilkhu[1], Gopal Soppa[1], Oswaldo Valencia[1], Johan Heiberg[2], Colin Royse[2], *Marjan Jahangiri[1]

[1]St. George's University Hospital, London, United Kingdom; [2]The Royal Melbourne Hospital, London, Australia

Invited Discussant: *Douglas R. Johnston

38. Preoperative Beta-Blocker Use Correlates with Worse Outcomes in Patients Undergoing Valve Surgery

Sarah A. Schubert[1], Robert B. Hawkins[1], J. Hunter Mehaffey[1], Clifford E. Fonner[2], Jeffery B. Rich[2], *Alan M. Speir[3], Mohammed Quader[4], *Irving L. Kron[1], Leora T. Yarboro[1], *Gorav Ailawadi[1]

[1]University of Virginia, Charlottesville, VA; [2]Virginia Cardiac Services Outcomes Initiative, Falls Church, VA; [3]Inova Fairfax Hospital, Falls Church, VA; [4]Virginia Commonwealth University, Richmond, VA

Invited Discussant: *Frank A. Baciewicz, Jr.

5:30 pm **Adjourn**

TUESDAY MORNING, MAY 2, 2017

7:00 am – 8:25 am **AATS/TSRA Preparing Yourself for an Academic Career Breakfast Session** Constitution AB, Sheraton

7:00 am – 8:25 am **Cardiac Surgery Forum** Room 310, Hynes

5 minute presentation, 5 minute discussion

Moderators: *Paul W. Fedak and *Craig H. Selzman

F1. Overexpression of MicroRNA-30a Contributes to the Aortic Dissection via Down-Regulation of Lysyl Oxidase

Tianxiang Gu, Yang Yu, Enyi Shi

The First Hospital of China Medical University, Shenyang, China

Invited Discussant: *Leora B. Balsam

F2. Circulating Endothelial Specific Exosome Profiles Enable Noninvasive Diagnosis of Aortic Aneurysm Disease

Laxminarayana Korutla[1], Andreas Habertheuer[1], Sanjana Reddy[1], Eric Lai[1], *Joseph Bavaria[1], Reed Pyeritz[1], Giovanni Ferrari[1], Antonio Frasca[1], Sudhish Sharma[2], Sunjay Kaushal[1], Kariana Milewski[1], Prashanth Vallabhajosyula[1]

[1]University of Pennsylvania, Philadelphia, PA; [2]University of Maryland, Baltimore, MD

Invited Discussant: *Gorav Ailawadi

F3. Model Bicuspid Aortic Valve by Knocking Out NOTCH1 Gene in Patient's Induced Pluripotent Stem Cells with CRISPR/Cas9

Bo Yang[1], JIao Jiao[2], Weihua Tian[3], Ping Qiu[1]

[1]University of Michigan, Ann Arbor, MI; [2]Ganlee Corp, Beijing, China; [3]University of Copenhagen, Copenhagen, Denmark

Invited Discussant: *Paul W. Fedak

F4. Donor Heart Specific Exosome Profiling enables Noninvasive Monitoring for Early Allograft Rejection in a Mouse Heterotopic Heart Transplantation Model

Andreas Habertheuer, Susan Rostami, Laxminarayana Korutla, Sanjana Reddy, Brigitte Köberlein, Ali Naji, Prashanth Vallabhajosyula

University of Pennsylvania, Philadelphia, PA

Invited Discussant: *Pavan Atluri

F5. Angiogenesis and Arteriogenesis Precede Cardiomyocyte Migration in the Regeneration of Mammalian Hearts

Arnar B. Ingason, Andrew B. Goldstone, Michael J. Paulsen, Bryan B. Edwards, Anahita Eskandari, Vi Truong, Alexandra T. Bourdillon, Tanner Bollig, Amanda N. Steele, *Y. Joseph Woo

Stanford University, Stanford, CA

Invited Discussant: Bradley G. Leshnower

F6. Regeneration of a Neoartery Through a Completely Autologous Acellular Conduit in a Minipig Model

Xuefeng Qiu[1], Tao Wang[2], Sze Yue Wong[3], Wen Zhao[4], ◆Nianguo Dong[2], Song Li[1]

[1]University of California, Los Angeles, CA; [2]Huazhong University of Science and Technology, Wuhan, Hubei Province, China; [3]University of California, Berkeley, CA; [4]Northwestern Polytechnical University, Xi'an, Shaanxi, China

Invited Discussant: *Kenneth G. Warner

F7. Prolonged Treatment with S-Nitroso Human Serum Albumin Is More Effective and Prevents Inflammatory and Oxydative Effects Compared to Inhaled Nitric Oxide in Experimental Congenital Pulmonary Arterial Hypertension

Alessio Rungatscher[1], Seth Hallström[2], Daniele Linardi[1], Livio San Biagio[1], Christine Renate Rossmann[2], ◆Giovanni Battista Luciani[1], *Giuseppe Faggian[1]

[1]University of Verona, Verona, Italy; [2]Medical University of Graz, Graz, Austria

Invited Discussant: *James S. Tweddell

8:25 pm Adjourn

7:00 am – 8:25 am **General Thoracic Surgery Forum** Room 306, Hynes
5 minute presentation, 5 minute discussion

Moderators: *Marc DePerrot and *Harvey I. Pass

F8. Therapeutic Targeting of Tumor-Promoting Macrophages in EGFR Mutant Lung Adenocarcinoma with Trabectedin

Hyun-Sung Lee, David Yoon, Yanlan Dong, Hee-Jin Jang, Jignesh Patel, Ori Wald, *David J. Sugarbaker, Bryan M. Burt

Baylor College of Medicine, Houston, TX

Invited Discussant: *David S. Schrump

F9. A Tumor Immune Microenvironment Signature Predicts Response to Immune Checkpoint Blockade in Malignant Pleural Mesothelioma

Hyun-Sung Lee, Hee-Jin Jang, David Yoon, Yanlan Dong, Jignesh Patel, Ori Wald, Thomas M. Wheeler, Veronica V. Lenge De Rosen, Jun Zhang, *David J. Sugarbaker, Bryan M. Burt

Baylor College of Medicine, Houston, TX

Invited Discussant: *Raphael Bueno

F10. Asbestos Up-Regulates EZH2 to Mediate Epigenetic Repression of the INK4a/ARF Gene Locus in Normal Human Mesothelial Cells

Eden C. Payabyab, Sichuan Xi, David M. Straughan, Emily S. Reardon, Mary Zhang, Julie A. Hong, R. Taylor Ripley, Chuong D. Hoang, *David S. Schrump

National Cancer Institute, Bethesda, MD

Invited Discussant: *Prasad Adusumilli

F11. Naturally-Occurring IgG Antibodies for the Treatment of Human Non-Small Cell Lung Cancer

Hyun-Sung Lee, Hee-Jin Jang, David Yoon, Mayra Hernandez Sanabria, Duy Tri Le, Jansen Smith, Sung Yun Jung, Ori Wald, *David J. Sugarbaker, Silke Paust, Bryan M. Burt

Baylor College of Medicine, Houston, TX

Invited Discussant: *Alexander S. Krupnick

F12. The Impact of Early Oral Feeding on Proinflammatory Cytokines After McKeown Minimally Invasive Esophagectomy for Cancer

Yin Li, Hai-Bo Sun, Xian-Ben Liu, Rui-Xiang Zhang, Zong-Fei Wang, Shi-Lei Liu, Yan Zheng, Xian-Kai Chen, Jian-Jun Qin

The Affiliated Cancer Hospital of Zhengzhou University, Zhengzhou, China

Invited Discussant: *Wayne Hoffstetter

F13. *In Vivo* Development of Transplant Arteriosclerosis in Humanized Mice Reflects BOS in lung Transplant Recipients and Is Controlled by Autologous Regulatory T Cells

Thierry Siemeni, A.K. Knöfel, Fabio Lus, K. Jansson, Jawad Salman, Wiebke Sommer, Murat Avsar, Igor Tudorache, Christian Kühn, *Axel Haverich, Gregor Warnecke

Hannover Medical School, Hannover, Germany

Invited Discussant: *Daniel Kreisel

F14. Matrix Metalloproteinase 12 Promotes Tumor Propagation in the Lung

Ezra Ella[1], Yaniv Harel[1], Michal Abraham[1], Hanna Wald[1], Ofra Benny[2], Adi Karsch-Bluman[2], Vincent Dive[3], Laurent Devel[3], Uzi Izhar[4], *Oz M. Shapira[4], David Yoon[5], Hyun-Sung Lee[5], *David J. Sugarbaker[5], Bryan M. Burt[5], Amnon Peled[1], Ori Wald[5]

[1]Hadassah Hebrew University Hospital, Jerusalem, Israel; [2]The Hebrew University, Jerusalem, Israel; [3]CEA Saclay, Saclay, France; [4]Hadassah Hebrew University Hospital, Jerusalem, Israel; [5]Baylor College of Medicine, Houston, TX

Invited Discussant: *Yolonda L. Colson

F15. Meta-Analysis Identifies a Novel Anti-Apoptotic Gene and Potential Therapeutic Target in Malignant Pleural Mesothelioma

Li Zhang, Anand Singh, Nisan Bhattacharyya, R. Taylor Ripley, *David S. Schrump, Chuong D. Hoang

National Institutes of Health, Bethesda, MD

Invited Discussant: *Jessica S. Donington

8:25 pm **Adjourn**

TUESDAY MORNING, MAY 2, 2017

7:00 am – 8:25 am **Adult Cardiac Emerging Technologies and Techniques/Case Video Forum** Room 311, Hynes

5 minute presentation, 5 minute discussion

Moderators: *T. Sloane Guy, *Wilson Y. Szeto, *Song Wan

T1. Transcarotid TAVR: A Comparison of In-Hospital and Intermediate Term Outcomes with Transapical and Transaortic Access

*Keith B. Allen[1], Adnan Chhatriwalla[1], *David J. Cohen[1], Sanjeev Aggarwal[1], Zuhair Hawa[1], Anthony J. Hart[1], Suzanne J. Baron[1], J. Russell Davis[1], Alex F. Pak[1], Zafir Hawa[2], Jim Mitchell[2], *A. Michael Borkon[1]

[1]St. Luke's Mid American Heart Institute, Kansas City, MO; [2]North Kansas City Hospital, North Kansas City, MO

T2. Surgical Treatment May Enhance Reverse Remodeling of the Ventricle in Patients with Functional Mitral Regurgitation

*Masashi Komeda[1], Takashi Kusunose[1], Hideki Kitamura[2], Toshimi Ujiie[1]

[1]Iseikai Hospital, Osaka, Japan; [2]Nagoya Heart Center, Nagoya, Japan

T3. Transcaval Transcatheter Aortic Valve Replacement: No Patient Left Behind!

*Talal Al-Atassi, David G. Cervantes, *Vasilis Babaliaros, *Ronnie Ramadan, *Vinod Thourani

[1]Iseikai Hospital, Osaka, Japan; [2]Nagoya Heart Center, Nagoya, Japan

T4. Sutureless Aortic Valve Replacement in High Risk Patients Neutralizes Expected Worse Hospital Outcome: A Clinical and Economic Analysis

Emmanuel Villa, Margherita Dalla Tomba, Antonio Messina, Andrea Trenta, Federico Brunelli, Marco Cirillo, Zean Mhagna, Giovanni Troise

Poliambulanza Foundation Hospital, Brescia, Italy

T5. Aortic Valve Repair for Aortic Insufficiency Associated with Ascending Aortic Aneurysms using Geometric Ring Annuloplasty

Marek J. Jasinski[1], *J. Scott Rankin[3], R. Gocol[2], D. Hudziak[2], Adam R. Kowalowka[2], *Marek A. Deja[2]

[1]Wroclaw Medical University, Wroclaw, Poland; [2]Silesian Heart Centre, Katowice, Poland; [3]West Virginia University, Morgantown, WV

T6. Hemodynamic Follow-Up After Valve-in-Valve TAVI for Failed Aortic Bioprosthesis

Konstantin Alexiou[1], Manuel Wilbring[2], Sebastian Arzt[1], Utz Kappert[1], Sems Malte Tugtekin[1], Klaus Matschke[1]

[1]University Heart Center, Dresden, Germany; [2]University Heart Center Halle, Germany

T7. Robotic Hybrid Coronary Bypass Grafting

Gianluca Torregrossa, *John Puskas

Mount Sinai Hospital, New York, NY

T8. Computational Fluid Dynamics Assessment of Type-B Dissections As Tool to Predict Evolution of the Disease and Indicate Treatment Strategies

Domenico Calcaterra[1], Liza Shrestha[2], Sarah Vigmostad[2], Robert Saeid Farivar[1], Kevin Harris[1]

[1]Minneapolis Heart Institute, Minneapolis, MN; [2]University of Iowa, Iowa City, IA

8:25 am **Adjourn**

TUESDAY MORNING, MAY 2, 2017

7:00 am – 8:25 am **Congenital Emerging Technologies and Techniques/Case Video Forum** Room 312, Hynes

6 minute presentation, 6 minute discussion

Moderators: *Kristine J. Guleserian and *David M. McMullan

T9. Primary Repair of Total Anomalous Pulmonary Venous Connection with Sutureless Strategy

*Yiqun Ding

Shenzhen Children's Hospital, Shenzhen, China

T10. Anatomical Correction Including Aortic Root Translocation and Hemi-Senning/ Bidirectional Glenn Atrial Switch Procedure in a Patient with Congenitally Corrected Transposition of the Great Arteries, Ventricular Septal Defect, Pulmonary Stenosis and Dextro

*Eun Seok Choi, *Chang-Ha Lee, *Sungkyu Cho

Sejong General Hosptial, Bucheon, Republic of Korea

T11. Novel Surgical Strategy for Complicated Pulmonary Stenosis Using Hemodynamic Analysis Based on a Virtual Operation with Numerical Flow Analysis
*Kagami Miyaji[1], Shohei Miyazaki[1], Keiichi Itatani[2], Koichi Sughimoto[1], Tadashi Kitamura[1], Tetsuya Horai[1], Mamika Motokawa[1]
[1]Kitasato University, Sagamihara, Japan; [2]Kyoto Prefectual Universty of Medicine, Kyoto, Japan

T12. Repair Quadricuspid Truncal Valve with Utilization of Pulmonary Cusp to Reconstruct RVOT, Repair without Conduit
Shu-chien Huang, Ling-Yi Wei
National Taiwan University Hospital, Taipei, Taiwan

T13. Chimney Reconstruction of the Aortic Arch in the Norwood Procedure
Satoshi Asada, Masaaki Yamagishi, Takako Miyazaki, Yoshinobu Maeda, Shuhei Fujita, Hisayuki Hongu, Haruka Fu, Keiichi Itatani, ◆Hitoshi Yaku
Kyoto Prefectural University of Medicine, Kyoto, Japan

T14. Through Tricuspid Closure for Doubly Committed Subarterial Ventricular Septal Defect with Right Vertical Subaxillary Mini-Incision: A Matched-Pair Analysis
Rui Liu, Zhongdong Hua
Chinese Academy of Medical Sciences & Peking Union Medical College Fuwai Hospital, Beijing, China

T15. A Successful Biventricular Repair for a Neonate with Critical Aortic Stenosis Complicated with Left Ventricular Aneurysm and Endocardial Fibroelastosis
Yujiro Ide
Mt. Fuji Shizuoka Children's Hospital, Shizuoka City, Japan

8:25 am **Adjourn**

TUESDAY MORNING, MAY 2, 2017

7:00 am – 8:25 am **General Thoracic Emerging Technologies and Techniques/Case Video Forum** Room 302/304, Hynes
5 minute presentation, 4 minute discussion
Moderators: *Jay M. Lee and *Varun Puri

T16. Laparoscopic Ligation of Cisterna Chyli
Ilitch Diaz Gutierrez, *Rafael Santiago Andrade
University of Minnesota, Minneapolis, MN

T17. The Role of Minimally Invasive Thoracoscopic Approach for the Operation of Non-Small Cell Lung Cancer Involving Vertebral Column
Kwanyong Hyun, Chang Hyun Kang, Samina Park, Yoohwa Hwang, Hyun Joo Lee, In Kyu Park, *Young Tae Kim
Seoul National University College of Medicine, Seoul, Republic of Korea

T18. Endoscopic Repair of Bronchogastric Fistula After Esophagectomy
Igor Brichkov
Rutgers Cancer Institute of New Jersey, New Brunswick, NJ

T19. Thoracoscopic Anatomical Lung Segmentectomy Based on Dissection Along the Intersegmental Veins, Left Lateral Basal Segmentectomy
Hiroyuki Oizumi, Hirohisa Kato, Jun Suzuki, Hikaru Watarai, Akira Hamada, *Kenta Nakahashi, Mitsuaki Sadahiro
Yamagata University, Yamagata, Japan

T20. Electromagnetic Navigation Bronchoscopy-Guided Dye Marking for Minimally Invasive Resection of More Than 100 Pulmonary Nodules
Kunal Mehta, *Arjun Pennathur, Tadeusz Witek, Michael R. Reidy, Valentino Bianco, William E. Gooding, *Matthew J. Schuchert, *James D. Luketich, Omar Awais
University of Pittsburgh, Pittsburgh, PA

T21. Predicting Pulmonary Air Leak Resolution Using Transpleural Airflow Data After Lung Resection
◆Sebastien Gilbert[1], Daniel G. French[2], Natalie Japkowicz[3], Mohsen Ghazel[1]
[1]University of Ottawa, Ottawa, ON, Canada; [2]Dalhousie University, Halifax, NS, Canada; [3]American University, Washington, DC

T22. Laparoscopic Trans-Diaphragmatic Chest Surgery: Early Experience
Ilitch Diaz Gutierrez, Eitan Podgaetz, Madhuri Rao, *Rafael Santiago Andrade
University of Minnesota, Minneapolis, MN

T23. The Impact of an Energy Sealing Device in Thoracoscopic Anatomic Segmentectomy for Small-Sized Pulmonary Nodules
Hirohisa Kato, Hiroyuki Oizumi, Jun Suzuki, Akira Hamada, Hikaru Watarai, Kenta Nakahashi, Mitsuaki Sadahiro
Yamagata University, Yamagata-shi, Japan

T24. Using a Biploar Seal-and-Cut Device for Minimally Invasive Lung Resections Seal-and-Cut Device for Minimally Invasive Lung Resections
Thomas Kiefer[1], Sarah Counts[2]
[1]Klinikum, Konstanz, Germany; [2]Yale University, New Haven, CT

8:25 am **Adjourn**

TUESDAY MORNING, MAY 2, 2017

8:35 am – 9:55 am **Plenary Scientific Session** Ballroom ABC, Hynes
6 minute presentation, 10 minute discussion

Moderators: *Thoralf M. Sundt, III and *Marc R. Moon

39. Intraoperative Extracorporeal Membrane Oxygenation Improves Survival in Lung Transplantation

Konrad Hoetzenecker, Stefan Schwarz, Alberto Benazzo, Peter Jaksch, Gabriella Muraközy, Helmut Hager, Georg Roth, György Lang, Shahrokh Taghavi, *Walter Klepetko

Medical University of Vienna, Vienna, Austria

Invited Discussant: *Shaf Keshavjee

40. Long-Term Outcome Following Concomitant Mitral Valve Surgery and Cox Maze Procedure for Atrial Fibrillation: High Return to Sinus Rhythm and Remarkably Low Incidence of Stroke

*Niv Ad[1], Sari D. Holmes[2], Paul S. Massimiano[3], Anthony J. Rongione[3], Lisa M. Fornaresio[2]

[1]West Virginia University Heart and Vascular Institute, Morgantown, WV; [2]Adventist HealthCare, Takoma Park, MD

Invited Discussant: *A. Marc Gillinov

41. Surgery for Congenital Heart Disease Beyond 50 Years of Age: Mid-Term Outcomes and Risk Factors of an Emerging Population

Mauro Lo Rito, Tommaso Generali, Alessandro Varrica, Mario Carminati, Angelo Micheletti, *Alessandro Frigiola, Marco Ranucci, Massimo Chessa, *Alessandro Giamberti

IRCCS Policlinico San Donato, San Donato Milanese, Italy

Invited Discussant: *Vaughn A. Starnes

9:30 am **In the Beginning . . . A Video History of the AATS**

9:55 am – 10:30 am **Coffee Break in the Exhibit Hall**

10:00 am – 10:25 am
Integrity and Professionalism: Our Guides to Educating the Next Generation AATS CT Theater I
Booth #106, Exhibit Hall
Not for Credit

Moderator and Presenter: *G. Alexander Patterson, *Washington University*

Panelists:
*Clifford W. Barlow, *Southampton General Hospital*
*Edward D. Verrier, *University of Washington*
*Richard I. Whyte, *Beth Israel Deaconess Medical Center*

10:30 am **Award Presentations**

10:40 am – 11:45 am **Plenary Scientific Session** Ballroom ABC, Hynes
7 minute presentation, 11 minute discussion
Moderators: *Duke E. Cameron and *Marc R. Moon

10:40 am **20th Annual C. Walton Lillehei Resdient Forum Winner Presentation**
Introduced by: *Thoralf M. Sundt, *III, AATS President*

42. Clinical Outcomes and Rates of Aortic Reoperation Following 1-Stage Repair of Extensive Chronic Thoracic Aortic Dissection
*Nicholas T. Kouchoukos[1], *Alexander Kulik[2], Catherine F. Castner[1]
[1]Missouri Baptist Medical Center, St. Louis, MO; [2]Boca Raton Regional Hospital, Boca Raton, FL
Invited Discussant: *Joseph S. Coselli

43. Definitive Chemoradiation Compared to Induction Chemoradiotherapy Followed by Surgery in the Treatment of Esophageal Squamous Cell Carcinoma
Arianna Barbetta, Dessislava Stefanova, Koby Herman, *Prasad Adusumilli, *Manjit S. Bains, Matthew Bott, *James Huang, David H. Ilson, James M. Isbell, Yelena Y. Janjigian, Geoffrey Ku, *Bernard J. Park, *Valerie W. Rusch, Kay See Tan, Abraham Wu, *David R. Jones, Daniela Molena
Memorial Sloan Kettering Cancer Center, New York, NY
Invited Discussant: *David J. Sugarbaker

44. Surgeon Volume Impact on Mitral Valve Repair Rates, Durability and Survival in New York State
*Joanna Chikwe, Nana Toyoda, *Anelechi Anyanwu, Shinobu Itagaki, Natalia N. Egorova, Percy Boateng, Ahmed El-Eshmawi, *David H. Adams
Mount Sinai Medical Center and Stony Brook University Hospital, New York, NY
Invited Discussant: *Ralph J. Damiano, Jr.

11:45 am **Basic Science Lecture** Ballroom ABC, Hynes
Enhancing Surgical Performance: Optimizing Intra-Operative Surgical Leadership and Decision-Making
Rhona Flin, *University of Aberdeen*

12:35 pm **Adjourn for Lunch in the Exhibit Hall**

12:40 pm – 1:50 pm

Enhancing Cardiac Surgery in Underserved Regions a Joint PASCaTS (Pan-African Society for Cardiothoracic Surgery)/AATS Global Forum

AATS CT Theater II
Booth #1828, Exhibit Hall
Not for Credit

Moderators: *R. Morton Bolman, *University of Vermont Medical Center*
*Carlos Mestres, *Cleveland Clinic Abu Dhabi*
Charles A. Yankah, *German German Heart Institute*

Adapting Global Standards for Developing Sustainable and Quality Pediatric Cardiac Programs: Is There a Model That Fits Best in Low and Middle-Income Regions?

Francis Fynn-Thompson, *Boston/Kumasi, Ghana*

Burn-Out Rheumatic Mitral Valve Disease in Adolescents: Repair Versus Replacement

Manuel Antunes, *Coimbra, Portugal*

Heart Valve Development and TAVI In Africa: Variability of Demographic Risk Factors and Valve Requirements

Francis Smit, *Bloemfontein, South Africa*

Integrating Cardiac Surgery into Tertiary Healthcare in Nigeria, A Population of 182 Million: Funding and Budgetary Constraints

Jonathan Nwiloh, *Atlanta/AdaziNnukwu, Nigeria*

12:45 pm Moderated Poster Competitions

Adult Cardiac Moderated Poster Competition Aisle 200, Exhibit Hall
4 minute presentation, 1 minute discussion *Not for Credit*

Moderators: *Richard Lee and *S. Chris Malaisrie

P1. Outcomes of Aortic Valve Replacement with Bioprostheteic or Mechanical Valves in End-Stage Renal Disease Patients

Taro Nakatsu[1], Kenji Minakata[1], Shiro Tanaka[1], Kazuhisa Sakamoto[1], Shingo Hirao[1], Shinichi Tsumaru[1], Hiroomi Nishio[1], Junichiro Nishizawa[2], Keiichi Fujiwara[3], Jiro Esaki[4], Koji Ueyama[5], Tadaaki Koyama[6], Michiya Hanyu[7], Nobushige Tamura[8], Tatsuhiko Komiya[9], Yuhei Saitoh[10], Naoki Kanemitsu[11], Yoshiharu Soga[12], Kotaro Shiraga[13], Shogo Nakayama[14], Michihito Nonaka[15], Genichi Sakaguchi[16], Kazunobu Nishimura[17], Kazuo Yamanaka[18], Tomohiro Nakata[1], Kazuhiro Yamazaki[1], Ryuzo Sakata8, Tadashi Ikeda[1], *Kenji Minatoya[1]

[1]Kyoto University, Kyoto, Japan; [2]Hamamatsu Rosai Hospital, Hamamatsu, Japan; [3]Hyogo Prefectural Amagasaki General Medical Center, Amagasaki, Osaka, Japan; [4]Japanese Red Cross Otsu Hospital, Otsu, Shiga, Japan; [5]Kitano hospital, Osaka, Japan; [6]Kobe City Medical Center General Hospital, Kobe, Japan; [7]Kokura Kinen Hospital, Kitakyusyu, Japan; [8]Kumamoto Chuo Hospital, Kumamoto, Japan; [9]Kurashiki Central Hospital, Kurashiki, Okayama, Japan; [10]Matsue Red Cross Hospital, Matsue, Shimane, Japan; [11]Mitsubishi Kyoto Hospital, Kyoto, Japan; [12]Nagahama City Hospital, Nagahama, Shiga, Japan; [13]National Hospital Organization Kyoto Medical Center, Kyoto, Japan; [14]Osaka Red Cross Hospital, Osaka, Japan; [15]Shiga Medical Center for Adults, Moriyama, Shiga, Japan; [16]Shizuoka General Hospital, Shizuoka, Japan; [17]Takamatsu Red Cross Hospital, Takamatsu, Kagawa, Japan; [18]Tenri Hospital, Tenri, Nara, Japan

P2. Long-Term Effects of Prosthesis Selection in Adults Under 40 Years Old Undergoing Mitral Valve Replacement at 117 Hospitals in the State of California

Andrew B. Goldstone, William L. Patrick, Peter Chiu, Michael J. Paulsen, Bharathi Lingala, Michael Baiocchi, *Y. Joseph Woo

Stanford University, Stanford, CA

P3. Early Reperfusion Strategy Improves the Outcome of Surgery for Type A Acute Aortic Dissection with Malperfusion

Keiji Uchida, Norihisa Karube, Keiichiro Kasama, Ryo Izubuchi, Kenichi Fushimi, Motohiko Goda, Shinichi Suzuki, Kiyotaka Imoto, Munetaka Masuda

Yokohama City University Medical Center, Yokohama, Japan

P4. Combined Transaortic and Transapical Approach to Septal Myectomy in Patients with Hypertrophic Cardiomyopathy and Complex Subaortic and Midventricular Obstruction

Dustin Hang, *Hartzell V. Schaff, Steve R. Ommen, *Joseph A. Dearani, Rick A. Nishimura

Mayo Clinic, Rochester, MN

P5. Computed Tomography Versus Coronary Angiography for Coronary Screening in Heart Valve Surgery

Joon Bum Kim, Jihoon Kim, Ho Jin Kim, Sung-Ho Jung, Suk Jung Choo, Cheol Hyun Chung, *Jae Won Lee

Asan Medical Center, Seoul, Republic of Korea

P6. Surgical Treatment of Atrial Fibrillation with Different Lesion Set and Energy Sources: Mid-Term Results in Nine Hundred Patients

Alexander Bogachev-Prokophiev, Alexander V. Afanasyev, Sergey Zheleznev, Alexei Pivkin, Ravil Sharifullin, Alexander Karas'kov

Novosibirsk State Research Institute of Circulation Pathology, Novosibirsk, Russian Federation

P7. The Impact of Specific Preoperative Organ Dysfunction in Patients Undergoing Mitral Valve Surgery

Amalia Winters[1], Jessica Forcillo[1], Jose Binongo[2], Yi Lasanajak[2], *Michael Halkos[1], Douglas Murphy[1], Jeffrey Miller[1], Omar Lattouf[1], Brent Keeling[1], *Edward Chen[1], Brad Leshnower[1], *Robert Guyton[1], *Vinod Thourani[1]

[1]Emory University, Atlanta, GA; [2]Rollins Institute of Public Health, Atlanta, GA

P8. Comparison of Hemodynamic Performance and Exercise Capacity of 3 Contemporary Bioprosthetic Aortic Valves: Results from a Prospective Randomized Study

Matteo Pettinari, Gabriele Tamagnini, Roger Devotini, Gutermann Herbert, Christiaan Van Kerrebroeck, *Robert Dion

Ziekenhuis Oost Limburg, Genk, Belgium

P9. Intercostal Artery Management in Thoracoabdominal Aortic Surgery: to Reattach or Not to Reattach?

Rana O. Afifi, Harleen K. Sandhu, Syed T. Zaidi, Ernest K. Trinh, Akiko K. Tanaka, Charles C. Miller, III, *Hazim J. Safi, *Anthony L. Estrera

McGovern Medical School, UTHealth at Houston, Houston, TX

P10. Statewide Impact of Proposed Coronary Artery Bypass Grafting Bundled Payment

Robert B. Hawkins, II[1], J. Hunter Mehaffey[1], Kenan W. Yount[1], Clifford E. Fonner[2], Mohammed Quader[3], *Alan Speir[4], *Gorav Ailawadi[1], *Jeffrey Rich[2]

[1]University of Virginia, Charlottesville, VA; [2]Virginia Cardiac Services Quality Initiative, Falls Church, VA; [3]Virginia Commonwealth University, Richmond, VA; [4]INOVA Heart and Vascular Institute, Falls Church, VA

P11. Use of an Administrative Database Improves Accuracy of Hospital Reported Readmission Rates

*James Edgerton, Morley Herbert, Steves Ring, Baron Hamman

Texas Quality Initiative, Irving, TX

P12. Cardiothoracic Surgery T32 Training Grants Are Vital to the Development of Academic Surgeons

Eric J. Charles[1], Adishesh K. Narahari[1], J. Hunter Mehaffey[1], Sarah A. Schubert[1], Victor E. Laubach[1], *Curtis G. Tribble[1], Richard B. Schuessler[2], *Ralph J. Damiano, Jr.[2], *Irving L. Kron[1]

[1]University of Virginia, Charlottesville, VA; [2]Washington University, St. Louis, MO

Late-Breaking Clincial Trial

LB3. Is Hybrid Thoracoscopic Approach Effective for Treatment of Long Standing Persistent Lone Atrial Fibrillation? Clinical Update of the Historic-AF Trial

Claudio Muneretto[1], Ralf Krakor[2], Gianluigi Bisleri[3], Fabrizio Rosati[1], Lorenzo Di Bacco[1], Laura Giroletti[1], Antonio Curnis[1], Elisa Merati[4], Massimo Moltrasio[4], Claudio Tondo[4], Gianluca Polvani[4]

[1]University of Brescia, Brescia, Italy; [2]THG Staedtisches Klinikum, Dortmund, Germany; [3]Queen's University, Kingston, ON, Canada; [4]University of Milan, Milan, Italy

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Congenital Heart Disease Moderated Poster Competition Aisle 200, Exhibit Hall
4 minute presentation, 1 minute discussion *Not for Credit*

Moderators: ◆James Gangemi and ◆Joe Turek

P13. Surgical Strategy of Anatomical Repair for Congenitally Corrected Transposition of the Great Arteries

Kai Ma, Shoujun Li, Lei Qi, Zhongdong Hua, Keming Yang, Hao Zhang, Jun Yan, Sen Zhang, Qiuming Chen

Fuwai Hospital, Beijing, China

P14. MELD Score and Ventilation Indices Are Strong Determinants of Death, Intensive Care Morbidity and Massive Transfusion After Adult Congenital Heart Disease Surgery

Jane E. Heggie[1], Emma Lei Lei[2], Jesse Creamer[1], Karim Ladha[1], Tait Gordon[1], Jo Carroll[1], Erwin Oechslin[1], Lucy Roche[1], *Vivek Rao[1], *Christopher Caldarone[1], *Glen Van Arsdell[1], *William G. Williams[1], Edward Hickey[1]

[1]Toronto General, Toronto, ON, Canada; [2]Westmead Hospital, Sydney, Australia

P15. The CHSS Complete Atrioventricular Septal Defect Inception Cohort: Pre-Intervention Echocardiographic Characteristics

James M. Meza[1], Luc Mertens[1], Gina Baffa[2], Meryl S. Cohen[3], Michael D. Quartermain[3], David Gremmels[4], Cheryl Fackoury[1], *Christopher A. Caldarone[1], *William G. Williams[1], *William M. DeCampli[5], David M. Overman[4]

[1]Hospital for Sick Children, Toronto, ON, Canada; [2]Nemours Cardiac Center, Wilmington, DE; [3]Children's Hospital of Philadelphia, Philadelphia, PA; [4]Children's Hospitals and Clinics of Minnesota, Minneapolis, MN; [5]Arnold Palmer Hospital for Children, Orlando, FL, Canada

P16. Effect of Atrioventricular Valve Repair on Multi-Stage Palliation Outcomes of Single Ventricle Anomalies

Raina Sinha, Firat Altin, Courtney McCracken, Andrew Well, Joshua Rosenblum, *Brian Kogon, Subhadra Shashidharan, *Bahaaldin AlSoufi

Emory University, Atlanta, GA

P17. Long-Term Results of Tissue-Engineered Vascular Grafts in Pediatric Patients with Congenital Heart Disease

Tadahisa Sugiura[1], Goki Matsumura[2], Shinka Miyamoto[1], Hideki Miyachi[1], Christopher K. Breuer[1], *Toshiharu Shinoka[1]

[1]Nationwide Children's Hospital, Columbus, OH; [2]Tokyo Women's Medical University, Tokyo, Japan

P18. Outcomes and Prognostic Factors for Acquired Pulmonary Vein Stenosis in the Current Era

David Kalfa[1], *Emre Belli[2], *Emile Bacha[1], Virginie Lambert[2], Duccio di Carlo[3], *Martin Kostolny[4], Matej Nosal[5], Jurgen Horer[6], Jukka Salminen[7], Jean Rubay[8], Illya Yemets[9], Mark Hazekamp[10], *Bohdan Maruszewski[11], *George Sarris[12], Hakan Berggren[13], François Lacour-Gayet[14]

[1]Columbia University, New York, NY; [2]Marie Lannelongue Hospital, Paris, France; [3]Ospedale Pediatrico Bambino Gesù, Roma, Italy; [4]Great Ormond Street Hospital, London, United Kingdom; [5]Childrens Heart Center, Bratislava, Slovakia; [6]German Heart Center, Munich, Germany; [7]University of Helsinki, Helsinki, Finland; [8]Saint-Luc Hospital, Brussels, Belgium; [9]Ukrainian Childrens Cardiac Center, Kyiv, Ukraine; [10]Leiden University, Leiden, Netherlands; [11]Children's Memorial Health Institute, Warsaw, Poland; [12]Athens Heart Surgery Institute and Iaso Children's Hospital, Athens, Greece; [13]The Queen Silvia Children's Hospital, Goteborg, Sweden; [14]Royal Hospital, Muscat, Oman

P19. Autosomal Dominant Mannose-Binding Lecithin Binding Deficiency Is Associated with Worse Neurodevelopmental Outcomes After Cardiac Surgery in Infants

Daniel Seung Kim[1], Yatong K. Li[2], Jerry H. Kim[1], Curtis Bergquist[2], Marsha Gerdes[3], Judy Bernbaum[3], Nancy Burnham[3], Donna M. McDonald-McGinn[3], Elaine H. Zackai[3], Susan C. Nicolson[3], *Thomas L. Spray[3], Deborah A. Nickerson[1], Hakon Hakonarson[3], Gail P. Jarvik[1], J. William Gaynor[3]

[1]University of Washington, Seattle, WA; [2]University of Michigan, Ann Arbor, MI; [3]Children's Hospital of Philadelphia, Philadelphia, PA

P20. Bovine Arch Anatomy Influences Re-Coarctation Rates in the Era of the Extended End-to-End Anastomosis

*Joseph W. Turek, Brian D. Conway, Nicholas B. Cavanaugh, Alex M. Meyer, Osamah Aldoss, Ben E. Reinking, Ahmed El-Hattab, *Nicholas P. Rossi

University of Iowa Children's Hospital, Iowa City, IA

P21. Atrioventricular Valve Regurgitation in Patients Undergoing Total Cavopulmonary Connection: Impact of Valve Morphology on Survival and Reintervention

Masamichi Ono, Julie Cleuziou, Jelena Pabst von Ohain, Elisabeth Beran, Melchior Strbad, Alfred Hager, Christian Schreiber, *Rüdiger Lange

German Heart Center Munich, Munich, Germany

P22. Cardiac Progenitor Cell Infusion to Treat the Patients with Single Ventricle Univentricular Heart Disease Strategy Using Cardiac Progenitor Cell Infusion in Children with Single Ventricle Regenerative Therapy Using Cardiac Progenitor Cell for Congenital Heart Disease

*Shunji Sano, Shuta Ishigami, Shinichi Ohtsuki, Toshikazu Sano, Daiki Ousaka, Shingo Kasahara, Hidemasa Oh

Okayama University, Okayama, Japan

P23. Selective Versus Standard Cerebro-Myocardiall Perfusion in Neonates Undergoing Aortic Arch Repair: A Multi-Center European Study – Versus Standard Cerebro-Myocardial Perfusion in Neonates Undergoing Aortic Arch Repair: A Multi-Center European Study

◆Giovanni Battista Luciani[1], Stiljan Hoxha[1], Emanuela Angeli[2], Francesco Petridis[2], Lucio Careddu[2], Alessio Rungatscher[1], *Massimo Caputo[3], Gaetano Gargiulo[2]

[1]University of Verona, Verona, Italy; [2]University of Bologna, Bologna, Italy; [3]University of Bristol, Bristol, United Kingdom

P24. The Most Prevalent Tetralogy of Fallot Surgical Repair Strategy Is Associated with Unfavourable Right Bundle Branch Block

Sara Hussain[1], Ahmad Makhdoum[2], Charis Tan[3], Prisca Pondorfer[4], Quazi Ibrahim[1], *Yves D'Udekem[3], Richard Whitlock[1], *Glen Van Arsdell[4]

[1]Population Health Research Institute, Hamilton, ON, Canada; [2]University of Toronto, Toronto, ON, Canada; [3]The Royal Children's Hospital Melbourne, Melbourne, Australia; [4]The Hospital for Sick Children, Toronto, ON, Canada

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General Thoracic Moderated Poster Competition
4 minute presentation, 1 minute discussion

Aisle 200, Exhibit Hall
Not for Credit

Moderators: *Yolonda L. Colson and *David T. Cooke

P25. Comparison of a Digital with a Traditional Thoracic Drainage System for Postoperative Chest Tube Management After Pulmonary Resection: A Prospective Randomized Trial

Kazuya Takamochi, Shuko Nojiri, Shiaki Oh, Takeshi Matsunaga, Kenji Suzuki

Juntendo University, Tokyo, Japan

P26. Are Minimum Volume Standards Appropriate for Lung and Esophageal Cancer Surgery?

Sebron Harrison, Virginia Tangel, Xian Wu, Licia Gaber-Baylis, Gregory P. Giambrone, *Jeffrey L. Port, *Nasser K. Altorki, Peter M. Fleischut, *Brendon M. Stiles

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

P27. Pneumonectomy After Induction Therapy for Non-Small Cell Lung Cancer: Development of a Nomogram Using Machine Learning Techniques to Assist Patient Selection

Chi-Fu Jeffrey Yang[1], Hanghang Wang[1], Derek Chan[1], Babatunde Yerokun[1], *Thomas A. D'Amico[1], Matthew Hartwig[1], *Mark Berry[2]

[1]Duke University, Durham, NC; [2] Stanford University, Stanford, CA

P28. Impact of the Number of Lymph Nodes Examined During a Sublobar Resection on the Survival of Patients with Stage I Non-Small Cell Lung Cancer

*Sai Yendamuri, Samjot Dhillon, Adrienne Groman, Grace Dy, Elisabeth Dexter, Anthony Picone, *Chukwumere Nwogu, *Todd Demmy, Mark Hennon
Roswell Park Cancer Institute, Buffalo, NY

P29. Improvements in TNM Staging of Pulmonary Neuroendocrine Tumors Requires Histology and Regrouping of Tumor Sizes

Maria Cattoni[1], Eric Vallieres[1], Lisa M. Brown[2], Amir A. Sarkeshik[2], Stefano Margaritora[3], Alessandra Siciliani[3], Pier Luigi Filosso[4], Francesco Guerrera[4], Andrea Imperatori[5], Nicola Rotolo[5], Farhood Farjah[6], Grace Wandell[6], Kimberly Costas[7], Catherine Mann[1], Michal Hubka[8], Stephen Kaplan[8], *Alexander S. Farivar[1], Ralph W. Aye[1], ◆Brian E. Louie[1]
[1]Swedish Cancer Institute, Seattle, WA; [2]UC Davis Health System, Sacramento, CA; [3]Catholic University of the Sacred Heart, Rome, Italy; [4]San Giovanni Battista Hospital, Turin, Italy; [5]University of Insubria-Ospedale di Circolo, Varese, Italy; [6]University of Washington, Seattle, WA; [7]Providence Regional Medical Center, Everett, WA; [8]Virginia Mason Hospital & Seattle Medical Center, Seattle, WA

P30. Tumor Site Microenvironment Factors May Influence Number of Circulating Tumor Cells (CTCs) in NSCLC Patients

Lukasz Gasiorowski, Aldona Woźniak, Magdalena Frydrychowicz, Agata Kolecka-Bednarczyk, Zielinski Pawel, Grzegorz Dworacki
Poznan University of Medical Sciences, Poznań, Poland

P31. Prognostic Significance of Ground Glass Opacity Component in the Clinical T Classification of Non-Small Cell Lung Cancer

Aritoshi Hattori, Kenji Suzuki, Takeshi Matsunaga, Kazuya Takamochi, Shiaki Oh
Juntendo University, Tokyo, Japan

P32. Natural History of Ground Glass Lesions Among Patients with Previous Lung Cancer: Predictors of Progression

Mara B. Antonoff, Jitesh Shewale, David B. Nelson, *David Rice, Boris Sepesi, *Wayne Hofstetter, *Reza J. Mehran, *Ara A. Vaporciyan, *Garrett Walsh, *Stephen Swisher, *Jack Roth
MD Anderson Cancer Center, Houston, TX

P33. The Dose-Response Relationship Between Perioperative Blood Transfusion and Decreased Survival After Pulmonary Resection for Non-Small Cell Lung Cancer

James Isbell, Kay See Tan, Daniela Molena, *James Huang, Matthew Bott, *Bernard Park, *Prasad Adusumilli, *Valerie Rusch, *Manjit Bains, *Robert Downey, *David R. Jones
Memorial Sloan Kettering Cancer Center, New York, NY

P34. Impact of Body Mass Index on Lung Transplant Survival in the United States Following Implementation of the Lung Allocation Score

Ramiro Fernandez, Niloufar Safaeinili, Stephen Chiu, David D. Odell, *Malcolm M. DeCamp, Ankit Bharat
Northwestern University, Chicago, IL

P35. Anastomotic Complications After Esophagectomy: Impact of Omentoplasty in Propensity-Weighted Cohorts Following Neoadjurant Chemoradiation

Michael Lu, Daniel G. Winger, *James D. Luketich, Ryan M. Levy, *Arjun Pennathur, Inderpal Sarkaria, Rajeev Dhupar, *Katie S. Nason

University of Pittsburgh, Pittsburgh, PA

P36. Using the National Cancer Database to Create a Scoring System that Identifies Patients with Early-Stage Esophageal Adenocarcinoma at Risk for Nodal Metastases

◆Benny Weksler, Jennifer L. Sullivan

University of Tennessee, Memphis, TN

TUESDAY AFTERNOON, MAY 2, 2017

12:45 pm – 2:00 pm | **Cardiac Studies in Progress** | **5 minute presentation, 8 minute discussion** | AATS CT TheaterI | Booth #106, Exhibit Hall | *Not for Credit*

Moderators: *David H. Adams and *Joseph S. Coselli

LB4. Prospective US IDE Trial of a New Sutureless Aortic Bioprosthesis in Standard Risk Surgical Patients: One Year Hemodynamic, Clinical and Functional Outcomes

*Rakesh M. Suri[1], Hoda Javadikasgari[1], David Heimansohn[2], Neil Weissman[3], *Gorav Ailawadi[4], *Niv Ad[5], *Gabriel Aldea[6], *Vinod Thourani[7], *Wilson Szeto[8], *Robert Michler[9], Hector Michelena[10], Reza Dabir[11], *Bartley Griffith[12], *Eric E. Roselli[1]

[1]Cleveland Clinic, Cleveland, OH; [2]St. Vincent Heart Center of Indiana, Indianapolis, IN; [3]MedStar Health Research Institute, Washington, DC; [4]University of Virginia, Charlottesville, VA; [5]West Virginia University, Morgantown, WV; [6]University of Washington, Seattle, WA; [7]Emory University, Atlanta, GA; [8]University of Pennsylvania, Philadelphia, PA; [9]Montefiore Medical Center, New York City, NY; [10]Mayo Clinic, Rochester, MN; [11]Beaumont Hospital Dearborn, Dearborn, MI; [12]University of, Baltimore, MD

Invited Discussant: *Michael A. Borger

*AATS Member ◆AATS New Member

LB5. A Prospective Trial of Anticoagulation and Antiplatelet Strategies After Mechanical Aortic Valve Replacement

*John D. Puskas[1], Marc Gerdisch[2], Dennis Nichols[3], Lilibeth Fermin[4], Birger Rhenman[5], Divya Kapoor[5], *Jack Copeland[6], Reed Quinn[7], *G. Chad Hughes[8], Hormoz Azar[9], Michael McGrath[7], Michael Wait[10], Bobby Kong[11], Tomas Martin[12], Charles Douville[13], Steven Meyer[14], Jian Ye[15], *W.R. Eric Jamieson[15], Lance Landvater[16], Robert Hagberg[17], Timothy Trotter[18], *John Armitage[19], Jeffrey Askew[20], *Kevin Accola[21], Paul Levy[22], David Duncan[23], Bobby Yanagawa[24], John Ely[25], Allen Greave[26]

[1]Mount Sinai Saint Luke's, New York, NY; [2]St. Francis Health, Indianapolis, IN; [3]Tacoma General Hospital, Tacoma, WA; [4]University of Miami, Miami, FL; [5]Southern Arizona VA Medical Center, Tucson, AZ; [6]University of Arizona, Richmond, VA; [7]Maine Medical Center, Portland, ME; [8]Duke University, Durham, NC; [9]Mid-Atlantic Cardiothoracic Surgeons, Norfolk, VA; [10]University of Texas Southwestern, Dallas, TX; [11]Integrated Healthcare Associates, Ypsilanti, MI; [12]University of Florida, Orlando, FL; [13]Providence Portland Medical Center, Portland, OR; [14]University of Alberta, Edmonton, AB, Canada; [15]University of British Columbia, Vancouver, BC, Canada; [16]University of North Carolina, Raleigh, NC; [17]Hartford Hospital, Hartford, CT; [18]Oklahoma City VA Medical Center, Oklahoma City, OK; [19]Medical Clinic, Springfield, OR; [20]Mary Washington Hospital, Fredericksberg, VA; [21]Florida Hospital Center, Orlando, FL; [22]New Mexico Heart Institute, Albuquerque, NM; [23]Novant Health Forsyth Medical Center, Winston-Salem, NC; [24]University of Toronto, Toronto, ON, Canada; [25]On-X Life Technologies, Austin, TX; [26]MultiCare Cardiothoracic Surgical Associates, Tacoma, WA

Invited Discussant: ◆Joseph Lamelas

LB6. Early Patency of Externally Stented Saphenous Vein Grafts in CABG – Interim Report from the Multicenter Randomized VEST III Trial

David Taggart[1], Alexandros Paraforos[2], George Krasopolous[1], John T. Donovan[2], Cha Rajakaruna[3], Hunaid A. Vohra[3], Joseph Zacharias[4], Mohammed Nittal Bittar[4], Amal Bose[4], Ravi De Silva[5], Marius Berman[5], Leonid Ladyshenskij[6], Matthias Thielmann[7], Daniel Wendt[7], Sigrid Sandner[8], Philipp Angleitner[8], Günther Laufer[8], Nikolaos Bonaros[9], Yeong-Hoon Choi[10], Oliver Liakopoulos[10], Sunil Ohri[11], Stephan Jacobs[12], Alexander Lipey[13], Gil Bolotin[14], Ivar Friedrich[2]

[1]John Radcliffe Hospital, Oxford, United Kingdom; [2]Brüderkrankenhaus Trier, Trier, Germany; [3]Bristol Royal Infirmary, Bristol, United Kingdom; [4]Blackpool Victoria Hospital, Blackpool, United Kingdom; [5]Papworth Hospital, Cambridge, United Kingdom; [6]Immanuel Klinikum, Bernau, Germany; [7]Westdeutsches Herzzentrum Essen, Essen, Germany; [8]Medical University of Wien, Wien, Austria; [9]Medical University Innsbruck, Innsbruck, Austria; [10]Herzzentrum Uniklinik-Köln, Köln, Germany; [11]University Hospital Southampton, Southampton, United Kingdom; [12]Deutsches Herzzentrum Berlin, Berlin, Germany; [13]The Chaim Sheba Medical Center, Ramat Gan, Israel; [14]Rambam Health Care Campus, Haifa, Israel

Invited Discussant: *Sertac Cicek

LB7. Surgical and Pharmacological Novel Interventions to Improve Overall Results of Saphenous Vein Graft Patency in Coronary Artery Bypass Grafting surgery: An International Multicenter Randomized Controlled Clinical Trial (SUPERIOR SVG Study)

Saswata Deb[1], Steve K. Singh[2], Michael W.A. Chu[3], Domingos Souza[4], Richard Whitlock[5], Steven R. Meyer[6], Subodh Verma[7], Michael Raabe[8], Anders Jeppsson[9], Laura Jimenez-Juan[1], Anna Zavodni[1], Ayman Al-Saleh[5], Katheryn Brady[5], Purnima Rao-Melacini[5], Emilie P. Belley-Cote[5], *Richard J. Novick[10], *Stephen E. Fremes[1]

[1]University of Toronto, Toronto, ON, Canada; [2]Brigham and Women's Hospital, Boston, MA; [3]University of Western Ontario, London, ON, Canada; [4]Orebro Medical Centre Hospital, Orebro, Sweden; [5]McMaster University, Hamilton, ON, Canada; [6]University of Alberta, Edmonton, AB, Canada; [7]St. Michael's Hospital, Toronto, ON, Canada; [8]St. Boniface General Hospital, Winnepeg, MB, Canada; [9]Salhgrenska University Hospital, Gothenburg, Sweden; [10]University of Calgary, Calgary, AB, Canada

Invited Discussant: *Clifford W. Barlow

TUESDAY AFTERNOON, MAY 2, 2017

2:00 pm – 3:30 pm **Transcatheter Valve Therapies: Implications for Your Practice and How to Stay Engaged** Ballroom ABC, Hynes

Course Directors: *Michael A. Borger, *Columbia University*
*Lars G. Svensson, *Cleveland Clinic*
*Vinod H. Thourani, *Emory University*

Panelists: *John V. Conte, *Johns Hopkins University*
Patrick T. O'Gara, *Brigham & Women's Hospital*

2:00 pm **Introduction**

*Michael A. Borger, *Columbia University*

2:02 pm **TCT1. Transcatheter Aortic Valve Replacement in Patients with Severe Mitral or Tricuspid Regurgitation at Extreme Surgical Risk**

*Michael J. Reardon[1], *G. Michael Deeb[2], Neal S. Kleiman[3], *Thomas G. Gleason[4], Steven J. Yakubov[5], *David H. Adams[6], Jeffrey J. Popma[7]

[1]Houston Methodist Hospital, Houston, TX; [2]University of Michigan, Ann Arbor, MI; [3]The Methodist DeBakey Heart and Vascular Center, Houston, TX; [4]University of Pittsburgh, Pittsburgh, PA; [5]Riverside Methodist Hospital, Columbus, OH; [6]Mount Sinai Health System, New York, NY; [7]Beth Israel Deaconess Medical Center, Boston, MA

Invited Discussant: *Lars G. Svensson

2:14 pm **TCT2. Outcomes After Transcatheter and Surgical Aortic Valve Replacement in Intermediate Risk Patients with Preoperative Mitral Regurgitation: Analysis of PARTNER IIA Randomized Cohort**

*S. Chris Malaisrie[1], Robert W. Hodson[2], Thomas McAndrew[2], Charles Davidson[1], Jeffrey Swanson[4], Rebecca T. Hahn[5], Philippe Pibarot[6], Wael Jaber[7], Nishath Quader[8], Alan Zajarias[8], *Lars Svensson[7], *Isaac George[5], *Alfredo Trento[9], *Vinod H. Thourani[10], *Wilson Y. Szeto[11], *Todd Dewey[12], *Craig R. Smith[5], Martin B. Leon[5], John G. Webb[13]

[1]Northwestern University, Chicago, IL; [2]Providence Heart Clinic, Portland, OR; [-]Cardiovascular Research Foundation, New York, NY; [4]Providence Heart Clinic, Portland, OR; [5]Columbia University, New York, NY; [6]Laval University, Quebec City, QC, Canada; [7]Cleveland Clinic, Cleveland, OH; [8]Washington University, St. Louis, MO; [9]Cedars Sinai Medical Center, Los Angeles, CA; [10]Emory University, Atlanta, GA; [11]University of Pennsylvania, Philadelphia, PA; [12]HCA Medical City Dallas, Dallas, TX; [13]St. Paul's Hospital, Vancouver, BC, Canada

Invited Discussant: *John V. Conte

2:26 pm **Epidemiology of MR: Where Are All the Patients?**
Patrick T. O'Gara, *Brigham & Women's Hospital*

2:35 pm **Making the Most of MitraClip**
*Gorav Ailawadi, *University of Virginia Health System*

2:44 pm **New Techniques for Treating Degenerative MR**
*Michael A. Borger, *Columbia University*

2:53 pm **Discussion**

3:01 pm **New Trans-Septal Techniques for Functional MR**

3:10 pm **Transapical and Trans-Septal MV Replacement: The Future or a Fad?**
*Vinod H. Thourani, *Emory University*

3:19 pm **Discussion and Closing**

3:28 pm **Closing**
*Michael A. Borger, *Columbia University*

3:30 pm – 4:10 pm **Coffee Break in the Exhibit Hall**

2:00 pm – 3:30 pm **ELSO at AATS** Room 306, Hynes

2:00 pm **Building Quality in an ECMO Program**
*D. Michael McMullan, *Seattle Children's Hospital*

2:20 pm **Critical Decision Making in ECMO Use for the Failing Heart**
*Johnathan W. Haft, *University of Michigan*

2:40 pm **ECMO for Acute Lung Failure**
Cara Agerstrand, *New York Presbyterian Hospital/Columbia University Medical Center*

3:00 pm **The Use of ECMO in Trauma**
*Matthew Bacchetta, *New York Presbyterian Hospital/ Columbia University Medical Center*

3:15 pm **Discussion**

3:30 pm – 4:10 pm **Coffee Break in the Exhibit Hall**

3:30 pm – 4:00 pm
AATS/AmSECT Heater-Cooler-Induced Nontuberculous Mycobacterium Infections: An Emerging Public Health Concern AATS CT Theater II Booth #1828, Exhibit Hall *Not for Credit*

Panelists: Richard L. Prager, *University of Michigan*
Adam Saltman, *FDA*

A Surgeon's Perspective
*Keith B. Allen, *Mid America Heart & Lung Surgeons*

A Perfusionist's Perspective
Al Stammers, *SpecialtyCare*

4:05 pm – 5:35 pm **Adult Cardiac Surgery Simultaneous Scientific Session: Valve Surgery and Ablation** Ballroom ABC, Hynes

6 minute presentation, 9 minute discussion

Moderators: *Vinay Badhwar and *Faisal G. Bakaeen

45. Complex Versus Simple Degenerative Mitral Valve Disease: Does Valve Complexity Matter?

Hoda Javadikasgari, *Tomislav Mihaljevic, *Rakesh M. Suri, *Lars G. Svensson, *Jose L. Navia, Robert Z. Wang, Asley Lowry, *Eugene H. Blackstone, Stephanie Mick, A. Marc Gillinov

Cleveland Clinic, Cleveland, OH

Invited Discussant:

46. Respect When You Can, Resect When You Should: A Realistic Approach to Mitral Valve Repair

*Gilles Daniel Dreyfus[1], Filip Dulguerov[1], Cecilia Marcacci[1], Clara Alexandrescu[1], Franck Levy[1], Shelley Rahman[2], Elie Dan Schouver[1]

[1]Cardiothoracic Center of Monaco, Monte Carlo, Monaco; [2]Royal Brompton and Harefield NHS Foundation Trust, London, United Kingdom

Invited Discussant: *Gebrine El Khoury

47. Outcome of Tricuspid Valve Surgery in the Presence of Permanent Pacemaker: Analysis of 616 Patients

Nishant Saran, Sameh Said, *Hartzell Schaff, *Kevin Greason, *Lyle Joyce, David Joyce, *John Stulak, *Simon Maltais, *Alberto Pochettino, *Joseph Dearani, *Richard Daly

Mayo Clinic, Rochester, MN

Invited Discussant: *T. Sloane Guy

48. Transcatheter or Surgical Intervention for the Failed Pulmonary Valve Homograft in the Ross Population?

Khadija Alassas[1], Talal Hijji[2], Aysha Husain[1], Abdelmoneim Eldali[1], Ziad Dahdouh[1], Valeria Pergola[3], Giovanni Di Salvo[3], Mansour Aljufan[1], Zohair Yousef Al Halees[1], Bahaa Michel Fadel[1]

[1]King Faisal Specialist Hospital and Research Centre, Riyadh, Saudi Arabia; [2]Al Faisal University, Riyadh, Saudi Arabia; [3]Croydon University Hospital, London, United Kingdom

Invited Discussant: *Gosta B. Petterson

49. The Aortic Root and Arch Do Not Dilate Over Time After Aortic Valve and Ascending Aorta Replacement in Patients with Bicuspid Aortic Valves

Sonya K. Hui[1], Chun-Po Steve Fan[2], Shakira Christie[1], *Christopher M. Feindel[1], *Tirone E. David[1], Maral Ouzounian[1]

[1]University of Toronto, Toronto, ON, Canada; [2]Hospital for Sick Children, Toronto, ON, Canada

Invited Discussant: *Y. Joseph Woo

Late-Breaking Clinical Trial

LB8. Biatrial Maze Procedure Versus Pulmonary Vein Isolation in the CTSN Randomized Trial of Surgical Ablation of Atrial Fibrillation During Mitral Valve Surgery

*Eugene H. Blackstone[1], Helena L. Chang[2], Jeevanantham Rajeswaran[1], Michael K. Parides[2], Hemant Ishwaran[3], Liang Li[4], John Ehrlinger[1], Annetine C. Gelijns[2], Alan J. Moskowitz[2], Marissa A. Miller[5], *Michael Argenziano[6], Joseph J. DeRose, Jr.[7], *François Dagenais[8], *Gorav Ailawadi[9], *Peter K. Smith[10], *Michael A. Acker[11], *Michael J. Mack[12], *Patrick T. O'Gara[13], *A. Marc Gillinov[1]

[1]Cleveland Clinic, Cleveland, OH; [2]Icahn School of Medicine at Mount Sinai, New York, NY; [3]University of Miami, Miami, FL; [4]MD Anderson Cancer Center, Houston, TX; [5]National Heart, Lung, and Blood Institute, NIH, Bethesda, MD; [6]Columbia University , New York, NY; [7]Montefiore Medical Center, Bronx, NY; [8]Quebec Heart and Lung Institute, Québec, QC, Canada; [9]University of Virginia, Charlottesville, VA; [10]Duke University, Durham, NC; [11] University of Pennsylvania, Philadelphia, PA; [12]The Heart Hospital Baylor, Plano, TX; [13]Brigham and Women's Hospital, Boston, MA

Invited Discussant: *James R. Edgerton

TUESDAY AFTERNOON, MAY 2, 2017

4:05 pm – 5:35 pm **MCS/Transplant Session** Room 306, Hynes
5 minute presentation, 7 minute discussion

Moderators: *Anelechi C. Anyanwu and *Vivek Rao

50. Impact of Initial Pump Positioning on Pump Thrombosis: Insights from the PREVENT Study

◆Ahmet Kilic[1], John Ransom[2], *Simon Maltais[3], *Benjamin Sun[4], John W. Entwistle, III[5], Stephen Bailey[6], *Ranjit John[7], *Charles T. Klodell[8], *Igor Gregoric[9], Brett Sheridan[10], Joyce Chuang[11], David J. Farrar[11], Kartik Sundareswaran[11], Robert Adamson[12]

[1]Ohio State University, Columbus, OH; [2]Baptist Health Heart and Transplant Institute, Little Rock, AR; [3]Mayo Clinic, Rochester, MN; [4]Minneapolis Heart Institute, Minneapolis, MN; Thomas Jefferson University, Philadelphia, PA; [6]Allegheny General Hospital, Pittsburgh, PA; [7]University of Minnesota, Minneapolis, MN; [8]University of Florida, Gainesville, FL; [9]Memorial Hermann – Texas Medical Center, Houston, TX; [10]California Pacific Medical Center, San Francisco, CA; [11]St. Jude Medical, Pleasanton, CA [12]Sharp Memorial Hospital, San Diego, CA

Invited Discussant: *Ashish S. Shah

*AATS Member ◆AATS New Member

51. The High Cost of Gastrointestinal Bleeding in LVAD Patients: Impact of Readmissions on Financial Burden and Patient Morbidity

Danielle Savino, Fenton McCarthy, Danielle Spragan, Taylor Dibble, Desmond Graves, Keith Dufendach, Katherine McDermott, Peter Groeneveld, *Nimesh Desai

University of Pennsylvania, Philadelphia, PA

Invited Discussant:

52. Posttransplant Outcomes in Patients on Venoarterial Extracorporeal Membrane Oxygenation: A Comparison with Population on Continuous-Flow Left Ventricular Assist Device Support

Shinichi Fukuhara, Trung Tran, Jiho Han, Koji Takeda, *Yoshifumi Naka, ◆Hiroo Takayama

Columbia University, New York, NY

Invited Discussant:

53. High-Risk Conventional Cardiac Surgery in Patients with Profound Left Ventricular Dysfunction – A Proposed Treatment Algorithm in the Mechanical Circulatory Support Era

Nassir M. Thalji, *Simon Maltais, David L. Joyce, *Lyle D. Joyce, *Richard C. Daly, Shannon M. Dunlay, *John M. Stulak

Mayo Clinic, Rochester, MN

Invited Discussant: David A. D'Alessandro

54. Ten-Year Experience with Continuous-Flow External Ventricular Assist Device: Evolution and Improving Outcomes in the Treatment of Refractory Cardiogenic Shock

Koji Takeda, Arthur R. Garan, Veli K. Topkara, Jiho Han, *Paul Kurlansky, Melana Yuzefpolskaya, Maryjane A. Farr, Paolo C. Colombo, *Yoshifumi Naka, ◆Hiroo Takayama

Columbia University, New York, NY

Invited Discussant: *Stephan W. Schueler

55. Early Circulatory Support with Extracorporeal Membrane Oxygenation Improves Outcomes After Severe Graft Dysfunction

Pierre-Emmanuel Noly[1], Erwan Flecher[2], Mélanie Hebert[1], Marion Mauduit[2], Yoan Lamarche[1], Amandine Martin[2], Jean-Philippe Verhoye[2], *Michel Carrier[1]

[1]Montreal Heart Institute, Montreal, QC, Canada; [2]Rennes Hospital, Rennes, France

Invited Discussant: *Pavan Atluri

5:35 pm **Executive Session,** *AATS Members Only* Ballroom ABC, Hynes

2:00 pm – 5:35 pm **Aortic/Endovascular Surgery** Room 311, Hynes
Simultaneous Scientific Session
6 minute presentation, 8 minute discussion

Moderators: *Michael A. Borger, *Scott A. LeMaire, *Malakh Shrestha

56. Frozen Elephant Trunk and Total Arch Replacement for Type A Aortic Dissection: Competing Risk Analysis of Long-Term Outcomes in 1063 Patients

Wei-Guo Ma[1], Wei Zhang[1], Xu-Dong Pan[1], Jun Zheng[1], Jian-Rong Li[1], Bulat A. Ziganshin[2], Jun-Ming Zhu[1], *John A. Elefteriades[2], *Li-Zhong Sun[1]

[1]Capital Medical University, Beijing, China; [2]Yale School of Medicine, New Haven, CT

Invited Discussant: *Friedhelm Beyersdorf

57. Epidemiologic Analysis and Descriptive Assessment of Management Strategies for Thoracic Aortic Dissections and Thoracic Aortic Aneurysms — A Population Based Study

R. Scott McClure[1], Susan B. Brogly[2], Katherine Lajkosz[2], Darrin Payne[2], Stephen F. Hall[2], Ana P. Johnson[2]

[1]University of Calgary, Calgary, AB, Canada; [2]Queen's University, Kingston, ON, Canada

Invited Discussant: *John A. Elefteriades

58. Stroke Following Thoracic Endovascular Aortic Repair: Implications for Branched Endovascular Arch Repair

Arnoud V. Kamman[1], Bo Yang[2], David M. Williams[1], Karen M. Kim[1], Minhajuddin Khaja[3], Frans L. Moll[2], Kim A. Eagle[1], Santi Trimarchi[3], *Himanshu J. Patel[1]

[1]University of Michigan, Ann Arbor, MI; [2]University of Utrecht, Utrecht, Netherlands; [3]Policlinico San Donato IRCCS, San Donato Milanese, Italy

Invited Discussant: *Nimesh D. Desai

59. The Impact of Chronic Kidney Disease on Outcomes After Crawford Extent II Thoracoabdominal Aortic Aneurysm Repair in 1003 Patients

*Joseph S. Coselli, Qianzi Zhang, Hiruni S. Amarasekara, Matt D. Price, Susan Y. Green, *Scott A. LeMaire

Baylor College of Medicine, Houston, TX

Invited Discussant: *Leonard N. Girardi

Aortic Surgery in the 21st Century: Have We Gone Too Far?
*D. Craig Miller, *Stanford University, Stanford, CA*

3:20 pm – 3:55 pm **Coffee Break in the Exhibit Hall**

60. Height Alone (Rather than Body Surface Area) Suffices for Risk Estimation in Ascending Aortic Aneurysm

Mohammad A. Zafar[1], Yupeng Li[2], Sven Peterss[3], John A. Rizzo[2], Paris Charilaou[1], Bulat A. Ziganshin[1], Maryann Tranquilli[1], *John A. Elefteriades[1]

[1]Yale University, New Haven, CT; [2]Stony Brook University, Stony Brook, NY; [3]Ludwig Maximilians University, Munich, Germany

Invited Discussant: *T. Brett Reece

61. Differences in Outcomes Between Mechanical and Non-Mechanical Valve Replacement following Repair of Acute Type A Dissection

Gabriel Loor[1], *Thomas G. Gleason[2], Truls Myrmel[3], Amit Korach[4], Santi Trimarchi[5], *Nimesh D. Desai[6], *Joseph E. Bavaria[6], Carlo De Vincentiis[5], Maral Ouzounian[7], Udo Sechtem[8], Daniel G. Montgomery[9], *Edward P. Chen[10], *Hersh Maniar[11], *Thoralf M. Sundt[12], *Himanshu J. Patel[9]

[1]University of Minnesota, Minneapolis, MN; [2]University of Pittsburgh, Pittsburgh, PA; [3]Tromso University Hospital, Tromso, Norway; [4]Hadassah Hebrew University, Jerusalem, Israel; [5]IRCCS Policlinico San Donato, San Donato, Italy; [6]University of Pennsylvania, Philadelphia, PA; [7]Toronto General Hospital, Toronto, ON, Canada; [8]Robert-Bosch Krankenhaus, Stuttgart, Germany; [9]University of Michigan, Ann Arbor, MI; [10]Emory University, Atlanta, GA; [11]Washington University, St. Louis, MO; [12]Massachusetts General Hospital, Boston, MA

Invited Discussant: *Thomas M. Beaver

62. Late Reoperations After Acute Type A Dissection: A Report from the Nordic Consortium for Acute Type A Aortic Dissection (NORCAAD) Study

Emily Pan[1], Ari Mennander[2], Arnar Geirsson[3], Anders Ahlsson[4], Simon Fuglsang[5], Emma Hansson[6], Vibeke Hjortdal[5], Anders Jeppsson[6], Shahab Nozohoor[7], Christian Olsson[8], Anders Wickbom[4], Igor Zindovic7, Tomas Gudbjartsson[3], Jarmo Gunn[1]

[1]University Hospital of Turku, Turku, Finland; [2]University Hospital of Tampere, Tampere, Finland; [3]Landspitali University Hospital, Reykjavik, Iceland; [4]Örebro University Hospital, Örebro, Sweden; [5]Skejby University Hospital, Aarhus, Denmark; [6]Sahlgrenska University Hospital, Gothenburg, Sweden; [7]Skane University Hospital, Lund, Sweden; [8]Karolinska University Hospital, Stockholm, Sweden

Invited Discussant: *Edward P. Chen

63. Total Aortic Arch Replacement with Frozen Elephant Trunk Technique – Results from Two European Institutes

Alessandro Leone[1], *Davide Pacini[1], Erik Beckmann[2], Andreas Martens[2], Luca Di Marco[1], Antonio Pantaleo[1], *Axel Haverich[2], ◆Roberto Di Bartolomeo[1], *Malakh Shrestha[2]

[1]S.Orsola-Malpighi Hospital, Bologna, Italy; [2]Hannover Medical School, Hannover, Germany

Invited Discussant:

64. Valve Sparing Root Replacement in Patients with Bicuspid Versus Tricuspid Aortic Valves

Maral Ouzounian, *Christopher M. Feindel, Cedric Manlhiot, Carolyn David, *Tirone E. David

University of Toronto, Toronto, ON, Canada

Invited Discussant: *Lars G. Svensson

65. The Fate of Abdominal Aorta After TEVAR in Chronic Debakey IIIb Aneurysms and Risk Factor Analysis – Is Residual Abdominal Aortic Dissection Stabilized After TEVAR?

Tae-Hoon Kim, Suk-Won Song, Kwang-Hun Lee, Min-Young Baik, Kyung-Jong Yoo, *Bum-Koo Cho

Yonsei University College of Medicine, Seoul, Republic of Korea

Invited Discussant:

5:35 pm **Executive Session,** *AATS Members Only* Ballroom ABC, Hynes

TUESDAY AFTERNOON, MAY 2, 2017

2:00 pm – 5:35 pm **Congenital Heart Disease**
Simultaneous Scientific Session
8 minute presentation, 10 minute discussion
Moderators: *Charles B. Huddleston and Damien J. LaPar

Room 312, Hynes

Insights from the Congenital Heart Surgeons' Society Anomalous Coronary Artery Database

*Marhsall L. Jacobs, *Johns Hopskins Hospital, Baltimore, MD*

66. Patients with Anomalous Aortic Origin of the Coronary Artery Remain at Risk Even After Surgical Repair

Shannon N. Nees, Jonathan N. Flyer, Anjali Chelliah, Jeffrey D. Dayton, David Kalfa, ◆Paul J. Chai, *Emile A. Bacha, Brett R. Anderson

Columbia University, New York, NY

Invited Discussant: *Ralph S. Mosca

67. Selection of Prosthetic Aortic Valve and Root Replacement in Young Patients Less Than Thirty Years of Age

Rita K. Milewski, Andreas Habertheuer, *Joseph E. Bavaria, Stephanie Fuller, *Wilson Szeto, *Nimesh Desai, Varun Korutla, Prashanth Vallabhajosyula

University of Pennsylvania, Philadelphia, PA

Invited Discussant: *Glen Van Arsdell

3:20 pm – 3:55 pm **Coffee Break in the Exhibit Hall**

68. Outcomes of the Arterial Switch Operation in ≤2.5 kg Neonates: A 10 Year Study

Michael Salna, ◆Paul J. Chai, David M. Kalfa, Yuki Nakamura, Ganga Krishnamurthy, Marc Najjar, Amee Shah, Stephanie Levasseur, Brett R. Anderson, *Emile A. Bacha

Columbia University, New York, NY

Invited Discussant: *V. Mohan Reddy

69. Reoperation for Coronary Artery Stenosis After Arterial Switch Operation

Joon Chul Jung, Eung Re Kim, Ji Hyun Bang, Jae Gun Kwak, Woong-han Kim

Seoul National University Hospital, Seoul, Republic of Korea

Invited Discussant: *Charles D. Fraser, Jr.

70. Laryngeal Ultrasound Detects a High Prevalence of Vocal Cord Paresis After Aortic Arch Repair in Neonates and Young Children

Melissa G.Y. Lee, Johnny Millar, Elizabeth Rose, Aleesha Jones, Dora Wood, Taryn L. Luitingh, Johann Brink, *Igor E. Konstantinov, ◆Christian P. Brizard, *Yves d'Udekem

Royal Children's Hospital, Parkville, Australia

Invited Discussant: *Scott A. Bradley

71. Management of Aortic Aneurysms Following Repair of Congenital Heart Disease

*Christian Pizarro, Gina M. Baffa, Majeed A. Bhat, Ryan Robert Davies, Kristi Fitzgerald

Alfred I. duPont Hospital for Children, Wilmington, DE

Invited Discussant: *Duke E. Cameron

72. Outcomes of Patients Undergoing Surgical Repair of Multiple Ventricular Septal Defects: A 22-Year Study of 157 Patients

Michael Daley[1], ◆Christian P. Brizard[1], *Igor E. Konstantinov[1], Johann Brink[1], Andrew Kelly[2], Bryn O. Jones[1], Diana Zannino[3], *Yves d'Udekem[1]

[1]Royal Children's Hospital, Melbourne, Australia; [2]Women's and Children's Hospital, Adelaide, Australia; [3]Murdoch Children's Research Institute, Melbourne, Australia

Invited Discussant: *Richard D. Mainwaring

5:35 pm **Executive Session,** *AATS Members Only* Ballroom ABC, Hynes

2:00 pm – 5:35 pm **General Thoracic Surgery** Room 302/304, Hynes
Simultaneous Scientific Session:
Practice Management and Economics
8 minute presentation, 10 minute discussion

Moderators: *Ke-Neng Chen and *Thomas A. D'Amico

73. The Impact of Enhance Recovery After Surgery Protocol Compliance on Morbidity from Resection for Lung Cancer: Experience from a UK Specialist Center
Luke J. Rogers[1], David Bleetman[2], David E. Messenger[3], Natasha A. Joshi[3], L. Wood[3], N.J. Rasburn[3], T. Batchelor[3]
[1]Derriford Hospital, Plymouth, United Kingdom; [2]Barts Heart Centre, London, United Kingdom; [3]Bristol Royal Infirmary, Bristol, United Kingdom

Invited Discussant: *Virginia R. Litle

74. The Economic Impact of a Nurse Practitioner Directed Lung Cancer Screening, Incidental Pulmonary Nodule, and Tobacco Cessation Clinic
Christopher R. Gilbert[1], Joelle T. Fathi[1], Rob Ely[1], Hannah Modin[2], Candice L. Wilshire[1], Ralph W. Aye[1], *Alexander S. Farivar[1], ◆Brian E. Louie[1], Eric Vallieres[1], Jed A. Gorden[1]
[1]Swedish Cancer Institute, Seattle, WA; [2]Northwell Health Center for Learning and Innovation, New Hyde Park, NY

Invited Discussant: Betty C. Tong

75. Intraoperative Costs of VATS Lobectomy Can Be Dramatically Reduced Without Compromising Outcomes
Michael T. Richardson, Leah M. Backhus, *Mark F. Berry, Kelsey C. Ayers, Mehran Teymourtash, *Joseph B. Shrager
Stanford University, Palo Alto, CA

Invited Discussant: *Thomas K. Waddell

76. Financial Impact of Adapting Robotics to a Thoracic Practice in an Academic Institution
*Abbas E. Abbas, Sam Weprin, Kimberley Muro, Charles Bakhos, *Larry Kaiser
Temple University, Philadelphia, PA

Invited Discussant: *Robert J. Cerfolio

3:20 pm – 3:55 pm **Coffee Break in the Exhibit Hall**

3:30 pm – 3:50 pm
General Thoracic Deep Dive Session: Impact of Quality on the Future of Surgery for Early Stage Lung Cancer
AATS CT Theater I
Booth 106, Exhibit Hall
Not for Credit

Moderator: *Bryan F. Meyers, *Washington University*
Panelists: *Malcolm M. DeCamp, *Northwestern University*
Seth B. Krantz, *NorthShore University Health System*

22. Variability in Surgical Quality in Patients with Early Stage Non-Small Cell Lung Cancer Undergoing Wedge Resection Impacts Overall Survival When Compared to Stereotactic Body Radiation Therapy *(Presented during General Thoracic Surgery Simultaneous Scientific Session on Monday, May 1)*

24. Declining Use of Surgical Therapy for Early Stage Non-Small Cell Lung Cancer in the United States *(Presented during General Thoracic Surgery Simultaneous Scientific Session on Monday, May 1)*

General Thoracic Surgery Simultaneous Scientific Session:
Lung Transplant and Lung Failure

Moderators: *Hiroshi Date and *Dan Kreisel

77. Lung Transplantation in the Era of Lung Allocation Scoring: A Single Center Experience of 1500 Patients
Keki Balsara, *Alexander Krupnick, Ramsey Hachem, Elbert Trulock, Chad Witt, Derek Byers, Roger Yusen, *Bryan Meyers, G. Alexander Patterson, *Varun Puri, *Daniel Kreisel
Washington University, St. Louis, MO

Invited Discussant: *John D'Cunha

78. Extracorporeal Life Support As a Bridge to Lung Transplantation: Experience of a High-Volume Transplant Center
Konrad Hoetzenecker, Laura Donahoe, Jonathan C. Yeung, Eddy Fan, Niall D. Ferguson, Lorenzo Del Sorbo, *Marc de Perrot, Andrew Pierre, *Kazuhiro Yasufuku, Lianne Singer, *Thomas K. Waddell, *Shaf Keshavjee, *Marcelo Cypel
University of Toronto, Toronto, ON, Canada

Invited Discussant: *Frank D'Ovidio

79. Early Initiation of Extracorporeal Membrane Oxygenation for Influenza Associated Adult Respiratory Distress Syndrome Improves Survival
Desiree A. Steimer, Omar Hernandez, Kaitlyn J. Lingle, Rajasekhar Malyala, Patrick R. Aguilar, Brian Lima, *David Mason, Gary S. Schwartz
Baylor University, Dallas, TX

Invited Discussant: *Walter Klepetko

80. Management of Bronchial Stump in Lobar Lung Transplantation

Hidenao Kayawake, ◆Toyofumi Fengshi Chen-Yoshikawa, Akihiro Aoyama, Hideki Motoyama, Masatsugu Hamaji, Kyoko Hijiya, *Hiroshi Date

Kyoto University, Kyoto, Japan

Invited Discussant: *Walter Weder

81. A Propensity Score Matched Study of Lung Transplant Surgery and Concomitant Coronary Artery Bypass Surgery

*Yoshiya Toyoda, Suresh Keshavamurthy, Jesus Gomez-Abraham, Tomo Yoshizumi, Francis Cordova, Kartik Shenoy, Albert J. Mamary, Brian O'Murchu, Riyaz Bashir, Gerard Criner, Huaqing Zhao, Abul Kashem

Temple University, Philadelphia, PA

Invited Discussant: *R. Duane Davis

5:35 pm **Executive Session,** *AATS Members Only* Ballroom ABC, Hynes

WEDNESDAY MORNING, MAY 3, 2017

7:30 am – 9:35 am **Adult Cardiac Surgery** Room 302/304, Hynes
Simultaneous Scientific Session
5 minute presentation, 7 minute discussion

Moderators: *Clifford Barlow, *Friedrich W. Mohr, *Craig R. Smith

82. Triage and Optimization: A New Paradigm in the Treatment of Massive Pulmonary Embolism

Chetan Pasrija, Anthony Kronfli, Maxwell Raithel, Francesca Boulos, Mehrdad Ghoreishi, Gregory J. Bittle, Lewis Rubinson, Michael A. Mazzeffi, *James S. Gammie, *Bartley P. Griffith, Zachary N. Kon

University of Maryland, Baltimore, MD

Invited Discussant: *Lyle D. Joyce

83. Mid-Term Outcomes in 850 Patients Treated with Aortic Valve Neo-Cuspidization Using Glutaraldehyde-Treated Autologous Pericardium

*Shigeyuki Ozaki, Isamu Kawase, Hiromasa Yamashita, Shin Uchida, Mikio Takatoo, Nagaki Kiyohara

Toho University, Tokyo, Japan

Invited Discussant: *J. Michael DiMaio

84. Role of Transcatheter Versus Surgical Mitral Valve Procedures in High-Risk Patients with Recurrent Mitral Valve Disease

Dave G. Cervantes, Norihiko Kamioka, Jessica Forcillo, Talal Al-Atassi, Ronnie Ramadan, Stamatios Lerakis, Chandanreddy Devireddy, Douglas Murphy, Jeffrey Miller, *Robert A. Guyton, *Michael Halkos, Emeka Ndubisi, Vasilis Babaliaros, *Vinod H. Thourani

Emory University, Atlanta, GA

Invited Discussant: *Vinay Badhwar

85. Training the Cardiothoracic Surgeon of the Future: The Power of Live Animal Operating and Tailored Bootcamps in the UK Cardiothoracic Training Programme

Louise Kenny[1], Karen Booth[1], Sridhar Rathinam[2], Gary Reynolds[1], Narain Moorjani[3]

[1]Freeman Hospital, Newcastle, United Kingdom; [2]University Hospital of Leicester, Leicester, United Kingdom; [3]Papworth Hospital, Cambridge, United Kingdom

Invited Discussant: *Jennifer S. Lawton

86. Teaching Operative Cardiac Surgery in the Era of Increasing Patient Complexity: Can It Still Be Done?

George Tolis, Jr., Philip J. Spencer, Jordan P. Bloom, Serguei Melnitchouk, David A. D'Alessandro, Mauricio A. Villavicencio, *Thoralf M. Sundt, III

Massachusetts General Hospital, Boston, MA

Invited Discussant: Spencer Melby

87. Sutureless Aortic Valves Versus Transcatheter Aortic Valve in Patients with Severe Aortic Stenosis and Intermediate Risk Profile: A Propensity Match Comparison in the Real World

*Claudio Muneretto[1], Alberto Repossini[1], Lorenzo Di Bacco[1], ◆Roberto Di Bartolomeo[2], Carlo Savini[2], Gianluca Folesani[2], Manfredo Rambaldini[3], Maurizio Tespili[4], Juan Pablo Maureira[5], Francois Laborde[6], Thierry Folliguet[7]

[1]University of Brescia, Brescia, Italy; [2]University of Bologna, Bologna, Italy; [3]Carlo Poma Hospital of Mantova, Mantova, Italy; [4]Azienda Ospedaliera Bolognini, Seriate, Italy; [5]CHU de Nancy, Nancy, France; [6]Institut Mutualiste Montsouris, Paris, France; [7]Centre Hospitalo-Universitaire Brabois ILCV, Nancy, France

Invited Discussant: Mattia Glauber

88. Oral Anticoagulation Is Not Necessary Following Cox-MAZE IV Procedure for Persistent Atrial Fibrillation Discharged in Sinus Rhythm

Takashi Murashita[1], Lawrence M. Wei[1], Mohamad Alkhouli[1], Callum R. Hamilton[2], Robert Hull[1], *J. Scott Rankin[1], *Vinay Badhwar[1]

[1]West Virginia University, Morgantown, WV; [2]University of Pittsburgh, Pittsburgh, PA

Invited Discussant: *Ko Bando

89. Concomitant Cox-Maze IV Procedure Is Associated with Improved Long-Term Survival in Patients with a History of Atrial Fibrillation Undergoing Cardiac Surgery: A Propensity Matched Study

Farah N. Musharbash, Matthew R. Schill, Laurie A. Sinn, Richard B. Schuessler, Spencer J. Melby, *Hersh S. Maniar, *Marc R. Moon, *Ralph J. Damiano, Jr.

Washington University, St. Louis, MO

Invited Discussant: *Niv Ad

Late-Breaking Clinical Trials

LB9. Off-Pump Versus On-Pump Coronary Artery Bypass Grafting: Insights from the Arterial Revascularization Trial

Umberto Benedetto[1], Doug Altman[2], Stephen Gerry[2], Alastair Gray[2], Belinda Lees[2], Marcus Flather[3], *David Taggart[2]

[1]University of Bristol, Bristol, United Kingdom; [2]University of Oxford, Oxford, United Kingdom; [3]University of East Anglia, Norwich, United Kingdom

LB10. The Effect of an Additional Radial Artery on Single and Bilateral Internal Thoracic Artery Grafts – Insights from the Arterial Revascularization Trial

*David Taggart[1], Marcus Flather[2], Doug Altman[1], Stephen Gerry[1], Alastair Gray[1], Belinda Lees[1], Umberto Benedetto[3]

[1]University of Oxford, Oxford, United Kingdom; [2]University of East Anglia, Norwich, United Kingdom; [3]University of Bristol, Bristol, United Kingdom

Invited Discussant *David Yuh

9:35 am – 9:45 am **Coffee Break**

WEDNESDAY MORNING, MAY 3, 2017

7:30 am – 9:35 am **Congenital Heart Disease** Room 306, Hynes
Simultaneous Scientific Session
5 minute presentation, 7 minute discussion

Moderators: ◆Paul J. Chai and *Jennifer C. Hirsch-Romano

90. Staged Ventricular Recruitment via Atrial Septation Alone in Patients with Borderline Ventricles and Large Ventricular Septal Defects

Olubunmi Oladunjoye, Puja Banka, Gerald Marx, Roger Breitbart, *Pedro del Nido, ◆Sitaram Emani

Boston Children's Hospital, Boston, MA

Invited Discussant: *Emile A. Bacha

91. Planned Growth of Hypoplastic Cardiac Structures to Achieve Improved Long-Term Outcomes

Daniel Labuz[1], Lee Pyles[2], James Berry[3], *John Foker[3]

[1]Oregon Health Sciences University, Portland, OR; [2]West Virginia University, Morgantown, WV; [3]University of Minnesota, Minneapolis, MN

Invited Discussant: *Thomas L. Spray

Staged Ventricular Recruitment – Strategies to Rehabilitate Borderline Ventricles

◆Sitaram Emani, *Boston Children's Hospital, Boston, MA*

*AATS Member ◆AATS New Member

92. Surgical Algorithm and Results for Repair of Pulmonary Atresia/Ventricular Septal Defect/Major Aortopulmonary Collaterals

*Frank L. Hanley, *Richard Mainwaring, William L. Patrick, Steve Roth, Komal Kamra, Lisa Wise-Faberowski

Stanford University, Stanford, CA

Invited Discussant: *Christian P. Brizard

93. Descending Aortopexy and Posterior Tracheopexy for Severe Tracheomalacia and Left Mainstem Bronchomalacia

Hester F. Shieh, C. Jason Smithers, Thomas E. Hamilton, David Zurakowski, Gary A. Visner, Michael A. Manfredi, Russell W. Jennings, Christopher W. Baird

Boston Children's Hospital, Boston, MA

Invited Discussant: *Michael E. Mitchell

94. Early and Mid-Term Results of Autograft-Sparing/Ross Reversal: A One-Valve Disease Need Not Become a Two-Valve Disease

Syed T. Hussain, David Majdalany, Robert D. Stewart, Antoine Addoumieh, *Eugene H. Blackstone, Gosta B. Pettersson

Cleveland Clinic, Cleveland, OH

Invited Discussant: *Giovanni Battista Luciani

95. Surgical Unroofing of Hemodynamically Significant Myocardial Bridges in a Pediatric Population

Katsuhide Maeda, Daniel J. Murphy, Ingela Schnittger, Jennifer A. Tremmel, *Frank L. Hanley, Robert Scott Mitchell, Ian S. Rogers

Stanford University, Stanford, CA

Invited Discussant: ◆Paul J. Chai

96. Intraoperative Completion Angiogram May Be Superior to Transesophageal Echocardiogram for Detection of Pulmonary Artery Residual Lesions in Congenital Heart Surgery

Luke Lamers, Erick Jimenez, Catherine Allen, Derreck Hoyme, Entela B. Lushaj, Petros V. Anagnostopoulos

University of Wisconsin, Madison, WI

Invited Discussant:

9:35 am – 9:45 am **Coffee Break**

7:30 am – 9:45 am **General Thoracic Surgery** Room 312, Hynes
Simultaneous Scientific Session
5 minute presentation, 6 minute discussion

Moderators: *Wayne Hoffstetter and ◆Katie Nason

97. Induction Therapy for Locally Advanced Distal Esophageal Adenocarcinoma: Is Radiation Always Necessary?
Douglas Z. Liou, Leah Backhus, *Joseph Shrager, *Mark F. Berry
Stanford University, Stanford, CA

Invited Discussant: *Brendon M. Stiles

98. Use of Drain Amylase Allow for Early and Definitive Intervention of Esophageal Leaks and Aids in Preventing Esophagectomy Mortality
*Philip A. Linden, Yaron Perry, Vanessa Ho, Luis Argote-Greene, Jennifer Ginsberg, Susan Fu, Miri Shlomi, Christopher W. Towe
University Hospitals Cleveland Medical Center, Cleveland, OH

Invited Discussant: *Jay M. Lee

99. Endoscopic Mucosal Resection for Submucosal Esophageal Cancer
David B. Nelson[1], Arlene M. Correa[1], Rajeev Dhupar[2], Alexei Goltsov[1], Dipen Maru[1], Boris Sepesi[1], Mara Antonoff[1], *Reza Mehran[1], *David C. Rice[1], *Garrett L. Walsh[1], *Ara Vaporciyan[1], *Stephen Swisher[1], *Jack A. Roth[1], Raquel Davila[1], Sonia Betancourt[1], Heath Skinner[1], Mariela Blum[1], *Wayne L. Hofstetter[1]
[1]MD Anderson Cancer Center, Houston, TX; [2]University of Pittsburgh, Pittsburg, PA

Invited Discussant: *Gail E. Darling

100. Esophagectomy Versus Endoscopic Resection for Patients with Early-Stage Esophageal Cancer: A National Cancer Database Propensity-Matched Study
Katy A. Marino, Jennifer L. Sullivan, ◆Benny Weksler
University of Tennessee, Memphis, TN

Invited Discussant: *Haiquan S. Chen

Impact of Technology on Approach and Outcomes for Barrett Cancer and High Grade Dysplasia
Invited Speaker: *Bryan F. Meyers, *Washington University*

101. Adjuvant Chemotherapy Improves Survival in Patients with Completely Resected, T3N0 Non-Small Cell Lung Cancer Invading the Chest Wall
Justin Drake, Jennifer L. Sullivan, ◆Benny Weksler
University of Tennessee, Memphis, TN

Invited Discussant: *Abbas E. Abbas

102. Macroscopic Complete Resection Does Not Affect Survival in Patients with Malignant Pleural Mesothelioma: It Is All Histology and Nodal Disease

*Hasan F. Batirel[1], Muzaffer Metintas[2], Hale Basak Ozkok[3], Guntulu Ak[2], Perran Fulden Yumuk[1], Rengin Ahiskali[1], Emine Bozkurtlar[1], Tunc Lacin[1], Bedrettin Yildizeli[1], Mustafa Yuksel[1]

[1]Marmara University Hospital, Istanbul, Turkey; [2]Lung and Pleural Cancers Research and Clinical Center, Eskisehir, Turkey; [3]Medipol University, Istanbul, Turkey

Invited Discussant: *Isabelle Opitiz

103. A Phase I Trial of Extrapleural Pneumonectomy or Pleurectomy/Decortication, Intrathoracic/Intraperitoneal Hyperthermic Cisplatin and Gemcitabine with Intravenous Amifostine and Sodium Thiosulfate Cytoprotection for Patients with Resectable Malignan

*David J. Sugarbaker[1], William Richards[2], *Raphael Bueno[2]

[1]Baylor College of Medicine, Houston, TX; [2]Brigham and Women's Hospital, Boston, MA

Invited Discussant: *Marc DePerrot

104. Lung Adenocarcinoma with Perioperatively Diagnosed Pleural Seeding: Is Main Tumor Resection Beneficial for Prognosis?

Chi Li, Shuenn-Wen Kuo, Hsao-Hsun Hsu, Mong-Wei Lin, Jin-Shing Chen

National Taiwan University Hospital, Taipei, Taiwan

Invited Discussant: ◆Benny Weksler

105. Lymph Nodal Metastasis in Thymic Malignancies-Results of the Chinese Alliance for Research in Thymomas Prospective Observational Study

Wentao Fang[1], Zhitao Gu[1], Yun Wang[2], Liewen Pang[3], Weiyu Cheng[4], Yi Shen[4], Peng Zhang[5], Yongyu Liu[6], Chun Chen[7], Xinming Zhou[8], *Keneng Chen[9], Yangchun Liu[10], Jianhua Fu[11], Jianyong Ding[12], Lijie Tan[12], Yongtao Han[13], Yin Li[14], Zhentao Yu[15], Teng Mao[1], Jun Yang[1], Kejian Cao[1]

[1]Shanghai Chest Hospital, Shanghai, China; [2]West China Hospital, Chengdu, China; [3]Huashan Hospital, Shanghai, China; [4]Affiliated Hospital of Qingdao University, Qingdao, China; [5]Tianjin Medical University, Tianjin, China; [6]Liaoning Cancer Hospital, Shenyang, China; [7]Fujian Medical University, Fuzhou, China; [8]Zhejiang Cancer Hospital, Hangzhou, China; [9]Peking University, Beijing, China; [10]Jiangxi People's Hospital, Nanchang, China; [11]Sun Yat-sen University, Guangzhou, China; [12]Zhongshan Hospital, Shanghai, China; [13]Sichuan Cancer Hospital, Chengdu, China; [14]Affiliated Cancer Hospital of Zhengzhou University, Zhengzhou, China; [15]Tianjin Medical University, Tianjin, China

Invited Discussant: *Cameron D. Wright

9:45 am – 9:55 am Coffee Break

Masters of Surgery Video Sessions

9:45 am **Advanced Techniques for Complex Cardiac Surgical Challenges – Video Session** Room 302/304, Hynes

Moderator: *Marc R. Moon, *Washington University*

Panelists: *David H. Adams, *Mount Sinai Medical Center*
*Malakh L. Shrestha, *Hannover Medical School*
*Lars G. Svensson, *Cleveland Clinic*

9:50 am **Endocarditis with Annular Reconstruction**
*Gosta B. Pettersson, *Cleveland Clinic*

10:10 am **Papillary Muscle Repositioning and Anterior Sliding Plasty During MV Repair**
*Gilles D. Dreyfus, *Cardithoracic Centre of Monaco*

10:30 am **AVR via Right Anterior Thoracotomy**
◆Joseph Lamelas, *Mount Sinai Medical Center*

10:50 am **Hybrid Aortic Surgery**
Martin Czerny, *University Hospital Berne*

11:10 am **Transcatheter Mitral Valve Repair/Replacement**
*Wilson Y. Szeto, *University of Pennsylvania*

11:30 am **AATS Centennial Adjourns**

9:45 am **Congenital Masters of Surgery Video Session** Room 306, Hynes

Moderators: *Jonathan M. Chen, *Seattle Childrens's Hospital*
*Robert D. Jaquiss, *UT Southwestern*

9:45 am **Hemi-Mustard-Raselli**
*Frank L. Hanley, *Stanford University*

10:00 am **Wrapped Ross**
*James S. Tweddell, *Cincinnati Children's Hospital*

10:15 am **Ozaki Procedure**
*Pedro J. del Nido, *Boston Children's Hospital*

10:30 am **Valve Sparing Aortic Root Replacement in Children**
*Duke E. Cameron, *Massachusetts General Hospital*

*AATS Member ◆AATS New Member

10:45 am **Cone Repair**
*Jose Da Silva, *Children's Hospital of Pittsburgh*

11:00 am **Double Switch**
*Richard G. Ohye, *University of Michigan*

11:15 am **Discussion**

11:30 am **AATS Centennial Adjourns**

9:55 am **General Thoracic Masters of Surgery Video Session** Room 312, Hynes
Moderator: *Bryan F. Meyers, *Washington University*

9:55 am **VATS Right Lower Lobectomy with Bronchoplasty**
*Shanda H. Blackmon, *Mayo Clinic*

10:15 am **Novel Uses of Energy for Pulmonary Lobectomy and Segmentectomy**
*Scott J. Swanson, *Brigham and Women's Hospital*

10:35 am **Novel Stapling Strategy for Lobectomy and Segmentectomy, with Pitfalls**
*Todd L. Demmy, *Roswell Park Cancer Institute*

10:55 am **Open Chest Wall Resection and Reconstruction**
Matt Bott, *Memorial Sloan Kettering Cancer Center*

11:15 am **Discussion**

11:30 am **AATS Centennial Adjourns**

MONDAY, MAY 1, 201

6:30 am **Update on Maintenance of Certification for the American Board of Thoracic Surgery** Room 312, Hynes *Not for Credit*

Presenter: *Yolonda L. Colson, Brigham *and Women's Hospital, Boston, MA*

See page 31 for description.

7:20 am **Business Session,** *AATS Members Only* Ballroom ABC, Hynes

7:30 am – 11:05 am **Plenary Scientific Session** Ballroom ABC, Hynes
8 minute presentation, 12 minute discussion

Moderators: *Thoralf M. Sundt, III and *Marc R. Moon

1. Comparative Effectiveness of CABG Versus PCI in a Real World STICH Population

Alexander Iribarne[1], Anthony W. DiScipio[1], *Bruce J. Leavitt[2], Yvon R. Baribeau[3], Paul W. Weldner[4], Yi-Ling Huang[1], Michael P. Robich[5], Robert A. Clough[6], Gerald L. Sardella[7], Elaine M. Olmstead[1], David J. Malenka[1]

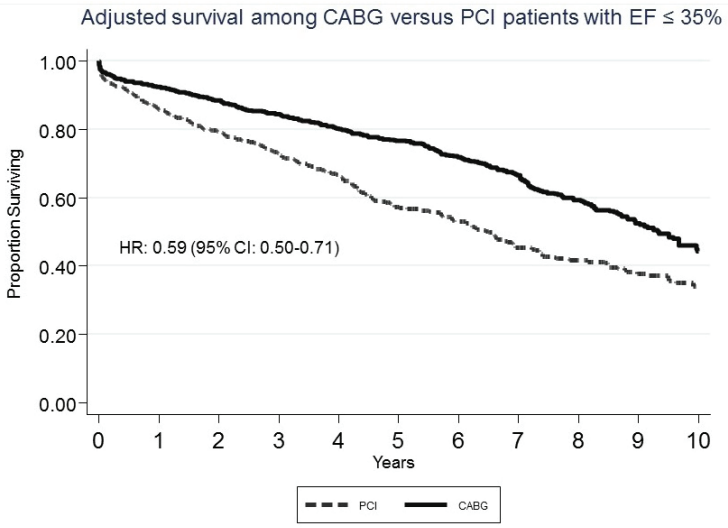
[1]Dartmouth-Hitchcock Medical Center, Lebanon, NH; [2]University of Vermont, Burlington, VT; [3]Catholic Medical School, Manchester, NH; [4]Central Maine Medical Center, Lewiston, ME; [5]Maine Medical Center, Portland, ME; [6]Eastern Maine Medical Center, Bangor, ME; [7]Concord Hospital, Concord, NH

Invited Discussant: *John D. Puskas

Objective: Ten-year data from the STICH trial demonstrated a survival benefit of coronary artery bypass grafting (CABG) plus medical therapy when compared to medical therapy alone, but no trials have examined the role of CABG versus percutaneous coronary intervention (PCI) among patients with heart failure with reduced ejection fraction (EF). The goal of this study was to examine the comparative effectiveness of CABG versus PCI among patients with multivessel disease and reduced EF in a STICH-like population.

Methods: A multicenter, retrospective analysis of all CABG (n = 18,292) and PCI (n = 55,438) patients from 2004 to 2014 among 7 medical centers reporting to a prospectively maintained clinical registry was conducted. Inclusion criteria were: EF ≤ 35% and 2 or 3 vessel disease (VD). Exclusion criteria were: prior PCI or cardiac surgery, emergent status, left main ≥50%, STEMI, or procedure within 24 hours of a myocardial infarction. After applying inclusions/exclusion criteria, baseline comorbidities were balanced using inverse probability weighting for a matched study cohort of 955 CABG and 718 PCI patients. The primary end point was all-cause mortality. Secondary endpoints included rates of stroke, repeat revascularization, intra-aortic balloon pump (IABP) use, and 30-day mortality.

Results: The mean duration of follow-up was 4.3 ± 3.2 years. Groups were successfully matched on age, gender, body surface area, major baseline comorbidities, number of diseased vessels, and EF. Among matched patients, CABG was associated with improved long-term survival when compared to PCI (HR: 0.59 [0.50–0.71], p < 0.01; Figure). Groups did not differ in rates of 30-day mortality (CABG 3.2% (n = 30), PCI 4.7% (n = 34), p = 0.14). Although CABG patients did have higher rates of periprocedural stroke (CABG 2.6% [n = 25], PCI 0.28% [n = 2], p < 0.01) and IABP use (CABG 18.2% [n = 174], PCI 3.8% [n = 27], p < 0.01), PCI patients had higher rates of repeat revascularization (CABG 3.4% [n = 33], PCI 13.8% [n = 99], p < 0.01). In subgroup analysis of CABG versus PCI, CABG was still associated with improved survival in patients ≥65 years old (HR: 0.54 [0.43–0.66]), women (HR: 0.57 [0.41–0.79]), 2VD (HR: 0.7 [0.54–0.90]), 3VD (HR: 0.5 [0.39–0.64]), and diabetics (HR: 0.53 [0.42–0.67]). The median EF of the study cohort was 30 [25–35]%. CABG was associated with improved survival among patients with an EF 30–35% (HR: 0.57 [0.42–0.78]), EF 25–29% (HR: 0.34 [0.23–0.51]), and EF <25% (HR: 0.66 [0.47–0.93]). The rate of drug-eluting stent (DES) use in the PCI group was 69.8 % (n = 501). Among patients receiving a DES in this cohort, CABG was still associated with better survival (HR: 0.49 [0.38–0.63]).



Conclusions: Among patients with reduced EF and multivessel disease, CABG was associated with greater long-term survival when compared to PCI. Notably, the survival advantage conferred by CABG was observed across subgroups of age, gender, and diabetes.

2. A Comparison of the Belsey Mark IV and Laparoscopic Nissen Fundoplication in Patients with Large Paraesopahgeal Hernia

Danuel Laan, John Agzarian, William S. Harmsen, K. Robert Shen, *Shanda H. Blackmon, *Francis C. Nichols, III, *Stephen D. Cassivi, *Dennis A. Wigle, *Mark S. Allen
Mayo Clinic, Rochester, MN

Invited Discussant: *James D. Luketich

Objectives: Large paraesophageal hernias are more likely to recur after repair than their smaller counterparts. Despite a reported recurrence rate of up to 50% for laparoscopic Nissen repair for large hiatal hernias, the Nissen fundoplication is the most widely utilized operation nationally. We compared the outcomes between the Belsey Mark IV fundoplication and laparoscopic Nissen.

Methods: A retrospective review of a prospectively collected institutional database was performed, including all patients from 2002 to 2012 who had repair of a large paraesophageal hernia (>50% of the stomach within the thorax). The first 118 sequential Belsey patients were matched 1 to 1 with laparoscopic Nissen patients; matching on year of surgery, gender, and age. Patients were excluded if their index operation at our institution was for failed fundoplication done elsewhere (n = 27). The 2 groups were evaluated for recurrence by esophagram, esophagogastroduodenoscopy (EGD), or CT scan and symptomatic follow-up (1–4 Likert scale). Using chi-square, Fisher's exact and Wilcoxon rank sum test, we compared these two groups, examining recurrence, need for re-operation, and perioperative outcomes. Recurrence free survival was reported using Kaplan-Meier method of analyses.

Results: A total of 118 Belsey patients were matched to Nissen patients. Patient demographic and postoperative characteristics are summarized in the Table. Leak, reoperation and recurrence were greater in the Nissen fundoplication group. In patients with five years or less follow-up (Belsey, n = 77; Nissen, n = 77), there was no difference in symptoms between the 2 groups. In patients with follow-up greater than five years (Belsey, n = 41; Nissen, n = 41), symptoms in the Belsey and Nissen group were excellent (78% vs 46%), good (7% vs 10%), fair (12% vs 29%), and poor (2% vs 14%), respectively, p = 0.002. Ten-year survival free of recurrence in the Belsey patients was 80.3% (95% CI [65.1%–91.9%]) compared with 45.3% (95% CI [28.7%–71.5%]) in Nissen patients, corresponding with a significant increased risk of recurrence, HR: 2.5, 95% CI [1.3–5.1], p = 0.009.

Table: Patient Demographics and Postoperative Characteristics of Patients with Large Paraesophageal Hernia Repair

	Belsey n = 118	Nissen n = 118	p-Value
Age, mean (SD)	68.7 (11.7)	69.8 (10.1)	
Male	35 (29.7%)	35 (29.7%)	
BMI, mean (SD)	30.3 (5.0)	28.8 (4.7)	0.04
CD Score			0.67
<3	21 (17.8%)	13 (11.0%)	
>3	4 (3.4%)	13 (11.0%)	
Intraoperative Complications	0	4 (3.4%)	0.12

*AATS Member ◆AATS New Member

	Belsey n = 118	Nissen n = 118	p-value
Leak, yes	0	8 (6.8%)	0.006
Recurrence, yes	12 (10.2%)	25 (21.2%)	0.009
Re-operation, yes	3 (2.5%)	11(9.3%)	0.04
Follow-up days, median (IQR)	667.0 (63, 2444)	959.5 (67, 2395)	

SD = Standard deviation, IQR = Interquartile range, CD = Clavien-Dindo

Conclusion: Laparoscopic Nissen fundoplication for large paraesophageal hernias was associated with a higher recurrence, increased rate of leak and a higher rate of reoperation when compared with Belsey Fundoplication. Symptomatic follow-up was worse for Nissen patients at longer intervals of follow-up. Belsey Fundoplication should be strongly considered when evaluating patients with large paraesophageal hernias.

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3. Outcomes of Surgical Intervention for Anomalous Aortic Origin of a Coronary Artery: A Large Contemporary Prospective Cohort Study

Carlos M. Mery[1], Luis E. De León[1], Silvana M. Molossi[1], S. Kristen Sexson-Tejtel[1], Hitesh Agrawal[1], Rajesh Krishnamurthy[2], Prakash M. Masand[1], E. Dean McKenzie[1], *Charles D. Fraser, Jr.[1]

[1]Texas Children's Hospital, Houston, TX; [2]Nationwide Children's Hospital, Columbus, OH

Invited Discussant: *Pedro J. del Nido

Objective: Anomalous aortic origin of a coronary artery (AAOCA) is the second leading cause of sudden cardiac death (SCD) in the young. The purpose of this study was to prospectively analyze the outcomes of patients with AAOCA undergoing surgical intervention as part of a standardized management algorithm.

Methods: All patients aged 2–18 years who underwent surgical intervention for AAOCA as part of a formal Coronary Anomalies Program between December 2012 and August 2016 were prospectively included. A standardized algorithm for management was created. All patients were consented for participation in the study and underwent nuclear perfusion test (NPT) ± stress MRI and retrospectively ECG-gated computerized tomography (CTA) preoperatively and at 3 months postoperatively. Surgical indications included an anomalous left coronary, ischemic symptoms, positive NPT, or high-risk anatomy on CTA (long intramural segment, ostial stenosis). Patients were cleared for exercise at 3 months postoperatively if asymptomatic and repeat NPT, MRI, and CTA were normal.

Results: Forty-one patients, median age 14 years (8–18), underwent surgical intervention: 9 (22%) for an anomalous left coronary and 32 (78%) for an anomalous right coronary. Surgical procedures included unroofing of an intramural (IM) segment in 35 (85%) (Figure), coronary translocation (for patients with a short IM or when the segment traveled below the aortic valve) in 5 (12%), and ostioplasty in 1 (2%). Minor complications occurred in 6 (16%) patients (pericardial effusion, superficial wound dehiscence/erythema). One patient who presented with SCD from an anomalous left coronary and underwent ostioplasty (leaving the anomalous coronary arising from the incorrect sinus), presented one year later with a recurrent

episode of SCD while playing basketball and was found to have an unrecognized myocardial bridge and persistent compression of the coronary by the intercoronary pillar; he underwent unroofing of the myocardial bridge and coronary translocation. He is asymptomatic and all studies, including cardiac catheterization with intramuscular ultrasound and fractional flow reserve are negative. At last follow up (median 1.2 years [1 month to 4 years]), 37 (90%) patients are asymptomatic and 4 have non-specific chest pain; 36 (88%) patients have returned to full activity and 5 are waiting their 3-month appointment for clearance.

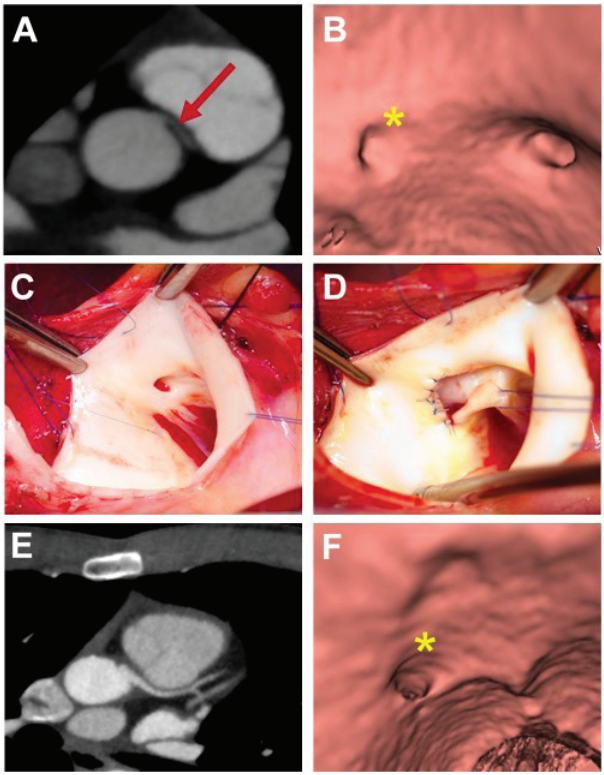


Figure. CT scans and intraoperative pictures of a patient undergoing coronary unroofing of an anomalous left coronary artery

Preoperative: A) Anomalous left coronary artery (LCA, arrow) with an inter-arterial course and a 10 mm intramural course. **B)** Slit-like LCA ostium (*).

Intraoperative: C) Before unroofing. **D)** IM segment has been unroofed.

Postoperative: E) The left coronary has been unroofed. **F)** Improved caliber of the LCA ostium arising from the correct sinus (*).

Conclusions: Surgical treatment for AAOCA is safe. Surgical intervention, by unroofing or translocation, should aim to place the coronary ostium on the correct sinus, away from the intercoronary pillar. Most patients are cleared postoperatively for exercise and remain asymptomatic. Longer follow-up is needed to assess the true efficacy of surgical intervention in the prevention of SCD.

8:35 am **In the Words of the Presidents: A Video Celebration of the AATS Centennial**

8:50 am **Award Presentations**

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

9:05 am – 9:35 am
Social Media in Cardiothoracic Surgery
AATS CT Theater II
Booth #1828, Exhibit Hall
Not for Credit

See page 32 for details.

9:40 am **Honored Guest Lecture**
Team of Teams – Rules of Engagement for a Complex World
General Stanley A. McChrystal, *McChrystal Group*

10:20 am **Plenary Scientific Session**
Moderators: *Duke E. Cameron and *Marc R. Moon

4. Safety and Feasibility of Lobectomy Following Concurrent Chemotherapy and High Dose Radiation for Stage IIIA NSCLC: Pooled Surgical Results of NRG Oncology RTOG 0229 and 0839

*Jessica S. Donington[1], Rebecca Paulus[2], Martin Edelman[3], *Mark Krasna[4], Quynh Le[5], Mohan Suntharalingam[6], Billy Loo[5], Steven Feigenberg[6], Elizabeth Gore[7], Vita McCabe[8], Cliff Robinson[9], Gregory Videtic[10], Nathaniel Evans[11], Paul Thurmes[12], Maximilian Diehn[5], Mark Smith[13], Roy Decker[14], Jeffery Bradley[15]

[1]New York University, New York, NY; [2]NRG Oncology, Philadelphia, PA; [3]University of Maryland, Baltimore, MD; [4]Rutgers-Robert Wood Johnson Medical School, Jersey Shore University Medical Center, Neptune, NJ; [5]Stanford University, Stanford, CA; [6]University of Maryland, Baltimore, MD; [7]Medical College of Wisconsin, Milwaukee, WI; [8]Michigan Cancer Research Consortium, Ann Arbor, MI; [9]Washington University in St. Louis, St. Louis, MO; [10]Cleveland Clinic, Cleveland, OH; [11]Thomas Jefferson University Hospital, Philadelphia, PA; [12]Metro Minnesota CCOP, Minneapolis, MN; [13]University of Iowa, Iowa City, IA; [14]Yale University, New Haven, CT; [15]Washington University, St. Louis, MO

Invited Discussant: *David R. Jones

Objective: Concern exists regarding surgery after thoracic radiation. We aim to assess safety and feasibility of anatomic resection following induction therapy with platinum-based chemotherapy (C) and full-dose thoracic radiation (RT) for resectable N2 positive stage IIIA NSCLC.

Methods: Two prospective trials were recently conducted by NRG Oncology in patients with resectable N2 positive IIIA NSCLC with the primary end point of mediastinal node sterilization following concurrent chemotherapy and full-dose radiation (RTOG 0229 and 0839). In each trial, surgeons were required to demonstrate expertise with post-induction resection and to adhere to specific management guidelines. Patients underwent surgical evaluation prior to starting induction therapy, which consisted of weekly carboplatin (AUC = 2.0) and paclitaxel (50 mg/m^2) and concurrent RT 60 Gy in 30 fractions (0839)/61.2 Gy in 34 fractions (0229). Patients in 0839 were randomized to weekly panitumumab (EGFR monoclonal antibody) during induction. The mediastinum was pathologically reassessed prior to or at the time of resection. Primary results have been reported previously and were similar in all treatment arms. Short-term surgical outcomes are combined here.

Results: A total of 118 eligible patients enrolled, >90% received induction chemotherapy and >87% received RT per protocol dose. Ninety-one (77%) patients underwent anatomic resection, 81 lobectomy, 6 pneumonectomy, 3 bilobectomy, and 1 sleeve lobectomy. Most common reasons for not undergoing resection were medical contraindication and persistent nodal disease on post-induction invasive staging. R0 resections occurred in 74 (81%). Twelve resections (10%) were attempted minimally invasively and 2 uneventfully converted to open. Overall ≥Gr 3 adverse events (AEs) related to surgery were reported in 22 (24%), ≥Gr 3 pulmonary AEs in 17 (19%) and 30-day mortality in 4 (4%). All mortalities were related to a pulmonary AE (BPF, respiratory failure, PA hemorrhage, and ARDS). Rates of AEs and mortality were similar between trials. Compared with lobectomy, patients undergoing more extensive resections suffered higher rates of ≥Gr3 AEs (50%, 95% CI [19%, 81%] vs 21%, 95% CI [13%, 31%], p = 0.06), ≥Gr 3 pulmonary AEs (50%, 95% CI [19%, 81%] vs 15%, 95% CI [8%, 24%], p = 0.02), and mortality (30%, 95% CI [7%, 65%] vs 1% [95%, CI [0%, 7%], p = 0.004) (Table)

	0229	0839	Combined
Accrual dates	09/04-11/08	11/10-08/15	
Number of accruing institutions	22	33	46
Patients enrolled	57	61	118
Patients undergoing protocol resection	37	54	91
Median Age (range)	58 (41-75)	61 (32-78)	60 (32-78)
R0 resection	28 (76%)	46 (85%)	74 (81%)
Lobectomy	34	47	81
≥Grade 3 AE	7(21%)	10 (21%)	17 (21%)
≥Grade 3 pulmonary AE	6 (18%)	6 (13%)	12 (15%)
Mortality	0	1 (2.1%)	1 (1%)
>Lobectomy (pneumonectomy, bilobectomy, sleeve resection)	3	7	10
≥grade 3 AE	1 (33%)	4 (57%)	5 (50%)
≥grade 3 pulmonary AE	1 (33%)	4 (57%)	5 (50%)
Mortality	1 (33%)	2 (29%)	3 (30%)

Conclusions: This multi-institutional prospective analysis demonstrates that lobectomy can be performed safely after full-dose concurrent chemoradiation. Additional research is needed to determine the optimal approach to complex resections after chemoradiotherapy.

Funding: This project was supported by grants UG1CA189867 (NCORP), U24CA180803 (IROC), U10CA180868 (NRG Oncology Operations), U10CA180822 (NRG Oncology SDMC) from the National Cancer Institute (NCI) and Amgen.

5. 10 Year Clinical Experience of Humanitarian Cardiothoracic Surgery: Building a Platform for Ultimate Sustainability in a Resource-Limited Setting

Ralph Morton Bolman, III[1], JaBaris D. Swain[2], Colleen Sinnott[3], Suellen Breakey[4], Rian Hasson Charles[5], Gita Mody[2], Naphthal Nyirimanzi[6], Gabriel Toma[7], Egidia Rugwizangoga[2], Ceeya Patton-Bolman[8], Patricia Come[8], Gapira Ganza[9], Emmanuel Rusingiza[10], Nathan Ruhamya[11], Joseph Mucumbitsi[11], Jorge Chiquie Borges[12], Martin Zammert[12], Jochen D. Muehlschlegel[12], Robert Oakes[13], *Bruce Leavitt[1]

[1]University of Vermont, Burlington, VT; [2]Brigham and Women's Hospital, Boston, MA; [3]Harvard Medical School, Boston, MA; [4]Massachusetts General Hospital, Boston, MA; [5]The Ohio State University, Columbus, OH; [6]The University of Rwanda, Butare, Rwanda; [7]Partners in Health, Kigali, Rwanda; [8]Team Heart, Boston, MA; [9]Kanombe Military Hospital, Kilgali, Rwanda; [10]Kigali University Teaching Hospital, Kigali, Rwanda; [11]King Faisal Hospital, Kigali, Rwanda; [12]Brigham and Women's Hospital, Boston, MA; [13]Brylan Heart Institute, Lincoln, NE

Invited Discussants: *A. Pieter Kappetein and *David A. Fullerton

Objective: Despite its near complete eradication in resource-rich countries, rheumatic heart disease (RHD) remains the most common acquired cardiovascular disease in sub-Saharan Africa. Attendant morbidity and mortality marginalizes a key population at its peak age of productivity. With 1/10,500 physicians—including only 5 cardiologists for a population of 11.4 million, Rwanda represents a resource-limited setting lacking the local capital to detect and treat early cases of RHD and perform life-saving operations for advanced disease. Humanitarian surgical outreach in this region may improve delivery of cardiothoracic care by providing sustainability through mentorship, medical expertise, training, and knowledge transfer; and, ultimately, the creation of a cardiac center.

Methods: We describe the experience of 10 consecutive visits to Rwanda since 2008 and report outcomes of a collaborative approach to enable sustainable cardiothoracic surgery. The Ferrans and Power Quality of Life Index (QLI) tool-Cardiac Version (http://www.uic.edu/orgs/qli/) was administered to assess postoperative quality of life.

Results: Ten visits have been completed, performing more than 150 open procedures, including 171 valve implantations (NYHA class III or IV) with 5% 30-day mortality (Table). All procedures were performed with participation of local Rwandan personnel, alongside expatriate residents and faculty. Early complications included CVA (n = 3), hemorrhage requiring reoperation (n = 2), and death (n = 5). Four major domains of postoperative quality of life were considered: Health and Functioning, Social and Economic, Psychological/Spiritual, and Family. The mean total QLI was 20.79 ± 4.07 on a scale from 0 to 30, where higher scores indicated higher quality of life. Women had significantly lower "Social and Economic" subscores (16.81 ± 4.17) than men (18.64 ± 4.10), ($p < 0.05$). Patients who reported receiving their follow-up care in rural health centers also had significantly lower "Social and Economic" subscores (15.67 ± 3.81) when compared to those receiving follow-up care in urban health facilities (18.28 ± 4.16), ($p < 0.005$). Value afforded to family as well as psychological factors remained high among all groups. Major post-surgical challenges faced included barriers to follow-up and systemic anticoagulation.

Year	#Cases	#Male	Mean age	#Implanted Valves	Mechanical valve	Bioprosthetic valve	Discharged on Coumadin	Early Mortality (<30 d)
2008	11	10	28.1	8	7	1	8	0
2009	13	3	25.5	10	3	7	3	1
2010	14	7	23.5	18	13	5	8	3
2011	15	9	27.2	22	16	6	10	0
2012	16	6	25.1	25	19	6	15	0
2013	16	7	26.6	20	20	0	15	2
2014	16	5	24.1	24	24	0	14	0
2015	16	7	22.3	25	25	0	15	1
2016	16	3	22.1	19	19	0	14	0
2017	**16**	-	-	-	-	-	-	-
10Trips	**149**	**57**	**24.9**	**171**	**146**	**25**	**102**	**7**

Conclusions: Preliminary results show an overall low rate of complications as well as lower quality of life scores among female patients and patients receiving follow-up care in rural areas. This report represents the first account of a long-term humanitarian effort to develop sustainability in cardiothoracic surgery in a resource-limited setting with superior outcomes; utilizing volunteer teams to deliver care, transfer knowledge, mentor local personnel and train key individuals to assist in mitigating the burden of cardiovascular disease in sub-Saharan Africa.

11:05 am **New Member Induction** Ballroom ABC, Hynes

11:25 am **Presidential Address** Ballroom ABC, Hynes
Ancora Imparo: Always Learning
*Thoralf M. Sundt, *III, Massachusetts General Hospital, Boston, MA*

12:30 pm **Adjourn for Lunch in the Exhibit Hall**

12:45 pm – 2:00 pm **Ethics Forum Lunch** Room 310, Hynes
Separate Registration Required
Final Exit with Medical Help: Should State Law Legitimize Physician-Assisted Suicide?

See page 34 for details.

*AATS Member ◆AATS New Member

12:45 pm – 2:00 pm | **20th Annual C. Walton Lillehei Resident Forum** | 6 minute presentation, 4 minute discussion | AATS CT Theater I | Booth #106, Exhibit Hall | *Not for Credit*

Chairs: *Fredrick Y. Chen and *Dao M. Nguyen

L1. Mutations in ROBO4 Lead to the Development of Bicuspid Aortic Valve and Ascending Aortic Aneurysm

Hamza Aziz[1], Russell Gould[2], Courtney Wood[2], Ajay Kumar[3], Christoph Preuss[4], Hua Ling[2], Nara Sobreira[2], Christopher Bennett[5], Asad Shah[6], G. Chad Hughes[1], Salah A. Mohamed[7], Anders Franco-Cereceda[8], Per Eriksson[8], Gregor Andelfinger[4], Lut Van Laer[3], Bart Loeys[3], Andy McCallion[2], Harry C. Dietz[2]

[1]Duke University, Durham, NC; [2]Johns Hopkins School of Medicine, Baltimore, MD; [3]University of Antwerp, Antwerp, Belgium; [4]Université de Montréal, Montreal, QC, Canada; [5]Harvard Medical School, Boston, MA; [6]REX Cardiac Surgical Specialists, Raleigh, NC; [7]Universitaetsklinikum Schleswig-Holstein, Lubeck, Germany; [8]Karolinska Institutet, Stockholm, Sweden

Invited Discussant:

Objectives: Bicuspid aortic valve (BAV) affects up to 1% of the population with a third also having ascending aortic aneurysm (AscAA). The genetic etiology of BAV/AscAA is largely unknown with mutations in NOTCH1 and SMAD6 accounting for a minority of cases. We hypothesized that whole exome sequencing (WES) of the most distantly related affected individuals with BAV/AscAA would optimize our chance of finding a causal gene.

Methods: We performed WES on several large families with BAV/AscAA. Human aortic endothelial cells (HAEC) were transfected with ROBO4 constructs to evaluate functional impact of the mutations. Mice with a complete knock-out or knock-in (splice site mutation) of ROBO4 were aged to 5 months. Phenotyping was done with transthoracic echocardiography and tissue histology. Resequencing of 441 probands with BAV/AscAA versus 183 controls was conducted using a HaloPlex™ targeted panel. We filtered for ROBO 4 mutations with minor allele frequency of <0.01% or <0.1% and combined annotation dependent depletion (CADD) score >20.

Results: WES revealed perfect segregation of a heterozygous obligate splice site mutation in ROBO4 (c.2056 + 1G>T) in a multigenerational family with 7 probands. Functional analyses showed a stable transcript lacking constitutively utilized exon 13, predicting the formation of a transmembrane protein that could bind ligands (Slits) but would lack full signaling potential. A second family (trio) had a missense mutation (p.Arg64Cys) which was located in the first extracellular Ig-like domain of ROBO4. Targeted site directed mutagenesis and *in vitro* silencing resulted in enhanced endothelial "activation" with loss of tight junctions and barrier function suggesting a dominant negative behavior. Patient aortic tissue showed deep infiltration of ROBO4-expressing cells into the aortic media with attendant upregulation of α-smooth muscle actin and collagen production, which strongly suggests pathogenic endothelial-to-mesenchymal transition. A knock-out mouse model of Robo4 revealed (1/14) $Robo4^{+/-}$ and (7/43) $Robo4^{-/-}$ mice with abnormal aortic valve and/or dilation of the ascending aorta compared to (0/41) in the age-matched controls. The overall prevalence was 7% in heterozygous and 16% in homozygous knock-out

mice. A second knock-in mouse with the exact splice site mutation (c.2056+1G>T) showed similar penetrance and phenotype pattern. Lastly, resequencing of ROBO4 revealed 11 rare mutations in BAV/AscAA probands compared to a single mutation in the controls.

Conclusion: The data demonstrate ROBO4 is a causal gene for BAV/AscAA. ROBO4 mutations seem to recapitulate the full clinical spectrum of BAV/AscAA. The data point to a dominant negative, loss of function mutation in ROBO4 that increases endothelial layer permeability and might also initiate an endothelial-to-mesenchymal transition responsible for the pathogenesis of BAV/AscAA.

L2. Targeted Near-Infrared Intraoperative Molecular Imaging Can Identify Residual Disease During Pulmonary Resection

Jarrod D. Predina, Jane Keating, Andrew Newton, *Sunil Singhal

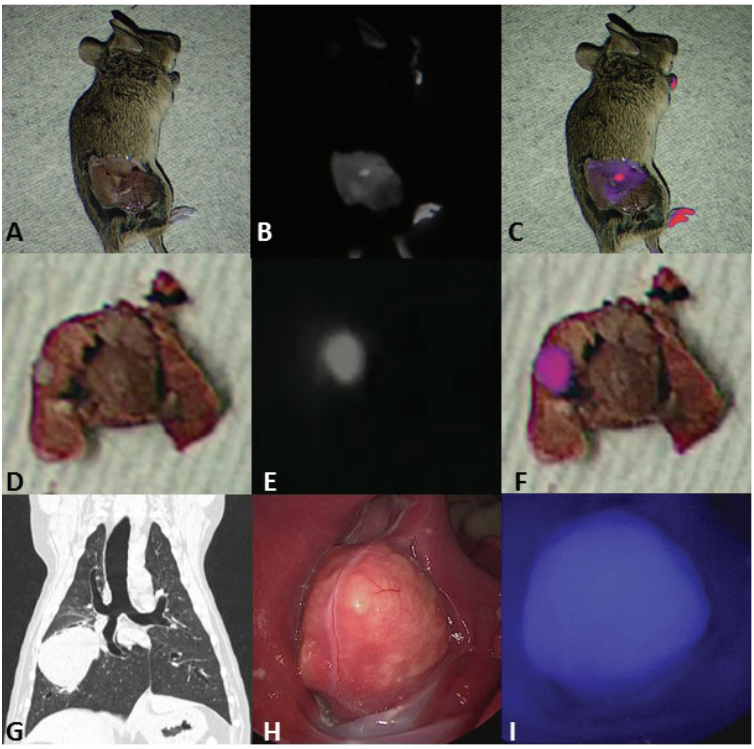
University of Pennsylvania, Philadelphia, PA

Invited Discussant:

Objectives: Intraoperative molecular imaging (IMI) is a novel technology that utilizes a fluorescent contrast agent to identify tumor cells during pulmonary resections. Initial human IMI experiences for NSCLC have been limited by technical hurdles including high background noise in inflammatory tissues (e.g., granulomas) and low signal output (e.g., visible wavelength noise). Thus, we hypothesized that a targeted near-infrared contrast agent specific for lung adenocarcinomas would improve our sensitivity and specificity during surgery.

Methods: We established surgical models of NSCLC that recapitulate local and systemic postoperative recurrences. Prior to resection, mice (n = 140) were injected intravenously with a near-infrared imaging agent (OTL0038) specific for pulmonary adenocarcinomas due to high affinity binding of the folate receptor alpha. After optimizing pharmacokinetic parameters, tumor-bearing mice were randomized to surgery with or without IMI. Suspicious residual disease was resected and analyzed by immunohistochemistry, flow cytometry, and immunofluorescence. Based on this data, OTL0038 was tested in a pilot study of five canines with spontaneously occurring lung cancer.

Results: In a local recurrence murine model (n = 80), surgeons identified 10 positive margins (25.0%) in mice randomized to imaging with IMI versus 3 positive margins (7.5%) in mice undergoing surgery alone (p = 0.033). In systemic recurrence models (n = 60), the mean number of pulmonary nodules located with IMI was 7.2 versus 3.4 in controls (p = 0.021). Residual tumor deposits ranged from 0.3 mm to 2.4 mm. Mean tumor-to-background ratio (TBR) of residual disease was 3.4. Sensitivity and specificity of IMI was 92.3% and 81.6%, respectively. Next, 5 canines with a presumed diagnosis of NSCLC were enrolled in our large-animal study. No toxicity was observed. Four of 5 canines had fluorescent tumors; the nonfluorescing tumor was discovered to be a metastatic mammary tumor on final pathologic analysis. The mean tumor size was 3.2 cm, and the mean TBR of adenocarcinomas was 3.1. In one canine, an otherwise undetectable 8 mm pulmonary adenocarcinoma was discovered with IMI.



(A-C) Brightfield, Near-Infrared and Overlay views of positive margin in mouse **(D-F)** Brightfield, NIR and Overlay views of pulmonary nodule in mouse **(G)** CT Chest in canine demonstrating pulmonary mass **(H, I)** Intraoperative brightfield and NIR views of canine pulmonary mass.

Conclusions: These data suggest that a targeted near-infrared contrast agent may improve IMI technology. Ultimately, this will enable accurate identification of residual disease that may otherwise be overlooked. These results are the basis of an ongoing Phase I human trial.

L3. Delivery of Endothelial Progenitor Cells with Injectable Shear-Thinning Hydrogels Maintains Ventricular Geometry andNormalizes Dynamic Strain to Stabilize Cardiac Function Following Ischemic Injury

Ann C. Gaffey, Minna H. Chen, Alen Trubelja, Chantel M. Venkataraman, Carol W. Chen, Susan Schultz, *Robert Gorman, Chandra M. Sehgal, Jason A. Burdick, *Pavan Atluri

University of Pennsylvania, Philadelphia, PA

Invited Discussant:

Objectives: The left ventricle undergoes adverse remodeling following myocardial infarction (MI) resulting in abnormal biomechanics and decreased function. Awareness of the progressive nature of MI-induced left ventricular remodeling and the relatively poor outcomes achieved with therapy for end-stage heart failure has led to an increasing interest in developing early post-MI therapies to limit adverse remodeling. We hypothesize that this tissue-engineered therapy could minimize adverse post-ischemic remodeling through reduction of mechanical stress and retention of tensile myocardial properties due to both improved endothelial progenitor cell (EPC) retention within the myocardium and intrinsic biomechanical properties of the hyaluronic acid shear-thinning gel (STG).

Methods: EPCs (DiLDL$^+$ VEGFR2$^+$ CD34$^+$) were harvested from adult Wistar Rats and resuspended in STG. STG+EPC constructs were circumferentially injected at the borderzone of ischemic rat myocardium following LAD ligation. Engraftment and retention were assessed by near infrared cellular tag. Myocardial remodeling, tensile properties, and hemodynamic function were analyzed in 4 groups: control (PBS), EPC injection (EPC), STG injection (STG), and STG+EPC construct (STG+EPC). Novel high-resolution, high-sensitivity ultrasound with speckle tracking allowed for analysis of epicardial and endocardial regional and global strain. Uniaxial testing assessed tensile biomechanical properties following treatment.

Results: STG+EPC injection significantly increased engraftment, migration, and retention of the EPCs within the myocardium one week after implantation compared to EPC alone. Using strain echocardiography, a significant increase in left ventricular function was noted in the STG+EPC cohort compared to control (69.5 ± 10.8 vs 40.1 ± 4.6%, p = 0.006). A significant normalization of myocardial longitudinal displacement with subsequent stabilization of myocardial velocity with STG+EPC therapy compared to control was also evident (0.84 ± 0.3 vs 0.11 ± 0.01 cm/s, p = 0.008). A significantly positive and higher myocardial strain was observed in STG+EPC (4.5 ± 0.45%) compared to STG (3.7 ± 0.24%), EPC (–3.5 ± 0.97%), and control (–8.6 ± 0.3%, p = 0.04), noting a lengthening and thickening of the myocardium following treatment with the STG and STG+EPC. A higher strain rate was tolerated within the STG+EPC group compared to control (31.3 ± 7.2 vs 12.3 ± 0.8 ms^{-1}). By uniaxial testing, a reduction in dynamic stiffness was noted in the STG+EPC cohort at 5% strain of 0.1 and 1.0 Hz.

Conclusions: This novel injectable shear-thinning hyaluronic acid hydrogel seeded with EPCs demonstrates stabilization of border zone myocardium with reduction in adverse myocardial remodeling and preservation of myocardial biomechanics. A marked increase in retention of delivered cells was evident with this tissue-engineered therapy.

L4. Targeted Cell Replacement in Human Lung Bioengineering

Brandon A. Guenthart, John D. O'Neill, Jinho Kim, Gordana Vunjak-Novakovic, *Matthew Bacchetta

Columbia University, New York, NY

Invited Discussant: *Marcelo Cypel

Objective: The growing need for transplantable lungs continues to drive the development of tissue engineering. Currently, four out of five donor lungs are deemed unacceptable for transplant. Due to the complexity of the lung, bioengineering strategies utilizing stem cells and fully decellularized or bioartificial scaffolds have been slow to make progress. As extracorporeal organ systems and *ex vivo* lung perfusion (EVLP) improves, our ability to intervene in the lung can expand beyond basic reconditioning. The replacement of damaged or diseased cells with patient-specific cell progenitors holds tremendous promise toward bioengineering a chimeric lung capable of gas exchange. To address this challenge, we developed a process for targeted decellularization (cell removal) and cell replacement in porcine and human lungs.

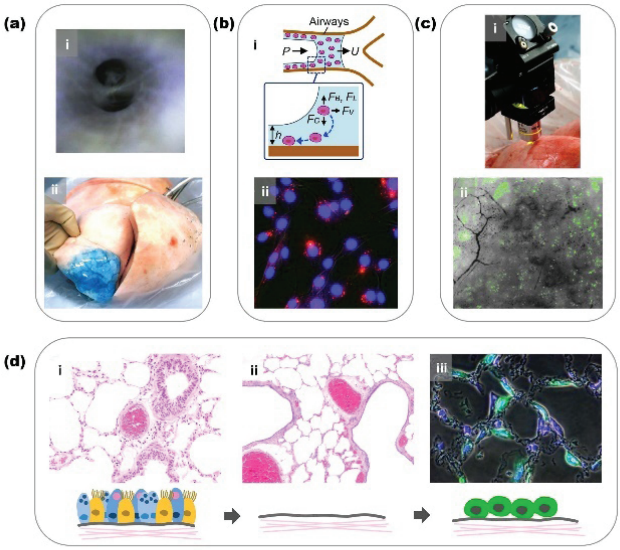


Fig. 1: **(a) (i)** Bronchoscopic view of decellularization solution (blue dye added for visualization). **(ii)** Gross appearance following delivery into the lateral segment of the right middle lobe. **(b) (i)** Mechanism of cell deposition. **(ii)** Cells labeled with quantum dot prior to delivery. **(c) (i)** Transpleural camera used to confirm cell delivery. **(ii)** Real-time non-invassive imaging of cells delivered into the distal airway. **(d) (i)** H&E of native lung. **(ii)** H&E demonstrating removal of lung epithelium with maintenance of the vasculature. **(iii)** Cell replacement with human airway epithelial cells (AEC) labeled with a green cell viability marker (CSFE).

Methods: Human lungs rejected for transplantation on the basis of standard clinical criteria, or healthy porcine lungs were harvested using standard protocols. The lungs were placed on our custom EVLP system, ventilated, and perfused with Perfadex (human) or whole blood (porcine). Video bronchoscopy and a custom microcatheter delivery and occlusion system facilitated the delivery of a decellularization

solution composed of CHAPS, NaCl, and EDTA (**Figure 1A**). Repeated bronchoalveolar lavage with normal saline was performed to remove cellular debris and detergent. Cells (human airway epithelial cells or human embryonic alveolar progenitor cells) were suspended, labeled with quantum dot or near infrared (NIR) cytoplasmic membrane dye (**Figure 1B**), and then delivered into decellularized lung regions. Following delivery, EVLP was continued for 4 to 6 hours to allow for cell engraftment. Lung wedge samples were collected at each time point for histologic analysis.

Results: Delivery, and distribution of labeled cells into targeted distal lung was confirmed using a noninvasive transpleural camera (**Figure 1C**) in real time. Following decellularization, H&E staining demonstrated removal of pseudostratified columnar epithelium in large airways and type I and II pneumocytes in the distal lung (**Figure 1D, ii**). Delivered cells were retained in the lung following EVLP and the fixation process. Distribution within the alveoli and cellular morphology suggest early engraftment (**Figure 1D, iii**).

Conclusion: Bioengineering human lung utilizing advanced therapeutic interventions and cell replacement strategies may help combat the critical shortage of donor lungs. Additionally, future patient specific *in vivo* application of this technology may eliminate the need for transplantation in select patients.

L5. Donor-Derived Non-Classical Monocytes Mediate Primary Lung Allograft Dysfunction by Recruiting Recipient Neutrophils via Toll Like Receptor-Dependent Production of MIP-2

Stephen Chiu[1], Zhikun Zheng[1], Mahzad Akbarpour[1], Ramiro Fernandez[1], Alexandra McQuattie-Pimentel[1], *Daniel Kreisel[2], Harris Perlman[1], G.R. Scott Budinger[1], Alexander Misharin[1], Ankit Bharat[1]

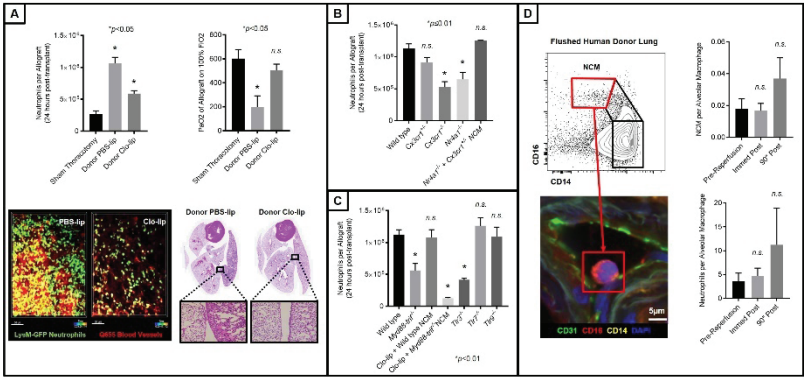
[1]Northwestern University, Chicago, IL; [2]Washington University, St. Louis, MO

Invited Discussant: *Christine L. Lau

Objective: Primary lung allograft dysfunction (PGD) is the predominant cause of perioperative mortality and the strongest risk factor for chronic rejection after transplant. Neutrophils recruited to the allograft mediate PGD. Although neutrophil depletion abrogates PGD, this may not be clinically feasible due to the importance of neutrophils in host defense. Here, we show that pulmonary nonclassical monocytes (NCM), retained in murine and human donor lungs, recruit neutrophils into the allograft, leading to the development of PGD.

Methods: Murine single lung transplants were performed between allogeneic strain combinations. Intravenous clodronate liposomes (clo-lip) were used to deplete monocytes. Two-photon intravital imaging and fluorescence activated cell sorting (FACS) were used to quantify neutrophil influx and sort NCM from lungs. PGD was diagnosed by analyzing PaO_2, vascular permeability, and histology. RT-qPCR and ELISA were used to quantify MIP-2 mRNA and protein levels. FACS and immunofluorescence microscopy were used to characterize myeloid cells in human donor lungs.

Results: Clo-lip treatment selectively depleted NCM in murine donor lungs and abrogated neutrophil influx into the allograft as well as development of PGD (Figure A). Genetic deletion of NR4A1, an orphan nuclear receptor necessary for the maturation of NCM, in donors resulted in depletion of NCM in allografts and protection against neutrophil infiltration. Reconstitution of *Nr4a1*$^{-/-}$ donor lungs with wild type NCM restored neutrophil influx (Figure B). Lungs from *Cx3cr1*$^{-/-}$ donors had preserved NCM but were protected from neutrophil influx due to the lack of fractalkine receptor on NCM (Figure B). Allografts from *Myd88-trif*$^{-/-}$ donors that have a global deficiency of Toll-like receptor (TLR) signaling were also protected against neutrophil influx. Reconstitution of clo-lip treated donor lungs with wild type NCM, but not *Myd88-trif*$^{-/-}$ NCM, restored neutrophil influx (Figure C). Post-reperfusion, donor-derived wild type NCM were found to express high levels of MIP-2, a key neutrophil chemoattractant, which was lacking in *Myd88-trif*$^{-/-}$ NCM. This was associated with increased MIP-2 levels in allografts. Individual TLR receptor deletion revealed that TLR3, but not others including TLR7 or TLR9, was necessary for neutrophil recruitment (Figure C). We confirmed that human donor lungs contained donor-derived NCM and their presence was associated with a rapid neutrophil influx after reperfusion (Figure D).



Conclusions: Pulmonary NCM, retained in human and murine donor lungs, produce MIP-2 and recruit neutrophils in a TLR-dependent manner. It is likely that these NCM sense double-stranded ribonucleic acids, known TLR3 ligands, released during ischemia-reperfusion injury. Depletion of donor NCM represents a novel and clinically relevant therapy, as it may abrogate PGD without affecting recipient host defense.

L6. *In Vivo* Lung Perfusion Rehabilitates Sepsis-Induced Lung Injury

J. Hunter Mehaffey, Eric J. Charles, Sarah A. Schubert, Ashish K. Sharma, Dustin Money, *Curtis G. Tribble, Victor E. Laubach, Mark E. Roeser, *Irving L. Kron

University of Virginia, Charlottesville, VA

Invited Discussant: *Jules Lin

Objective: Sepsis is the leading cause of lung injury in adults and can lead to Acute Respiratory Distress Syndrome (ARDS). The only available treatment is supportive therapy with prolonged mechanical ventilation and Extracorporeal Membrane Oxygenation (ECMO). We developed a novel method of isolated *in vivo* lung perfusion (IVLP), which allows for targeted delivery of lung rehabilitation therapies. Using this platform, we tested the hypothesis that normothermic IVLP can improve oxygenation and compliance in a porcine model of sepsis-induced lung injury.

Methods: We used a previously validated porcine lung injury model of intravenous lipopolysaccharide (LPS) to induce a systemic inflammatory response and subsequent severe ARDS requiring ECMO support. Mature adult swine (45–50 kg; n = 8) were administered LPS (50 µg/kg over 2 hours) via the external jugular vein followed by sternotomy and central ECMO cannulation (right atrium to ascending aorta). Left pulmonary artery (inflow) and left superior and inferior pulmonary veins (outflow) were dissected out and cannulated to isolate the left lung. The left lung underwent 4 hours normorthermic IVLP with Steen solution followed by 4 hours of lung reperfusion after IVLP decannulation. Airway pressures and lung-specific pulmonary vein blood gases were recorded hourly during the IVLP and reperfusion periods to calculate lung compliance and PaO_2/FiO_2 ratios. These parameters were compared between the right (LPS control) and left lungs (LPS+IVLP) of the same animal.

Results: All animals demonstrated a significant reduction in PaO_2/FiO_2 ratio and total lung compliance 2 hours after the start of LPS infusion (469 ± 19.7 vs 222.2 ± 21.4 mmHg, $p < 0.0001$; **Figure**). During IVLP, the left (treated) pulmonary vein oxygenation was superior to right (control) pulmonary vein oxygenation (**Figure**). After reperfusion and IVLP decannulation, six (75%) animals had improved lung function allowing for ECMO decannulation. Lung-specific oxygenation demonstrated superior function of the left lung compared to the right control at 4 hours of reperfusion (310.5 ± 54.7 vs 201.1 ± 21.7 mmHg, p = 0.04). Similarly, total lung compliance (**Figure**) improved after targeted rehabilitation of the left lung. Finally, the wet-to-dry ratio of lung tissue demonstrated reduced edema in rehabilitated left lungs compared to right controls (6.5 ± 0.3 vs 7.5 ± 0.4, p = 0.01).

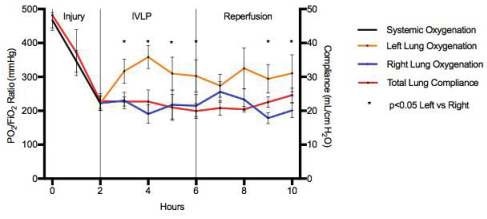


Figure: *In vivo* lung perfusion improves oxygenation and total lung compliance.

*AATS Member ◆AATS New Member

Conclusions: IVLP successfully rehabilitated LPS-induced lung injury to attenuate the need for ECMO support in this preclinical porcine model. When translated into a percutaneous platform, IVLP may provide a reliable means to rehabilitate various types of acute lung injury in patients on ECMO to reduce the morbidity and mortality in ARDS.

MONDAY AFTERNOON, MAY 1, 2017

2:00 pm – 5:30 pm **Adult Cardiac Surgery Controversies**
Simultaneous Scientific Sessions
Ballroom ABC, Hynes

2:00 pm **Adult Cardiac Surgery Controversies 1: Myocardial Protection**
5 minute presentation, no discussion

Moderator: *Anelechi Anyanwu

Panelists: Jennifer S. Lawton, *Ralph J. Damiano, Jr., *Thierry-Pierre Carrel, *Clifford W. Barlow

The Science Behind Cardioplegia
*Frank W. Sellke, Brown Medical School, Providence, RI

6. The Use of del Nido Cardioplegia in Surgery: A Prospective Randomized Trial

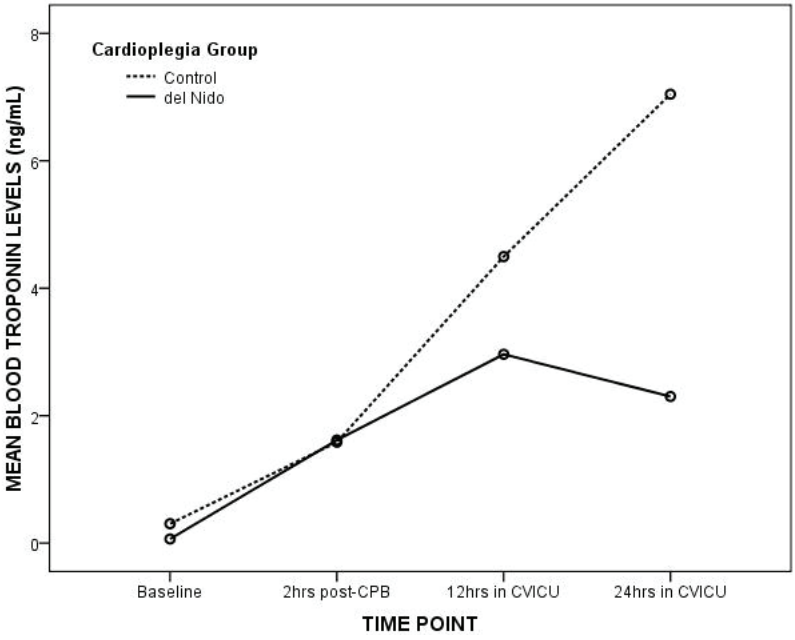
*Niv Ad[1], Sari D. Holmes[2], Paul S. Massimiano[3], Anthony J. Rongione[3], Lisa M. Fornaresio[2], David Fitzgerald[4]

[1]West Virginia University, Morgantown, WV; [2]Inova Heart and Vascular Institute, Falls Church, VA; [3]Adventist HealthCare, Takoma Park, MD; [4]Medical University of South Carolina, Charleston, SC

Objective: The del Nido cardioplegia solution has been used extensively in congenital heart surgery for more than 25 years, and more recently for the adult population. The primary objective of this prospective RCT was to determine whether expanding this technique to adult cardiac surgery would confer significant benefits in surgical workflow and clinical outcome compared with a blood-based cardioplegia strategy.

Methods: Adult patients presenting for first-time CABG or heart valve surgery requiring cardiopulmonary bypass (CPB) were randomized to receive del Nido cardioplegia solution (n = 48) or whole blood cardioplegia (n = 41). Delivery of del Nido solution was 1 L at a 1:4 ratio of blood:crystalloid at 6–10°C with subsequent doses of 500 mL if ischemic time over 90 minutes or spontaneous return of electrical activity. Whole blood cardioplegia induction doses ranged from 1 to 2 L with subsequent doses every 20 mins. Primary outcomes assessed myocardial preservation by TEE, ECG, troponin, and inotropes. Troponin I was measured at baseline, 2 hours after CPB termination, 12 hours after CVICU admission, and 24 hours after CVICU admission. Secondary outcomes assessed safety and workflow.

Results: Preoperative clinical characteristics were similar between the two groups, including age (65.3 vs 65.1 years), STS risk score (1.4% vs 1.3%), CABG surgery (75% vs 66%), and valve procedures (40% vs 39%). There was no difference between del Nido and control on CPB time (97 vs 103 mins, *P* = 0.288), but cross-clamp time was shorter for del Nido (70 vs 83 mins, *P* = 0.018). The del Nido group showed higher return to spontaneous rhythm (97.7% vs 81.6%, *P* = 0.023) and fewer patients who required inotropic support (65.1% vs 84.2%, *P* = 0.050). After adjustment for preoperative EF by TEE, del Nido and control groups were similar on postoperative EF by TEE (*t* = 0.3, *P* = 0.787). Incidence of STS-defined morbidity was low with no strokes, renal failure, or operative deaths. However, the composite outcome of any STS-defined complication did appear lower for the del Nido group (11.6% vs 26.3%, p = 0.089). Blood transfusion was similar for the del Nido and control groups (4% vs 7%, *P* = 0.658) as was preoperative and discharge HCT. None of the patients had a new Q wave on ECG and only 1 control group patient showed ST segment elevation. Interestingly, repeated measures analysis found that for del Nido, troponin levels after surgery did not increase as much as for controls (*F* = 4.1, *P* = 0.040; Figure).



Conclusions: Evidence from this study suggests that expanding the use of del Nido cardioplegia to routine adult cases is probably safe and may improve clinical outcomes, streamline surgical workflow, and reduce costs. The difference in troponin levels should be investigated further as it may reflect superior myocardial protection associated with the del Nido solution versus blood cardioplegia, especially with regard to vasodilation and microvascular response.

7. A Normokalemic Long Acting Blood Cardioplegia

Amber Malhotra, Vivek Wadhawa, Jaydip Ramani, Pankaj Garg, Arvind Kumar Bishnoi, Pranav Sharma, Manish Hinduja, Himani Pandya

U.N. Mehta Institute of Cardiology and Research Center, Ahmedabad, India

Objective: Blood cardioplegias have been the gold standard cardioprotective strategy. However, they provide myocardial protection for short durations and result in hyperkalemia induced myocardial edema leading to poor myocardial recovery. Complex cardiac surgeries require aortic cross clamp for extended durations. We have been using a long-acting blood-based (L) cardioplegia, with physiological potassium levels, less frequent dosing, and minimal hemodilution. The aim of our study was to compare the efficacy and safety of L cardioplegia with well-established cold blood (St. Thomas I blood ST1B) cardioplegia solution in patients undergoing multivalvular surgeries.

Methods: One hundred patients undergoing simultaneous aortic and mitral valve repair/replacements with or without tricuspid valve repair through median sternotomy were randomized in two groups. Emergency cases and patients with low ejection fraction were excluded. 12 mg adenosine was given in the aortic root immediately after cross clamping. In Group 1, a single dose of L solution was administered at 14°C (30 ml/kg), whereas in Group 2, ST1B was administered every 20 minutes at 14°C (30 ml/kg followed by 15 ml/kg). Moderate hypothermia of 30–32°C was achieved. Duration of CPB, inotropic score, Interleukin-6 (IL6), CPK-MB and Troponin I, ventilation time, ICU stay, and arrhythmias were compared.

Results: Mean CPB and cross-clamp times were 134.04 ± 36.12 and 154.34 ± 34.26 ($p = 0.004$) and 110.37 ± 24.80 and 132.48 ± 31.68 ($p = 0.002$) in L and ST1B group, respectively. Duration of mechanical ventilation was 6.45 ± 3.23 and 6.89 ± 3.30 hours ($p = 0.50$), ICU stay was 2.12 ± 1.60 and 2.45 ± 0.89 days ($p = 0.20$) and hospital stay was 6.67 ± 2.29 and 7.23 ± 2.52 days ($p = 0.24$) in L and ST1B group, respectively. Mean inotropic score was 6.32 ± 2.3 and 6.4 ± 2.48 ($p = 0.86$), incidence of postoperative new onset atrial fibrillation was 7/50 (14%) and 5/50 (10%) and incidence of ventricular arrhythmias after cross-clamp removal was 6/50 (12%) and 5/50 (10%) in L and ST1B group, respectively. Cardiac index, left and right ventricle stroke work index, mean CPK-MB, and troponin I levels at 6 and 12 hours were comparable (Table). Mean IL6 levels at 24 hours post bypass were 61.72 ± 15.33 and 75.44 ± 31.78 ($p = 0.007$) in L and ST1B group, respectively.

Conclusions: Single dose L (long-acting blood-based physiological potassium) cardioplegia gives a cardioprotective effect comparable to repeated doses of well-established cold blood cardioplegia. Though, the cardiac indices, ventilation time and ICU stay were similar in both the groups, the L cardioplegia demonstrated better biomarkers, bypass, and clamp time.

Table

	L Cardioplegia (n = 50)	ST1B Cardioplegia (n = 50)	p-value		L Cardioplegia (n = 50)	ST1B Cardioplegia (n = 50)	p-Value
Perioperative variables				*Biomarkers: CPK MB (U/L)*			
				6 hours	63.12 ± 8.70	68.02 ± 8.05	0.0043
Aortic cross-clamp time (minutes)	110.37 ± 24.80	132.48 ± 31.68	0.0002	24 hours	29.63 ± 3.87	32.80 ± 3.92	0.0001
CPB time (minutes)	134.04 ± 36.12	154.34 ± 34.26	0.0004	***Troponin I***			
Mechanical ventilation time (hours)	6.45 ± 3.23	6.89 ± 3.30	0.5020	6 hours	10.30 ± 2.25	12.08 ± 2.13	0.0001
Hospital stay (days)	6.67 ± 2.29	7.23 ± 2.52	0.2477	24 hours	4.53 ± 0.65	3.82 ± 0.60	<0.0001
ICU stay (days)	2.12 ± 1.60	2.45 ± 0.89	0.2055	***IL6***			
Euro score 2	2.34 ± 1.25	2.23 ± 1.36	0.6746	Pre bypass	5.02 ± 2.87	4.34 ± 3.20	0.2660
Mean inotropic score	6.32 ± 2.30	6.40 ± 2.48	0.8675	Post bypass	187.74 ± 25.18	193.7 ± 25.33	0.2427
Postoperative new onset AF	8 (16%)	6 (12%)	0.7732	24 hours	61.72 ± 15.33	75.44 ± 31.78	0.0071
Ventricular arrhythmias after cross-clamp removal	7 (14%)	6 (12%)	1.000				
				Final substrate concertation (mmol/liter)			
				Na^{+}	140	140	-------
Cardiac index (l/min/m²)				K^{+}	4	24	-------
6 hours	3.50 ± 0.62	3.48 ± 0.7	0.8801	Total Ca^{++}	2.1	2.2	
24 hours	3.24 ± 0.6	3.26 ± 0.7	0.8784	Mg^{++}	16	16	-------
Left ventricle stroke work index (ml/m²)				Sodium bicarbonate	24	24	-------
6 hours	53.5 ± 8.3	52.5 ± 8.2	0.5459	Osmolality (mOsm/L)	320–340	310–330	-------
24 hours	54.1 ± 8.4	54.4 ± 7.3	0.8492	Hematocrit (%)	25	25	-------
Right ventricle stroke work index (ml/m²)				Lidocaine (mg/liter)*	0.36 (140 mg)	-	-------
				Procaine (mg/liter)*	-	1 (13.64 mg)	-------
6 hours	4.1 ± 1.12	4.2 ± 1.0	0.6387	Dexamethasone	+	-	-------
24 hours	4.2 ± 1.1	4.2 ± 0.92	1.000	Mannitol	+	-	-------

*Calculated values, ST1B: St Thomas I blood based, L = Long-acting blood-based, AF: Atrial fibrillation, IL6 = Interleukin 6

*AATS Member ◆AATS New Member

8. Single Dose Cardioplegia Protects Myocardium As Well As Traditional Repetitive Dosing: A Randomized Study

Alessandro Vivacqua, Nicholas A. Tepe, Jeffrey M. Altshuler, Francis L. Shannon, Marc P. Sakwa

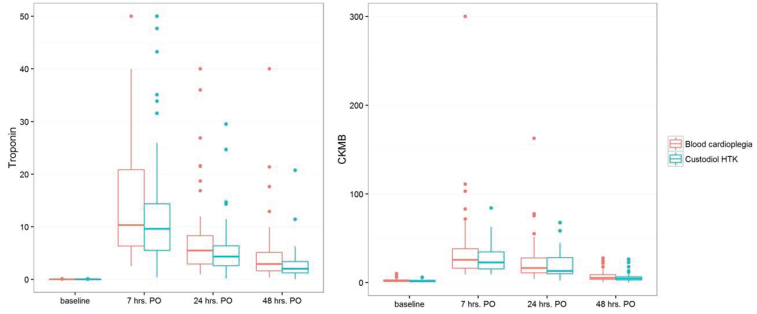
Beaumont Health, Royal Oak, MI

Panel Discussion

Objective: The present prospective non-inferiority randomized trial was designed to demonstrate the safety and efficacy of a single dose of Custodiol HTK compared to repetitive cold-blood cardioplegia solution.

Methods: From October 2012 to May 2014, 110 patients were randomly assigned to one of two groups: Group 1 (55 patients) received cold-blood cardioplegia (an initial dose of at least 1,000 mL of a 4:1 mixture of cold blood:cold crystalloid cardioplegia, then every 20 minutes, 200 mL), and Group 2 (55 patients) received Custodial HTK (a single dose of 20 cc/kg at a temperature of 4–5°C, over 6–8 minutes). Isolated AVR, isolated MVR or multivalve procedures represented the most frequent procedure, 39 cases (71%) in Group 1, 49 cases (89%) in Group 2, and were uniformly distributed (p = 0.15). No difference in cardiopulmonary bypass time (102 ± 26 min vs 99 ± 19 min, p = 0.70) and cross-clamp time (77 ± 19 min vs 74 ± 17 min, p = 0.33) was encountered between the two groups. All patients underwent preoperative ECG and determination of CK-MB and troponin I. LVEF and regional wall motion were determined by either TTE or intraoperative TEE. Postoperative, cardiac biomarkers were checked at 7, 24, 48, and an echocardiogram was obtained to check for LV function abnormalities.

Results: There was no difference in cardiac biomarkers release between the two groups at baseline, 7, 24, 48 hours postoperative (CK, p = 0.18; Troponin, p = 0.23) (Figure). Left ventricular function was similar between groups preoperatively (Group 1, 57 ± 8.1; Group 2, 57 ± 9.4, p = 0.63) and at 24 hours after the surgery (Group 1, 58 ± 9.2; Group 2, 58 ± 11, p = 0.92). No deaths or myocardial infarction were observed in both groups. There were no differences between the groups in ICU length of stay (3 vs 3 days, p = 0.39), incidence of atrial fibrillation (21 vs 14 patients, p = 0.15), use of inotropes or vasopressors support (43 vs 47 patients p = 0.32), time of intubation (11.4 vs 10.5 hours, p = 0.15), creatinine levels (0.94 vs 0.81, p = 0.042).



Conclusions: A single dose of Custodiol HTK cardioplegia is not inferior to repeated cold-blood cardioplegia during elective cardiac surgery.

2:50 pm **Adult Cardiac Surgery Controversies 2: Tricuspid Valve Repair**
5 minute presentation, 5 minute discussion

Moderator: *Rakesh M. Suri

Panelists: *David H. Adams, *Frank C. Wells, *Patrick M. McCarthy, *Gebrine El Khoury

9. Tricuspid Annulus Diameter Does Not Predict the Development of Tricuspid Regurgitation After Mitral Valve Repair for Mitral Regurgitation Due to Degenerative Diseases

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

Objective: Heart valve surgery guidelines suggest that tricuspid annuloplasty may be beneficial in patients with mild functional tricuspid regurgitation (TR) and a dilated tricuspid annulus (TA) ≥40 mm at the time of surgery for left side lesions (Class 2a). Given the broad spectrum of degenerative diseases that cause mitral regurgitation (MR), we examined the effect of the diameter on the TA on the development of TR after mitral valve (MV) repair.

Methods: The diameters of the TA and the mitral annulus (MA) were measured preoperatively in a cohort of 337 consecutive patients operated on from 2005 through 2010. Patients (25) who had concomitant tricuspid annuloplasty were excluded. The mean diameter of the TA was 36 ± 4 mm and MA was 41 ± 6 mm. TA ≥40 mm was present in 69 patients (all patients with moderate or advanced myxomatous degeneration of the MV and MA ≥45 mm).

Results: During a median echocardiographic follow-up of 4.4 years (3–10 years), 23 (8%) patients developed TR greater than mild, and 28 MR (10%). The mean TA diameter was 37 ± 4 mm before MV repair, and there was no correlation between TA diameter and the development of TR (HR: 1.04/mm, 95% CI [0.96–1.14], p = 0.34). TA diameter correlated well with MA diameter (r = 0.24, p < 0.001). In a multivariate model, postoperative TR was associated with age (HR: 1.85/5 years, 95% CI [1.04–1.58], p = 0.02), female sex (HR: 4.2, 95% CI [1.5–11.5], p = 0.006), preoperative hypertension (HR: 3.9, 95% CI [1.6–9.8], p = 0.006), left ventricular dysfunction (HR: 3.6/grade, 95% CI [1.7–7.6], p = 0.001), and TR during the first week after surgery (HR: 2.1/grade, 95% CI [1.3–3.6], p = 0.004). At 8 years, patients' survival was 94.4 ± 2.4%, and freedom from TR greater than mild was 91.7 ± 8.4%.

Conclusions: This study showed that TA diameter correlated well with MA diameter in patients with degenerative MV diseases and did not predict the development of TR after MV repair.

10. Outcome of Tricuspid Annuloplasty Following Current Guidelines

Filip Dulguerov[1], Clara Alexandrescu[1], Cecilia Marcacci[1], Franck Levy[1], Shelley Rahman[2], Elie Dan Schouver[1], *Gilles Daniel Dreyfus[1]

[1]Cardiothoracic Center of Monaco, Monte Carlo, Monaco; [2]Royal Brompton and Harefield NHS Foundation Trust, London, United Kingdom

Objective: Indications to treat functional tricuspid pathology remain controversial. Current guidelines consider Tricuspid Annular Dilatation (TAD) as a type IIa recommendation. We report our experience of patients who received a tricuspid annuloplasty (TA) according to tricuspid annular size only, below or above 40 mm, concomitantly to Mitral Valve Repair (MVR) in degenerative disease. The aim of the study is to report the outcome of such approach.

Methods: From January 2005 until December 2015, 701 patients with severe Mitral Regurgitation (MR) underwent MVR. There were 441 with degenerative MR, among which 234 (Group I, 53%) underwent concomitant TA for annular dilatation (≥40 mm). Two hundred seven (Group II, 47%) underwent MVR alone. Group I received rigid annuloplasty ring (mean size 32, range: 28—36). Patient mean age was 67 ± 13. There were 310 males. All patients were followed annually and echocardiograms were performed in our core lab.

Results: Preoperative evaluation of both group of patients showed no significant difference in terms of left ventricular ejection fraction (Group I = 64.6 ± 10.1%; Group II = 66.3 ± 8.55%), left ventricular end systolic diameter (Group I = 37.1 ± 6.96 mm; Group II = 36.1 ± 6.01 mm), left atrial volume index (Group I = 83.5 ± 38.7 ml/m^2; Group II = 82.1 ± 37.2 ml/m^2) and pulmonary artery systolic pressure (Group I = 39.2 ± 12.4 mmHg; Group II = 37.8 ± 12.3 mmHg). Atrial fibrillation was higher in Group I (Group I = 40.4 %; Group II = 26.5 %; $p < 0.001$) as well as left ventricular end diastolic diameter (Group I = 58.9 ± 7.98 mm; Group II = 56.7 ± 6.67 mm; $p = 0.02$) and moderate TR incidence (Group I = 30%; Group II = 11%; $p < 0.01$). Multivariate analysis (logistic regression) showed that only AF is a preoperative predictor of TA (HR = 2.34, 95% CI [1.30–4.41], $p = 0.005$). Hospital mortality (Group I = 0.7 %; Group II = 0.8%), pacemaker requirement (Group I = 2.2%; Group II = 1.7%), mean bypass time (Group I = 152.3 ± 164.6 min; Group II = 135.3 ± 77 min), and survival (Group I = 86.8%; Group II = 88.2%) were similar. At latest follow-up in Group I, residual TR was mild in 224 (95.5%), moderate in 8 (3.2%), and severe in 3 (1.3%). In Group II, residual TR was mild in 192 (92.6%) and moderate in 15 (7.4%), no severe TR was recorded. There are significantly more residual moderate TR in Group II (Log rank $p = 0.014$). Severe TR in Group I are related to pacemaker wires (n = 2) and to 1 misdiagnosed anterior leaflet tethering (n = 1). There was no reoperation for recurrent TR.

Conclusions: TA of the tricuspid valve only based on TAD in patients undergoing MVR for degenerative disease is safe and effective to prevent severe TR. Following the guidelines and considering only TAD irrespective TR grading shows that neither patients with tricuspid annulus above 40 mm who underwent TA nor patients with an annulus below 40 mm develop severe TR at long term. This could be a pledge to upgrade current guidelines into type I recommendation.

11. Long Term Effect of Concomitant Tricuspid Repair

Sarah Ward, Meghan Baker, *Steven Bolling
University of Michigan, Ann Arbor, MI

Objectives: Rates of concomitant tricuspid repair even with a class I indication are suboptimal, possibly due to fear of outcomes. Our objective was to review the relative effect of concomitant tricuspid repair on freedom from TR and RV remodeling.

Methods: Between May 2012 and May 2016, 227 patients underwent mitral valve surgery with concomitant tricuspid repair using the Tri-Ad® Tricuspid Annuloplasty Ring. Sizes used were 26 mm, 28 mm, and 30 mm. Exclusion criteria included concomitant CABG or aortic surgery or endocarditis. A subgroup of patients was selected for long-term follow-up with pre- and postoperative ECHO to assess for presence of RV remodeling. Data was analyzed using Wilcoxon signed rank test p-value for continuous variables.

Results: The average patient age was 66, and 50% were male. Preoperative measurements included an average EF of 53%, LV end diastolic diameter of 54 mm, mean pulmonary artery systolic pressure of 51 mm Hg, MR grade 3.1, and TR grade of 2.5. Average tricuspid ring used measured 27.3 mm. Average CPB and Xclamp time were 114 minutes and 92 minutes, respectively. Average length of ICU stay was 83.5 hours. Eighteen patients (8%) were readmitted within 30 days of discharge. Freedom from new permanent pacemaker was 95.6% and mortality was 0.9% at 30 days. Patients who underwent 1-year postoperative ECHO had no significant worsening in RV geometry or dimensions (see Table). Mean tricuspid valve gradient at one year measured 1.8 mmHg (p = .04). Patients had symptomatic improvement at one year, with an average decrease in NYHA to 1.5. Degree of TR showed an average improvement from moderate (2.5) regurgitation to trivial (.76) at one year.

Conclusions: In addition to providing a favorable mortality rate and reduction in TR, concomitant Triad annuloplasty TV repair provides low postoperative pacemaker rates for valvular surgery with concomitant TV repair. Moreover, freedom from TR and RV dimensions remained stable after 1 year, with the majority of patients endorsing symptomatic improvement.

Panel Discussion

3:40 pm – 4:10 pm **Coffee Break in the Exhibit Hall**

4:10 pm **Adult Cardiac Surgery Controversies 3: Aortic Valve Replacement**
6 minute presentation, 8 minute discussion

Moderators: *Niv Ad and *J. Michael DiMaio

Innovation in Valve Design
*James L. Cox, Washington University, St. Louis, MO

Late-Breaking Clincial Trial

LB1. One-Year Outcomes Associated with a Novel Bovine Pericardial Stented Aortic Bioprosthesis: PERIGON Pivotal Trial

*Joseph F. Sabik, III[1], Vivek Rao[2], *Rüdiger Lange[3], *A. Pieter Kappetein[4], *Francois Dagenais[5], Louis Labrousse[6], Vinayak Bapat[7], Michael Moront[8], Neil J. Weissman[9], *Himanshu Patel[10], *Michael J. Reardon[11], Federico M. Asch[9], Robert J.M. Klautz[12]

[1]University Hospitals Cleveland Medical Center, Cleveland, OH; [2]Toronto General Hospital, Toronto, ON, Canada; [3]German Heart Centre of the Technical University, Munich, Germany; [4]Erasmus Medical Centre, Rotterdam, Netherlands; [5]Quebec Heart and Lung Institute, Quebec City, QC, Canada; [6]University Hospital of Bordeaux, Pessac Cedex, France; [7]St. Thomas' Hospital, London, United Kingdom; [8]ProMedica Toledo Hospital, Toledo, OH; [9]MedStar Health Research Institute, Hyattsville, MD; [10]University of Michigan, Ann Arbor, MI; [11]Houston Methodist DeBakey Heart & Vascular Center, Houston, TX; [12]Leiden University Medical Center, Leiden, Netherlands

Invited Discussant: *W. Randolph Chitwood, Jr.

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12. Repeat Conventional Biological Valve Replacement over 20 Years: Surgical Benchmarks Should Guide Patient Selection for Transcatheter Valve-in-Valve Therapy

*John M. Stulak, Vakhtang Tchantchaleishvili, *Richard C. Daly, Mackram Eleid, *Kevin L. Greason, *Joseph A. Dearani, David L. Joyce, *Lyle D. Joyce, *Alberto Pochettino, Sameh M. Said, *Hartzell V. Schaff, *Simon Maltais

Mayo Clinic, Rochester, MN

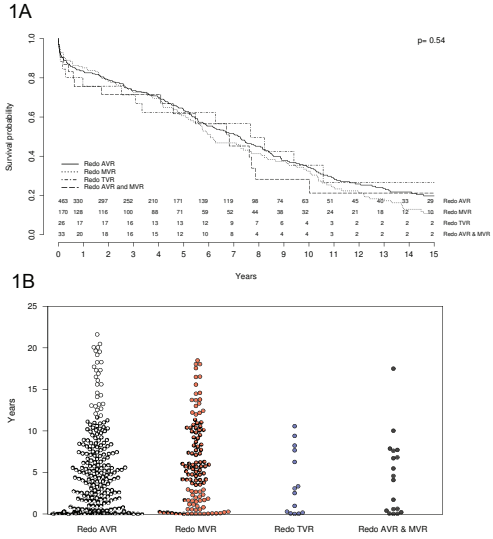
Invited Discussant: *Vinod H. Thourani

Objective: While primary transcatheter valve interventions have demonstrated acceptable early- and intermediate-term outcomes, data are lacking to guide patient selection for transcatheter valve-in-valve therapy. Furthermore, very few surgical benchmarks have been established for repeat conventional biological valve replacement in order to refine momentum for broad application of transcatheter intervention for the degenerated bioprosthesis.

Methods: From January 1993 to July 2014, 694 patients underwent repeat biological valve replacement at our Clinic. Median age at repeat operation was 71 years (range: 26–95 years), and there were 437 males (63%). Hypertension was present in 453 patients (65%), diabetes in 128 (18%), prior myocardial infarction in 85 (12%), and prior stroke in 81 (12%). Prior coronary bypass grafting was performed in 212 patients (31%). Median left ventricular ejection fraction was 41% (range: 20–61) and NYHA Functional Class III/IV was present in 529 patients (76%).

Results: Biological valve re-replacement included aortic valve in 464 patients (67%), mitral valve in 170 (24%), double valve in 34 (5%), and tricuspid valve in 26 (4%). Concomitant coronary bypass grafting was performed in 134 (19%). Mortality at 30 days occurred in 56 patients (8%). Multivariable analysis with backward stepwise regression identified NYHA Functional Class (per 1 increment) (HR: 2.1 [1.06, 4.3], p = 0.03) and prior CABG (HR: 3.5 [1.2, 10.9], p = 0.03) as independent

predictors of early death. Patients with the combination of prior CABG and NYHA Functional Class III, IV accounted for 26/56 (46%) of early deaths and in the absence of this preop combination, early death in the cohort was 30/694 (4%). Follow-up was available in 602/638 early survivors (94%) for a median of 45 months (range: 1 month to 23.4 years). Survival at 5 and 10 years was 63% and 34%, respectively; Kaplan-Meier methods showed no significant difference in late survival based on type of valve re-replacement (Figure 1A). For patients who died during follow-up, 2-dimensional scatter plots demonstrate durable length of postoperative survival (Median 5.5 years; maximum 22 years) (Figure 1B).



Conclusions: This study can serve as a surgical benchmark in order to guide patient selection for transcatheter valve-in-valve technology rather than employing a broader application of these techniques to those who may otherwise have low surgical risk and durable long-term survival after conventional valve surgery. Because prior CABG and advanced NYHA Functional Class (III, IV) were significantly associated with higher risk of early death, perhaps consideration of valve-in-valve therapy would be reasonable in these patients.

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13. Aortic Root Enlargement Does Not Increase the Operative Risk of Aortic Valve Replacement

Rodolfo V. Rocha, Cedric Manlhiot, *Christopher M. Feindel, *Terrence M. Yau, *Tirone E. David, Maral Ouzounian

University of Toronto, Toronto, ON, Canada

Invited Discussant: *Edward G. Soltesz

Objective: Aortic root enlargement (ARE) during aortic valve replacement (AVR) allows for larger prosthesis implantation and may be an important adjunct to sur-

gical AVR in the transcatheter valve-in-valve era. The incremental operative risk of adding ARE to AVR has not been established. We sought to evaluate the early outcomes of patients undergoing AVR with or without ARE.

Methods: From January 1990 to April 2016, 7,126 patients underwent AVR (AVR + ARE, n = 1,937; AVR, n = 5,138) at a single institution. Patients with aortic dissection and acute endocarditis were excluded. Mean age was 65 ± 13 years and 63% were male.

Results: Patients undergoing AVR + ARE were more likely to be female (46% vs 33%, p = 0.0001) and had higher rates of previous cardiac surgery (18% vs 12%, p = 0.0001), chronic obstructive lung disease (5% vs 3%, p = 0.0001), and urgent/emergent status (6% vs 4%, p = 0.01) than those undergoing AVR. Patients undergoing AVR + ARE had lower rates of NYHA ≥3 status (29% vs 34%, p = 0.001). Mean body surface area was lower in the ARE group (AVR + ARE: 1.86 ± 0.23 vs AVR: 1.88 ± .023, p = 0.0001). The majority of patients in both groups received a bioprosthetic valve (AVR + ARE: 72% vs AVR: 73%, p = 0.60) and also underwent concomitant cardiac procedures (AVR + ARE: 67% vs AVR: 66%, p = 0.53), including coronary artery bypass grafting (AVR + ARE: 43% vs AVR: 43%, p = 0.65), mitral valve surgery (AVR + ARE: 19% vs AVR: 18%, p = 0.19), and ascending aortic replacement (AVR + ARE: 9% vs AVR: 10%, p = 0.20). Mean prosthesis size implanted was slightly smaller following AVR + ARE compared to AVR alone (23.4 ± 2.0 vs 24.1 ± 2.2, p = 0.0001). In-hospital mortality was higher following AVR + ARE (4% vs 3%, p = 0.02), although when the cohort was restricted to patients undergoing isolated aortic valve replacement with or without root enlargement, mortality was similar (AVR + ARE (n = 630): 1.5% vs AVR (n = 1730): 1.1%, p = 0.41). The rates of most other adverse events were low and not different between the two groups. Following adjustment for baseline characteristics, AVR + ARE was not associated with an increased risk of in-hospital mortality when compared to AVR (OR: 1.16, 95% CI [0.73–1.87], p = 0.54). Furthermore, AVR + ARE was not associated with increased risk of postoperative pacemaker insertion (OR: 0.95, p = 0.71), myocardial infarction (OR: 1.29, p = 0.45), stroke or transient ischemic attack (0.74, p = 0.21), renal failure (OR: 0.96, p = 0.86), reoperation for bleeding (OR: 0.88, p = 0.41), or sepsis (OR: 0.94, p = 0.75) following multivariate adjustment.

Conclusions: In the largest analysis to date, enlargement of the aortic root was not associated with increased risk of mortality or adverse events. ARE is a safe adjunct to AVR in the modern era.

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14. Bioprosthetic Aortic Valve Replacement: Revisiting Prosthesis Choice in Patients Younger than 50 Years of Age

Nana Toyoda, *Joanna Chikwe, Samuel R. Schnittman, Shinobu Itagaki, Natalia N. Egorova, *David H. Adams

Mount Sinai Medical Center and Stony Brook University Hospital, New York, NY

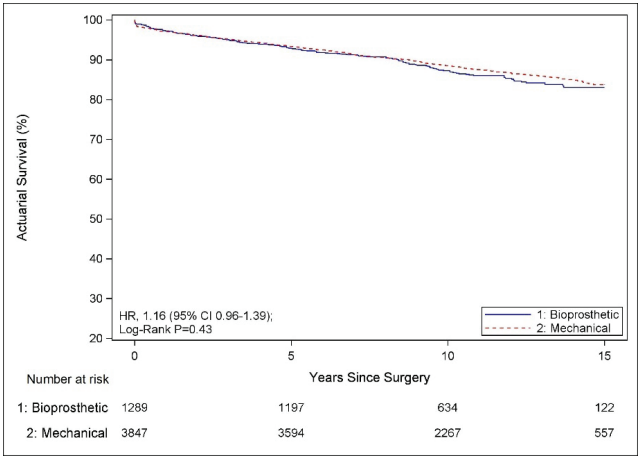
Invited Discussant: *Thierry G. Mesana

Background: Choice of aortic valve prosthesis is particularly controversial in adults aged 18–50 years because of the lack of robust, long-term comparative outcome

data. We sought to compare mortality and major morbidity in young adult patients after bioprosthetic versus mechanical aortic valve replacement.

Methods: Retrospective cohort analysis of 5,136 patients 18–50 years undergoing primary mechanical (n = 3,847 [74.9%]) or bioprosthetic (n = 1,287 [25.1%]) aortic valve replacement in California and New York states from 1997 to 2006. Patients from out of state, with endocarditis, or undergoing concomitant coronary bypass, other valve or congenital surgery were excluded. Median follow-up time was 10.7 years (maximum 18.4 years). Last follow-up for mortality was December 31, 2014. The primary endpoint was mortality; secondary endpoints were stroke, major bleeding, and reoperation on the aortic valve.

Results: Bioprosthetic valves increased from 14% of replacements in 1997 to 42% in 2011 ($p < 0.001$). No survival difference was observed with bioprosthetic versus mechanical aortic valve replacement in the overall study cohort (Figure), or in age-stratified subgroups: actuarial 15-year survival was 83.1% (95% CI [80.2–85.6%]) versus 83.8% (95% CI [82.2–85.2%]), respectively (HR: 1.16, 95% CI [0.96–1.39]). After bioprosthetic aortic valve replacement, stroke rates were significantly lower (5.2%, 95% CI [2.8–4.9%] vs 8.4%, 95% CI [7.4–9.4%], HR: 0.62; 95% CI [0.46–0.83]), bleeding rates were significantly lower (4.7%, 95% [CI 3.0–6.9%] vs 10.2%, 95% CI [9.1–11.4%], HR: 0.39, 95% CI [0.29–0.53]), but reoperation rates were significantly higher (24.6%, 95% CI [21.1–28.3%] vs 8.1%, 95% CI [7.6–13.2%], HR: 7.07, 95% CI [4.49–11.11]) at 15 years compared to mechanical valve replacement. The 30-day mortality following stroke, bleeding, and reoperation was 12.5%, 8.4%, and 5.0%, respectively.



Conclusions: Lifetime risks are incompletely represented. However, these findings suggest that in adults aged 18–50 years, bioprostheses are a very reasonable alternative to mechanical valves for aortic valve replacement.

5:30 pm **Adjourn**

2:00 pm – 5:15 pm **Controversies in CABG 2017** Room 311, Hynes

Course Co-Chairs: *John D. Puskas and *David P. Taggart

Expert Panel: *Bruce W. Lytle, *Joseph F. Sabik, Miguel Sousa Uva

2:05 pm **Controversies in CABG 2017**

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

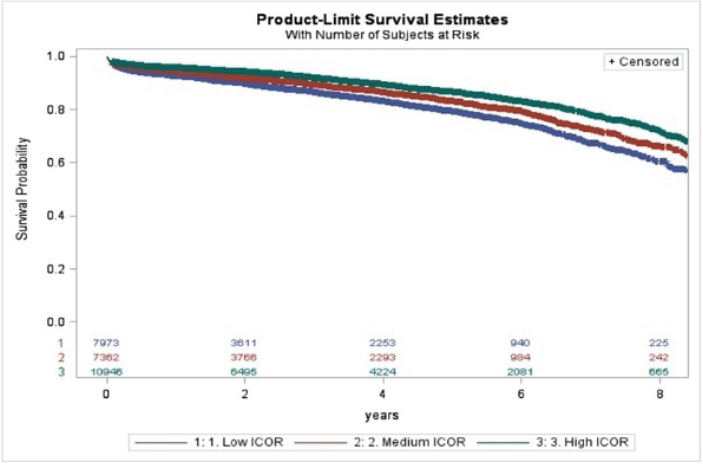
2:15 pm **C1. Priorities in CABG: Is Long-Term Survival More Dependent on Completeness of Revascularization or Multiple Arterial Graft?**

Joshua M. Rosenblum, William B. Keeling, John Hunting, Jose Binongo, Bradley G. Leshnower, *Edward P. Chen, Jeffrey S. Miller, Steven Macheers, Omar M. Lattouf, *Robert A. Guyton, *Vinod H. Thourani, *Michael E. Halkos

Emory University, Atlanta, GA

Objective: Both completeness of revascularization (COR) and multiple arterial grafts (MAG) have been associated with increased long-term survival following coronary artery bypass grafting (CABG). The purpose of this study was to evaluate the relative impact of COR and MAG on long-term survival following CABG.

Methods: A retrospective review of 26,472 patients who underwent isolated, primary CABG from 1/2002 to 6/2016 at a US academic institution was performed. Patients were divided into tertiles based on COR (High, medium, and low COR). Univariate analyses were utilized for comparison of demographic and operative details. Survival curves stratified by ICOR tertiles were drawn using the Kaplan-Meier method. Cox proportional hazards regression analysis was conducted to obtain estimates of hazard ratios, adjusted for preoperative variables.



Results: Patients undergoing MAG in this study more were younger and had a lower incidence of left main coronary artery stenosis compared to patients who received a single arterial graft. Within each COR tertile, patients who underwent MAG had a significantly higher COR than patients who underwent single arterial grafting ($p < 0.0001$). Adjusted short-term postoperative outcomes were no different between MAG and single arterial cohorts. The Figure shows long-term survival estimates for the three COR tertiles with a hazard ratio (HR) of 0.80 (95% CI [0.73–0.87]) for death when comparing medium versus low COR and a HR of 0.62 (95% CI [0.57–0.67]) for high versus low COR. Adjusted survival calculations showed a HR of 0.81 (95% CI [0.74–0.89]) for both medium versus low and high versus low COR. When adjusted for COR and other preoperative variables, the HR was 1.0 for MAG versus single arterial grafting.

Conclusions: Patients who undergo MAG have a higher degree of completeness of revascularization. For a fixed COR, there is no difference in long-term survival between patients who underwent MAG versus single arterial grafting in this dataset.

2:22 pm **Discussion: Priorities in CABG**

*Bruce W. Lytle, *The Heart Hospital at Baylor Plano*

2:30 pm **C2. Saphenous Vein Versus Right Internal Thoracic Artery As a Y-Composite Graft: 5-Year Angiography and Midterm Clinical Follow-Up of the SAVE RITA Trial**

Min-Seok Kim, Ho Young Hwang, Jun Sung Kim, Se Jin Oh, Seokyung Hahn, *Ki-Bong Kim

Seoul National University Hospital, Seoul, Republic of Korea

Objective: We compared 5-year graft patency rates and mid-term clinical outcomes of saphenous vein (SV) composite grafts with those of right internal thoracic artery ([R]ITA) composite grafts in patients who were enrolled in the the **SA**phenous **VE**in versus **R**ight **I**nternal **T**horacic **A**rtery as a Y-Composite Graft (**SAVE RITA)** trial.

Methods: From September 2008 to October 2011, a total of 224 eligible patients with multivessel coronary artery disease were randomized to undergo off-pump revascularization using the SV (SV group, n = 112) or RITA (RITA group, n = 112) as Y-composite grafts based on the *in situ* left ITA. A third SV conduit segment from the other lower leg was used in 44 patients (SV group vs RITA group, 8 vs 39) to extend the side-arm Y-composite graft for complete revascularization. Postoperative 5-year (60.9 ± 3.7 months) angiograms were performed in 171 patients (76.3%; SV group = 85; RITA group = 86). Follow-up was complete in 96.0% (215/224) of patients with a median follow-up of 78 months.

Results: The overall graft patency rate was 95.6% (587/614) at 5 years (95.1% in the SV group vs 96.1% in the RITA group, $p = 0.678$). The 5-year patency rate of the SV composite grafts was 93.8% (180/192) and was not significantly different from that of the RITA composite grafts (97.6% [160/164], $p = 0.157$). No statistically significant differences were found in the overall survival rates between the 2 groups at 5 and 8 years (94.9% and 93.8%, respectively, $p = 0.175$). Also, no statistically

significant differences were found between the 2 groups in the freedom from major adverse cardiac and cerebrovascular event rates at 5 and 8 years (94.8% and 90.9%, respectively, $p = 0.202$).

Table: Five-Year Angiographic Patency Rates of Distal Anastomoses

	Total (n = 171)	SV Group (n = 85)	RITA Group (n = 86)	p-value
Overall grafts	587/614 (95.6%)	293/308 (95.1%)	294/306 (96.1%)	0.678
Grafts using the left ITA	206/210 (98.1%)	105/107 (98.1%)	103/103 (100%)	0.181
Grafts using the second conduit (SV or RITA)	340/356 (95.5%)	180/192 (93.8%)	160/164 (97.6%)	0.157
Grafts using the third conduit	40/48 (83.3%)	8/9(88.9%)	32/39 (82.1%)	0.651

Conclusions: The SV composite grafts were comparable with the RITA composite grafts in terms of 5-year graft patency rates and midterm clinical outcomes.

2:37 pm **Discussion: Conduits in CABG**

*Joseph F. Sabik, *University Hospitals Cleveland Medical Center*

2:45 pm **C3. Minimally Invasive CABG with Bilateral Internal Thoracic Arteries: Will This Be the Future?**

Pradeep Nambiar
Moolchand Hospitals, Gurgaon, India

Objective: Usage of Bilateral Internal Thoracic arteries in CABG has shown excellent long-term survival and a very low rate of reintervention. Minimally Invasive CABG has myriad advantages over traditional CABG. A multivessel minimally invasive CABG technique has been developed, where the BITAS are directly harvested under vision and complete revascularization of the myocardium done by the off-pump method, using only Bilateral Internal Thoracic arteries (BITAS); (LITA–RITA Y) through a 2-inch left minithoracotomy.

Methods: From August 2011 to August 2016, 819 patients underwent off-pump minimally invasive multivessel CABG using BITAS through a 2-inch left minithoracotomy incision. Both ITAs were harvested directly under direct vision, and complete revascularization of the myocardium was done using the LITA-RITA Y composite conduit. Coronary artery stabilization for anastomoses was done by using epicardial stabilizers introduced through the minithoracotomy.

Results: Eight hundred nineteen patients had minimally invasive total arterial myocardial revascularization using BITAS (LITA–RITA Y composite conduit) via a left minithoracotomy. Average number of grafts were 3.1. One hundred seventy-one (21%) patients had 4 grafts and 557 (68 %) had 3 grafts. EF was 40.5 ± 5.2. There were 6 mortalities (0.7%) and 5 patients (0.6%) had re-exploration for bleeding. Four patients (0.4%) had an elective conversion to sternotomy due to hemodynamic instability. The RITA and LITA harvest times were 28.5 ± 10.2 and

22.2 ± 7.6 minutes, respectively. The total time in the OR (including extubation) was 295.5 ± 32.5 minutes and operating time was 175.8 ± 21.6 minutes. Six hundred fifty-one patients (79%) were extubated on the table. The average hospital stay was 3.1 days. Coronary angiograms were done in 195 (23%) and CT angiograms in 172 (21%) patients at 12 months and the grafts were patent. Stress test was done in 284 patients (34%) which were normal. Four patients (0.4%) required reintervention—angioplasty.

Conclusions: This minimally invasive technique encompassed using a 2-inch left minithoracotomy incision through which the BITAS were conveniently harvested under direct vision. Multivessel total arterial revascularization was then done using the LITA–RITA Y composite conduit by the off-pump methodology. The early outcomes have been good and coronary angiograms showed widely patent grafts. Reintervention was very low. We feel, that this novel technique may help optimize minimally invasive coronary surgery and the usage of bilateral internal thoracic arteries with its associated benefits, without the invasiveness and related complications of a median sternotomy, especially in diabetics. Further, this may also allay patient fears of heart surgery and has the potential for decreased morbidity, shorter hospital stay, cosmesis, and earlier return to active life.

2:52 pm **Discussion: BITA/ART Trial**

*David P. Taggart, *University of Oxford*

3:00 pm **C4. Hybrid Coronary Revasculrization Versus Percutaneous Strategies for Left Main Stenosis: A Propensity Match Study**

Alberto Repossini[1], Lorenzo Di Bacco[1], Laura Giroletti[1], Maurizio Tespili[2], Antonio Saino[2], Claudio Gentilini[3], Davide Personeni[2], Alfonso Lelasi[2], *Claudio Muneretto[1]

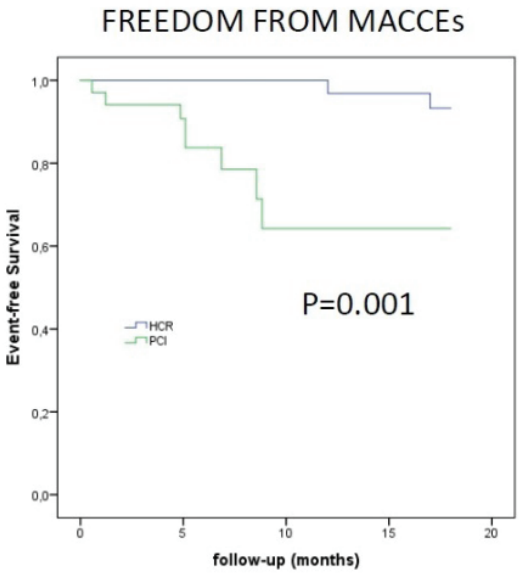
[1]University of Brescia, Brescia, Italy; [2]Ospedale Bolognini di Seriate, Seriate, Italy; [3]Ospedale di Chiari, Brescia, Italy

Objective: Coronary Artery Bypass Grafting is still considered the gold standard treatment for complex Left Main (LM) stenosis. Nevertheless, despite guidelines recommendation Percutaneous Coronary Intervention (PCI) is gaining popularity for LM treatment. Hybrid Revascularization (HCR) has been recently proposed as an effective alternative strategy in multi-vessel coronary disease, particularly in patients with high SYNTAX and risk assessment scores. There is lack of data concerning patients with LM stenosis. Objective of this study is to evaluate the outcomes of HCR versus PCI stenting in LM treatment.

Methods: From November 2013 to June 2016, 198 consecutive patients with LM critical lesions underwent myocardial revascularization after Heart Team discussion driven by anatomical and clinical features. Seventy-six patients (G1) were treated with HCR, meaning Left mammary artery on LAD off-pump grafting via left anterior mini thoracotomy (MIDCAB) associated to PCI stenting with DES on non-LAD vessels. One hundred twenty-two patients (G2) received PCI- DES stenting on LM. An adjusted analysis using inverse probability weighting (IPW) was performed

and two groups of 67 patients (G1) and 108 (G2) were obtained. Primary outcomes include: 30-day mortality, postoperative acute myocardial infarction, 18-months MACCEs (cardiac-death, stroke, acute myocardial infarction [AMI], repeated target vessel revascularization [TVR]).

Results: SYNTAX Scores were 29.5 ± 5.1 in G1 and 27.3 ± 5.6 in G2 (p = 0.117). Emergency/Urgency procedure was performed in 3 cases (2.7%) in G1 and in 23 patients (21.3%) in G2 (p < 0.001). In G2, three patients (2.7%) died for cardiogenic shock after the procedure; no deaths occurred in G1 (p = 0.853). In G2, seven patients (6.4%) had LM dissection during procedure: two died for AMI and cardiac arrest, five had an uneventful course. No major complications were reported in G1 and no mortality at 18-months' follow-up in both groups. Survival freedom from MACCEs at 18 months' follow-up was significantly higher in G1 (G1: 93.3 ± 4.6% vs G2: 64.3 ± 11.3, p = 0.001), mostly due to the higher freedom from TVR (G1: 93.3 ± 4.6% vs G2: 69.6 ± 11.6, p = 0.002). At Cox regression analysis, PCI stenting on LM is an independent predictor of MACCEs, post-procedural AMI, TVR HR = 10.8 (CI [2.06–56.6], p = 0.005).



Conclusion: PCI stenting in patients with LM and multivessel disease involvement is a viable strategy, mainly in case of acute coronary syndrome, with a good perioperative outcome. In elective cases, HCR, in spite of an enhanced surgical invasiveness compared to PCI-stenting alone, demonstrated a significantly lower incidence of cardiac adverse events such as perioperative AMI and TVR. The benefits of Left mammary artery on LAD over PCI in terms of patency rates or disease progression seems to be crucial. Future comparative studies will be helpful to identify the optimal patient population for HCR.

3:07 pm **Discussion: The Role of HCR**

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

3:15 pm **C5. Off-Pump Coronary Artery Bypass Grafting Provides More Clinical Benefit in Patients with Preoperative Renal Failure**

Chikara Ueki[1], Hiroaki Miyata[2], *Noboru Motomura[2], Ryuzo Sakata[2], Genichi Sakaguchi[1], Takehide Akimoto[1], *Shinichi Takamoto[2]
[1]Shizuoka General Hospital, Shizuoka, Japan; [2]Japan Cardiovascular Surgery Database Organization, Bunkyo-ku, Japan

Objective: Most of randomized controlled trials of off-pump versus on-pump coronary artery bypass grafting (CABG) have excluded patients with preoperative renal failure. The benefit of off-pump CABG (OPCAB) in patients with preoperative renal failure is still unclear. The aim of this study was to evaluate the relationship between clinical benefit of OPCAB and preoperative renal function using data from the Japan Cardiovascular Surgery Database (JCVSD).

Methods: We analyzed 68,825 patients with complete data on glomerular filtration rate (eGFR) who underwent primary, non-emergent, isolated CABG between 2008 and 2014, as reported in the JCVSD. These patients were stratified into five groups on the basis of their preoperative renal function: (1) eGFR ≥90 ml/min per 1.73 m^2, n = 1,480; (2) eGFR 60–89, n = 14,123; (3) eGFR 30–59, n = 40,210; (4) eGFR <30, n = 6,828; and (5) hemodialysis-dependent patients, n = 6,184. The operative mortality and morbidity were compared between patients undergoing off-pump and on-pump CABG in each stratum. Baseline differences between groups were adjusted by inverse probability of treatment weighting (IPTW) using propensity score calculated based on 24 preoperative variables. Composite outcome was defined as operative mortality or major morbidity (stroke, reoperation for bleeding, prolonged ventilation, newly required dialysis, or deep sternum infection).

	On-pump	Off-pump		Adjusted odds ratio	
	Number,%	Number,%	P value	(95% confidence interval)	P value
Overall cohort	24,209	44,616			
Mortality	492(2.0%)	612(1.4%)	<0.001	0.67(0.59-0.75)	<0.001
De novo dialysis	472(1.9%)	621(1.4%)	<0.001	0.74(0.66-0.84)	<0.001
eGFR ≥90	564	916			
Mortality	2 (0.4%)	11 (1.2%)	0.090	3.48(0.77-15.81)	0.107
De novo dialysis	2(0.4%)	4(0.4%)	0.809	1.26(0.23-6.96)	0.789
eGFR 60-89	5,070	9,053			
Mortality	42 (0.8%)	59 (0.7%)	0.232	0.76(0.51-1.14)	0.183
De novo dialysis	22(0.4%)	25(0.3%)	0.118	0.66(0.37-1.19)	0.170
eGFR 30-59	14,140	26,070			
Mortality	202 (1.4%)	243 (0.9%)	<0.001	0.63(0.52-0.77)	<0.001
De novo dialysis	146(1.0%)	174(0.7%)	<0.001	0.67(0.53-0.84)	0.001
eGFR <30	2,328	4,500			
Mortality	107 (4.6%)	117 (2.6%)	<0.001	0.56(0.43-0.73)	<0.001
De novo dialysis	273(11.7%)	365(8.1%)	<0.001	0.72 (0.61-0.85)	<0.001
Dialysis-dependent	2,107	4,077			
Mortality	139 (6.6%)	182 (4.5%)	<0.001	0.67(0.53-0.85)	0.001

Results: A total of 44,616 patients (64.8%) were intended for OPCAB. In overall cohort, OPCAB significantly reduced the incidence of operative death [adjusted OR: 0.67, P < 0.001], composite outcome (adjusted OR: 0.67, P < 0.001) and de novo dialysis (adjusted OR: 0.74, P < 0.001). In subgroups of patients with normal or mildly reduced renal function (eGFR ≥60), there was no significant difference in the incidence of operative death and de novo dialysis between off-pump and on-pump CABG. On the other hand, in subgroups of patients with moderate to severe renal failure (eGFR < 60), OPCAB was associated with a significantly lower incidence of operative death (eGFR 30–59; adjusted OR: 0.63, p < 0.001, eGFR

<30; adjusted OR: 0.56, P < 0.001), composite outcome (eGFR 30–59; adjusted OR: 0.63, P < 0.001, eGFR <30; adjusted OR: 0.66, P < 0.001) and de novo dialysis (eGFR 30–59; adjusted OR: 0.67, P = 0.001, eGFR <30; adjusted OR: 0.72, p < 0.001). In subgroup of dialysis-dependent patients, OPCAB was associated with a significantly lower incidence of operative death (adjusted OR: 0.67, P = 0.001) and composite outcome (adjusted OR: 0.65, P < 0.001).

Conclusions: OPCAB significantly reduced operative mortality and incidence of de novo dialysis in patients with moderate to severe renal failure, although this protective effect of OPCAB was not confirmed in patients with normal or mildly reduced renal function. Prospective trials focusing on patients with preoperative renal failure are needed.

3:22 pm **Discussion: OPCAB in 2017**
*David P. Taggart, *University of Oxford*

3:30 pm **Comparison of European and North American Guidelines for Surgical Myocardial Revascularization**
Miguel Sousa Uva, *Hospital Cruz Vermelha*

3:40 pm – 4:10 pm **Coffee Break in the Exhibit Hall**

4:10 pm **Avoiding Stroke in CABG**
*Joseph Sabik, *University Hospitals Cleveland Medical Center*

Late-Breaking Clincial Trial

LB11. Comparable Mid- and Long-Term Patency Rates for Skeletonized and Non-Skeletonized Internal Thoracic Artery Grafts: A Prospective Randomized Trial
Mats Dreifaldt[1], David Taggart[2], Lennart Bodin[3], Håkan Geijer[1], Mats Lidén[1], Domingos Souza[1]
[1]Örebro University, Örebro, Sweden; [2]Oxford University, Oxford, United Kingdom; [3]Karolinska institute, Solna, Sweden

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4:30 pm **C6. Lack of a Heart Team in Stand-Alone Interventional Cardiology Units Impacts the Rate of Percutaneous Coronary Intervention in Patients with Multi-Vessel Disease**
Eilon Ram, Yigal Kassif, Amit Segev, Jacob Lavee, Ronny Ben-Avi, Ilan Goldenberg, Nir Shlomo, *Ehud Raanani
Sheba Tel Hashomer Medical Center, Ramat Gan, Israel

Objective: The regional needs and consolidation of cardiac surgery services result in an increased number of stand-alone interventional cardiology units. The lack of on-site cardiac surgery may result in less patient-oriented heart teams, and potentially higher rates of percutaneous coronary intervention (PCI). We aimed to explore the impact of a heart team in stand-alone interventional cardiology units on the decision-making of patients with multivessel coronary disease referred for coronary revascularization.

Methods: This prospective study included 1,063 consecutive patients with multivessel disease enrolled between January and April 2013 from all 22 hospitals in Israel that perform coronary angiography and PCI (with or without on-site cardiac surgery units). Revascularization strategy was at the discretion of the treating team. Syntax score was evaluated for each patient using a core lab blinded to revascularization strategy.

Results: Of the 1,063 patients, 476 (45%) underwent coronary artery bypass graft (CABG) and 587 (55%) PCI. Mean Syntax score was 28.3 ± 17.9 and 18.1 ± 8.4 in the CABG and PCI groups, respectively. A higher proportion of patients underwent PCI in hospitals without on-site cardiac surgery (65%) compared to those with (46%), $p < 0.001$. Multivariate logistic regression analysis showed that the absence of on-site cardiac surgery and a heart team was an independent predictor for PCI (OR = 2.61 (1.89, 3.62). Other independent predictors for PCI vs CABG included female gender (1.95 [1.28, 3.01]), nondiabetic patients (1.58 [1.14, 2.21]), no prior stroke (2.03 [1.17, 3.53]), renal impairment (2.63 [1.6, 4.4]), and lower Syntax score (3.8 [2.35, 6.3]). Although the mean Syntax score in centers with or without on-site cardiac surgery was similar (22.8 vs 22.1, $p = 0.386$), patients referred to CABG from hospitals without on-site cardiac surgery compared to those with, had significantly higher mean Syntax scores (31 vs 26, $p = 0.018$).

Table: Mean Syntax Score in Centers with or without On-Site Cardiac Surgery Unit

		Center without Cardiac Surgery	Center with Cardiac Surgery	p-Value
All Patients	N	487	576	
	SYNTAX score (mean [sd])	22.80 (17.93)	22.13 (9.98)	0.470
CABG	N	170	306	
	SYNTAX score (mean [sd])	31.04 (26.36)	26.72 (9.62)	0.018

Conclusions: Our study demonstrates the potential for significant bias in referral patterns for coronary revascularization in stand-alone interventional cardiology units lacking a heart team. This real-life phenomenon could imply that regional needs and financial considerations associated with the consolidation of cardiac surgery services may not be beneficial for the patient. A heart-team approach should be mandatory even in centers without on-site cardiac surgery services.

4:38 pm **Discussion with Expert Panel: What Are the Barriers to a Real Heart Team at Our Institution(s) and How Are We Working to Overcome Them?**

4:47 pm **C7. Programmatic and Surgeon Specialization in Coronary Surgery Improves Morbidity and Mortality Following Isolated Coronary Bypass Grafting**

A. Claire Watkins, Mehrdad Ghoreishi, Nathan L. Maassel, Brody Wehman, *Bartley P. Griffith, *James S. Gammie, Bradley S. Taylor
University of Maryland, Baltimore, MD

Objective: Throughout surgery, specialization in a procedure has been shown to improve outcomes. Currently, there is no evidence for or against subspecialization in coronary surgery. Tasked with the goal of improving outcomes following isolated CABG, our institution sought to determine if the development of a subspecialized coronary surgery program would improve morbidity and mortality following CABG.

Methods: The STS database entries for all isolated CABG operations at a single institution were retrospectively examined in two distinct two periods, 2002 to 2013 and 2013 to 2016, before and after the implementation of subspecialized center dedicated to coronary surgery. Policies implemented in the coronary program included: subspecialization of a senior surgeon (program director) in coronary surgery, case review and surgical planning of CABG operations by program director, standardization of surgical technique, distribution of high-risk cases to program director and low-risk cases to mentored junior surgeons. Outcomes were collected and compared.

Results: Between 2002 and 2013, 3,214 CABG operations were done by 16 surgeons, the most frequent surgeon doing 33%. Between 2013 and 2016, 1,174 cases were done by 10 surgeons, 71% by the coronary program director. CABGs done in the specialized era had shorter bypass and clamps times and increased use of bilateral internal mammary arteries (IMA). Complications, including reoperation, postoperative renal failure, permanent stroke were significantly decreased following implementation of a coronary program (Table). Likewise, overall operative mortality (2.7% vs 1.4%, p = 0.01) and observed to expected mortality (1.2 vs 0.7, p = 0.04) were significantly reduced.

Table: Improved Morbidity and Mortality with Specialization in Coronary Surgery

	General Era (n = 3,214)	Specialized Era (n = 1,174)	p-value
CPB time (min)	106 ± 39	90 ± 33	0.0001
Cross-clamp time (min)	70 ± 28	61 ± 23	0.0001
Bilateral IMA use	9.8% (313/3210)	15% (178/1174)	<0.0001
Reoperation	5% (161/3211)	3% (36/1173)	0.05
Permanent stroke	1.6% (51/3211)	0.5% (6/1172)	0.02
Operative death	2.7% (17/3214)	1.4% (17/1173)	0.01
Observed: expected mortality	1.18 ± 10	0.7 ± 7	0.04

Conclusions: Subspecialization in CABG and development of dedicated coronary surgery programs leads to faster operations, fewer complications and improved survival following isolated CABG.

4:54 pm **Discussion with Expert Panel: Is It Time for a Subspecialty in Surgical Coronary Revascularization? Why? How? What Are the Obstacles?**

5:04 pm **Question and Answer with Expert Panel**

5:15 pm **Adjourn**

MONDAY AFTERNOON, MAY 1, 2017

2:00 pm – 5:15 pm **Congenital Heart Disease** Room 312, Hynes
Simultaneous Scientific Sessions
8 minute presentation, 10 minute discussion

Moderators: *Robert D. Jaquiss and *Andrew J. Lodge

15. Long Term Outcomes of the Expanded Polytetrafluoroethylene Conduit with Bulging Sinuses and a Fan Shaped Valve in the Right Ventricular Outflow Tract Reconstruction

Takako Miyazaki, Masaaki Yamagishi, Yoshinobu Maeda, Satoshi Taniguchi, Shuhei Fujita, Hisayuki Hongu, Haruka Fu, ◆Hitoshi Yaku
Kyoto Prefectural University of Medicine, Kyoto, Japan

Invited Discussant: *John W. Brown

Objective: Various types of conduits are available for the right ventricular outflow tract (RVOT) reconstruction. However, the clinical results of conventional conduits were not satisfactory. We have developed the expanded polytetrafluoroethylene (ePTFE) conduit with bulging sinuses and a fan-shaped bi- or tricuspid ePTFE valve. This study summarized the results of a multicenter study for the evaluation of the valved ePTFE conduit.

Methods: We retrospectively investigated the valve functions of 1,024 patients (median age: 3.8 years, range: 0 days to 57.2 years, median body weight: 12.4 kg, range: 2.1–91.3 kg) who received the RVOT reconstruction using the valved ePTFE conduits (10 different sizes, 6–24 mm in diameter) at 65 hospitals between 2001 and 2015. The valve functions were assessed by echocardiogram, cardiac catheterization, and magnetic resonance angiography.

Results: There was no late death related to the ePTFE conduit in the hospitals. The peak RVOT gradient was 16.5 ± 13.1 mmHg and the pulmonary insufficiency graded better than mild was 95.9%. The conduit reintervention was performed in 55 patients (5.3%). The causes of the reintervention were somatic growth (12 patients, 1.2%), peripheral pulmonary artery stenosis (12 patients, 1.2%), valvular stenosis (10 patients, 1.0%), RVOT stenosis (3 patients, 0.3%), and graft infection (3 patients, 0.3%). The freedom at 5 years and 10 years from a reintervention caused by overall size conduits was 96.1% and 94.3%, respectively. The freedom at 5 years and 10 years from the intervention by small conduits (6–16 mm in diameter) were 89.8% and 68.6%, respectively, whereas the freedom from the intervention caused by large conduits (18–24 mm in diameter) was 98.8% and 93.8%, respectively.

Conclusions: The long-term outcomes by the ePTFE conduit with a fan-shaped valve and bulging sinuses may be clinically satisfactory. We believe that the longevity of small-sized conduits can yield sufficient time to exchange the larger-sized conduits without any loss of their valve functions. With regard to longevity and resistance to infections, this ePTFE valved conduit can be one of the optimal ways to reconstruct RVOT.

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16. Valve-Sparing Repair with Intraoperative Balloon Dilation in Tetralogy of Fallot: Mid-Term Results and Therapeutic Implications

Sophie C. Hofferberth, Meena Nathan, Lynn A. Sleeper, Audrey C. Marshall, Christopher W. Baird, *Pedro J. del Nido, ◆Sitaram M. Emani

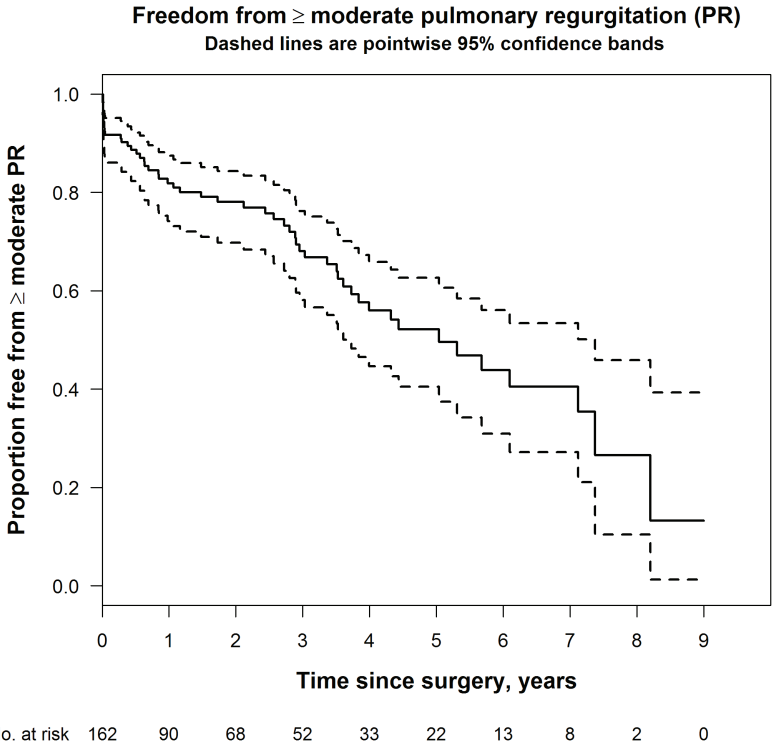
Boston Children's Hospital, Harvard Medical School, Boston, MA

Invited Discussant: *Giovanni Stellin

Objective(s): The significant morbidity of long-term pulmonary insufficiency has driven recent efforts toward preservation of pulmonary valve (PV) function at the time of primary repair of tetralogy of Fallot (ToF). Several approaches to PV preservation have been reported in the past decade, including valve-sparing repair with intraoperative balloon dilation (VS-IBD). The purpose of this study was to evaluate late PV function in patients who underwent complete primary repair of ToF with VS-IBD.

Methods: This single-center retrospective analysis included all patients <1 year of age who underwent complete primary repair of ToF with VS-IBD between 2007 and 2015. Adequacy of repair was assessed based on a pulmonary valve–specific technical performance score (TPS) at discharge, defined as Optimal (peak gradient <20 mmHg, none/trivial regurgitation), Adequate (peak gradient 20–40 mmHg, mild regurgitation) or Inadequate (peak gradient >40 mmHg, ≥ moderate regurgitation). Risk factors for PV reintervention, freedom from significant pulmonary regurgitation (PR), and longitudinal PV annulus growth were evaluated.

Results: Among 162 consecutive patients who underwent VS-IBD repair of ToF, median age at surgery was 98 days (IQR: 73, 98). Median follow-up was 29.7 months (IQR: 7.0, 59.2). Median preoperative PV annulus Z score was –2.2 (IQR: –2.5, –1.8). Twenty-five (15%) patients required PV reintervention for residual valvar stenosis post discharge. Multivariable regression analysis demonstrated baseline PV annulus Z score of ≤2.45 (HR: 3.33, CI [1.44–7.68], p = 0.005), younger age at surgery (months, HR 0.58, CI [0.43–0.78], p = <0.001) and suboptimal TPS class (Adequate—HR: 2.35, CI [0.64–8.60]; Inadequate:—HR: 9.23, CI [2.29–37.23], p = 0.002) were independently associated with higher hazard of PV reintervention. Freedom from significant PR (defined as ≥moderate) was approximately 50% at 5-years and 20% at 8 years post surgery (Figure). The cohort exhibited significant PV annular growth over time; median z-score was –1.97 at discharge, then increased to –1.57 and –1.01 at intermediate and latest follow-up, p = <0.001.



Conclusions: Valve-sparing repair with intraoperative balloon dilation in ToF is associated with the development of progressive PV insufficiency. In younger patients and those with significant PV hypoplasia, alternative approaches to PV preservation should be explored. Although ToF patients who undergo VS-IBD exhibit significant longitudinal PV annular growth, the observed lack of valve leaflet remodeling warrants further investigation. Compared to traditional trans-annular patch repair, the VS-IBD technique offers relief from significant PR for a period of time and therefore may delay the onset of right ventricular dilation. Nonetheless, the results of this study suggest that VS-IBD repair is not a suitable long-term solution to preserve PV function in ToF patients.

Deep Dive Session with Paper 16. ***Valve-Sparing Repair with Intraoperative Balloon Dilation in Tetralogy of Fallot: Mid-Term Results and Therapeutic Implications***

Panelists: ◆SItaram Emani, Sophie C. Hofferberth, *Giovanni Stellin

3:20 pm – 3:55 pm **Coffee Break in the Exhibit Hall**

*AATS Member ◆AATS New Member

17. Bicuspid Valved Polytetrafluoroethylene Conduits Versus Homograft Conduits for Right Ventricular Outflow Tract Reconstruction in Neonates, Infants and Young Children: An Institutional Experience

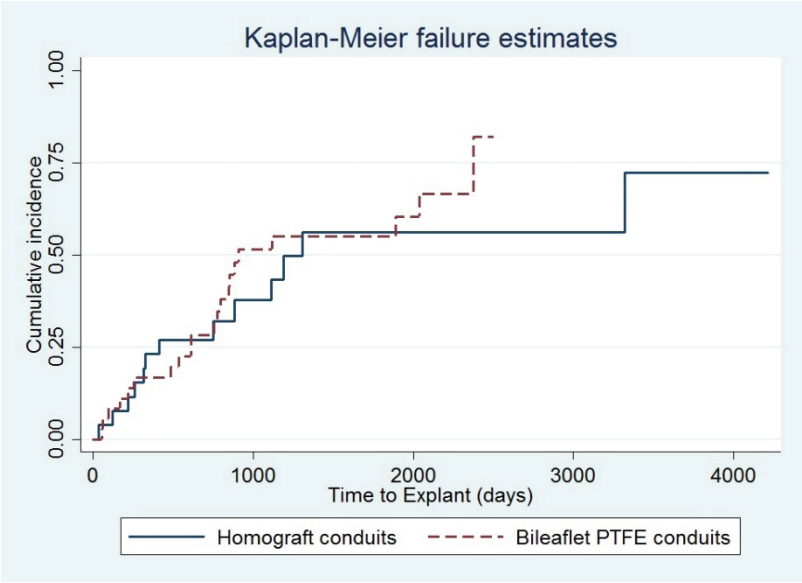
Christopher W. Mercer, Shawn C. West, Mahesh S. Sharma, *Victor O. Morell

Children's Hospital of Pittsburgh of UPMC, Pittsburgh, PA

Invited Discussant: *James A. Quintessenza

Objective: Our institution has developed a handmade bicuspid valved PTFE conduit as an alternative to homograft conduits. The objective of this study is to investigate the performance of these PTFE conduits versus homografts used for RVOT reconstruction in children less than 2 years old, and to evaluate risk factors for earlier conduit explant.

Methods: IRB-approved retrospective chart review of all patients less than 2 years of age who underwent surgical RVOT reconstruction with either a PTFE conduit or homograft (pulmonary or aortic) from July 2004 through December 2014. The endpoints of the study were defined as: conduit explant, conduit explant or reintervention, moderate conduit stenosis, and moderate conduit insufficiency.



Results: Fifty-five patients underwent 65 RVOT reconstructions with either a PTFE conduit (n = 39) or a homograft (n = 26, 23 pulmonary, 3 aortic). The majority of diagnoses were truncus arteriosus (n = 28) and tetralogy of Fallot with pulmonary atresia (n = 19). Median age of surgery was 134 [8–323] days and 128 [7–384] days and mean conduit size was 11.8 ± 2.2 mm and 11.2 ± 2.9 mm for PTFE and homografts, respectively. There was no difference in age, gender, weight, height, BSA, diagnosis, conduit size, conduit z-score, bypass time, or cross-clamp time between the two groups. There were two early deaths (both homografts) and two late

deaths (1 homograft, 1 PTFE). Adjusting for year of surgery, hospital length of stay (LoS) was significantly different between the 2 groups. Median LoS was 14 [6–30] days for the PTFE group and 24.5 [17–46] days for the homograft group (p = 0.002). Multivariable analysis showed that younger age at surgery was a risk factor for conduit explant (HR: 1.104 per 30 days younger, p < 0.001). The cumulative incidence of conduit explant at 1, 3, and 5 years was 17%, 52%, and 55% for PTFE conduits, and 23%, 43%, and 56% for homografts. Time-to-event analysis demonstrated no difference in time-to-explant (p = 0.474) or time-to-explant-or-reintervention (p = 0.213) between the two conduit types. There was no significant influence of conduit type on the development of moderate conduit stenosis (p = 0.931), severe conduit stenosis (p = 0.523), moderate conduit insufficiency (p = 0.830) or severe conduit insufficiency (p = 0.880). Larger-conduit z-score was associated with a lower hazard rate for developing moderate conduit stenosis (HR: 0.46, p = 0.001) and severe conduit stenosis (HR: 0.42, p = 0.035).

Conclusion: Larger-conduit z-score is associated with improved conduit function. PTFE conduits are associated with a decrease in hospital LoS. In our experience, the performance of bicuspid valved PTFE conduits at least matches that of homograft conduits in patients under 2 years of age for RVOT reconstruction, and should be considered a valid alternative. Their low cost and lack of potential sensitization makes them an even more appealing alternative to homograft conduits at our institution.

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18. Transcatheter Pulmonary Valve Replacement for Treatment of Dysfunctional Surgical Bioprostheses: A Multicenter Study

Allison K. Cabalka[1], Jeremy D. Asnes[2], David T. Balzer[3], John P. Cheatham[4], Matthew J. Gillespie[5], Thomas K. Jones[6], Henri Justino[7], Dennis W. Kim[8], Te-Hsin Lung[9], Daniel R. Turner[10], Doff B. McElhinney[11]

[1]Mayo Clinic, Rochester, MN; [2]Yale University, New Haven, CT; [3]Washington University, St. Louis, MO; [4]Nationwide Children's Hospital, Columbus, OH; [5]Children's Hospital of Pennsylvania, Philadelphia, PA; [6]Seattle Children's Hospital, Seattle, WA; [7]Texas Children's Hospital, Houston, TX; [8]Children's Healthcare of Atlanta/Emory University, Atlanta, GA; [9]Medtronic, Santa Rosa, CA; [10]Children's Hospital of Michigan, Detroit, MI; [11]Lucille Packard Children's Hospital, Stanford University, Palo Alto, CA

Invited Discussant: *John E. Mayer

Objective: Stented bioprosthetic valves (BPV) are commonly used for surgical pulmonary valve replacement in postoperative congenital heart disease. As in other implant locations, pulmonary BPVs develop structural failure in a time-related fashion. In 2010, a balloon-expandable transcatheter pulmonary valve (TPV) device consisting of a bovine jugular venous valve was approved in the United States for treatment of dysfunctional right ventricular outflow tract (RVOT) conduits. TPV replacement (TPVR) within obstructed or regurgitant BPVs has been utilized widely, but there is limited published data regarding outcomes of this procedure, Therefore, we sought to evaluate TPV function in a cohort of patients who underwent TPVR into a failing pulmonary BPV.

Methods: Patients who underwent TPVR within a BPV for ≥moderate stenosis and/or pulmonary regurgitation (PR) at 10 centers were enrolled retrospectively. Baseline, procedural, and follow-up data were collected on standardized case report forms, with all cases audited for accuracy. The primary outcomes were freedom from reintervention and TPV dysfunction (≥moderate PR or mean Doppler gradient >40 mmHg).

Results: A total of 100 patients who underwent TPVR for treatment of PR and/or RVOT obstruction at 10 centers between 1/2010 and 6/2015 were enrolled. The median age and weight were 22 [5–79] years and 62 [15–161] kg, respectively, and 48 patients were children. The underlying diagnosis included tetralogy of Fallot in 73 patients, and 84% of patients had moderate or severe PR. The TPV was implanted into multiple different types of surgical BPVs The median BPV size was 23 mm; 24 valves were ≤21 mm, 25 were 23 mm, 27 were 25 mm, 11 were 27 mm, and 10 were >27 mm. In most patients (n = 78), the TPV was implanted on a 22 mm delivery system. Acute hemodynamic outcomes included reduction of PR to ≤mild in all but 1 patient and of the mean Doppler RVOT gradient from a median of 29 to 16 mmHg ($P < 0.001$). During a median follow-up of 12.4 months (0–4.4 years), no patients underwent surgical explant or transcatheter reintervention on the TPV. Endocarditis (IE) was diagnosed in 1 patient, who was managed medically without intervention on the TPV, although there was severe PR after treatment. The most recent mean Doppler gradients were similar (median 14 mmHg, p = NS) compared to early post-implant. No patient had a gradient >35 mmHg, 86% of patients had no or trivial PR, with only 1 greater than mild (following the episode of IE as mentioned); no other patient met criteria for TPV dysfunction.

Conclusions: TPVR within dysfunctional surgical BPVs in the pulmonary position can be used to restore competence and relieve obstruction, with excellent medium term results. It will be important for surgeons and cardiologists to collaborate in an effort to determine the best lifetime management, combining surgical and transcatheter pulmonary valve replacement, in this population.

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19. Modified Repair of Type I and II Truncus Arteriosus Limits Early Right Ventricular Outflow Tract Re-Operation

Clauden Louis, Michael F. Swartz, Jill M. Cholette, Francisco Gensini, ◆George M. Alfieris
University of Rochester, Rochester, NY

Invited Discussant: *Jonathan M. Chen

Objective: As a result of branch pulmonary artery manipulation and changes in somatic growth, infants repaired with Type I and II truncus arteriosus often require early right ventricular outflow tract (RVOT) reoperation. Using a modified repair of truncus arteriosus, the branch pulmonary arteries are left *in situ*, minimizing branch pulmonary artery manipulation which may limit early RVOT reoperation. We hypothesized that using a modified approach for the correction of Type I and II truncus arteriosus would minimize early RVOT reoperation.

Methods: Infants, requiring repair for type I or type II truncus arteriosus were reviewed from 1990 to 2014 and divided into two groups based upon the type of repair. For infants repaired using the traditional technique, the branch pulmonary arteries were excised from the truncal root, and the corresponding aortic defect closed primarily or patched. Following closure of the ventricular septal defect (VSD), either a valved bioprosthetic conduit, or valved homograft was then used for reconstruction of the RVOT. For infants repaired using a modified approach, a hockey-stick incision was made on the truncal root, and extended into the left pulmonary artery. The truncal root was then septated using a Gore-Tex patch, the VSD closed, and a short (<2 cm) aortic homograft used to re-establish right ventricular to pulmonary artery continuity.

Results: Fifty-five infants were repaired, 35 using a modified approach and 20 using the traditional technique. Although there were no significant differences in the preoperative age, gender, or weight, there was a greater percentage of infants with interrupted aortic arch who were repaired using a modified approach (Table). There was no difference in conduit size between either group (11.3 ± 1.4 mm vs 11.8 ± 2.2 mm, p = 0.4). There was 100% follow-up, at 9.0 ± 5.5 years and 10.3 ± 8.8 years for the modified and traditional technique, respectively. There were no cases of the septation patch causing branch pulmonary artery or aortic obstruction. Freedom from RVOT reoperation was significantly greater at 5 (Modified: 79.4% vs Traditional: 36.6%, p = 0.004) and 10 years (Modified: 49.3% vs Traditional: 29.3%, p = 0.05) using the modified approach. In addition, the percentage of patients who required a second reoperation for RVOT reconstruction was significantly lower using the modified approach (Modified: 0 vs Traditional: 15% (3/20), p = 0.04).

Table: Perioperative Demographics

	Modified (n = 35)	Traditional (n = 20)	p-Value
Age at surgery (days)	39.1 ± 71.8	43.1 ± 43.4	0.9
Male gender	42.8% (15)	61.9% (13)	0.2
Truncus Type I	69% (24)	50% (10)	0.3
Truncus Type II	31% (11)	50% (10)	0.3
Interrupted aortic arch	20% (7)	0	0.04
Di George syndrome	17.1% (6)	15% (3)	1.0

Conclusion: Maintenance of branch pulmonary artery architecture using a modified approach in infants with type I and type II truncus arteriosus results in improved survival and greater freedom from right ventricular outflow tract reconstruction.

20. Impact of Truncal Valve Insufficiency on the Outcomes of Truncus Arteriosus Repair

Phillip Naimo, Tyson Fricke, *Yves d'Udekem, Robert Weintraub, Johann Brink, *Christian Brizard, *Igor Konstantinov

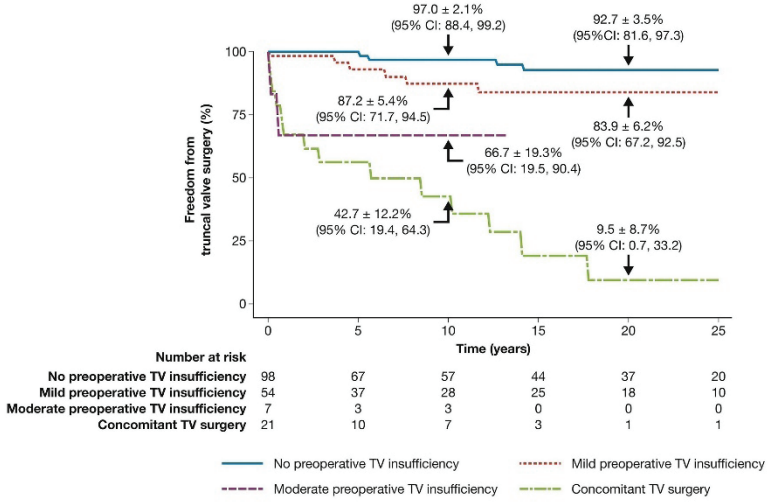
Royal Children's Hospital, Melbourne, Australia

Invited Discussant: *Carl L. Backer

Objectives: The impact of truncal valve (TV) insufficiency on the outcomes of truncus arteriosus (TA) repair is not well defined. We therefore sought to determine the impact of TV insufficiency on a large cohort of children, who underwent TA repair at a single institution.

Methods: We retrospectively reviewed 180 consecutive patients with median age 52 days (mean: 144 days, range: 1 day to 8.7 years) who underwent TA repair between 1979 and 2016. Preoperative echocardiography determined TV insufficiency in 80 patients (mild: 33.9%, 61/180; moderate: 9.4%, 17/180; and severe: 1.1%, 2/180). The TV was bicuspid in 13.3 % (24/180), tricuspid in 65% (117/180), and quadricuspid in 26.7% (48/180). Concomitant TV surgery at the time of TA repair was performed in 21 patients.

Results: There were 21 early deaths (21/180 [11.7%]) and 20 late deaths in the entire cohort. Overall survival was 73.5 ± 3.9% (95% CI [65.0, 80.3]) at 25 years. Of the 21 patients who underwent concomitant TA-TV repair, early mortality was 19% (4/21), and survival was 70.8 ± 10.1% (95% CI [46.2, 85.7]). Neither concomitant TA-TV repair (p = 0.5) nor degree of preoperative TV insufficiency (p = 0.94) were associated with mortality.



TV reoperation was common in patients with concomitant TV surgery, with freedom from TV reoperation was 9.5 ± 8.6% (95% CI [0.6, 33.2]) at 25 years (**Figure**). Of the remaining 159 patients who did not undergo concomitant TA-TV repair, 14 patients required late TV surgery due to persisting or worsening TV insufficiency.

Median time to TV operation was 7.9 years (range: 1 day to 25 years). Freedom from TV operation was 84.0 ± 4.6% (95% CI [72.5, 91.0]) at 25 years. Only 7 patients with preoperative moderate TV insufficiency did not undergo concomitant TA-TV repair, of whom 3 have required late TV surgery to address TV insufficiency.

Follow-up was 98.6% (137/139) complete. TV insufficiency was none or trivial in 79.6% (109/137), and mild or less in 98.5% (135/137) of patients at median follow-up of 18 years (mean: 16 years, range: 1–34 years). In the 28 surviving patients who have had TV surgery, 5 patients had mild TV insufficiency, whereas 1 patient had moderate TV insufficiency.

Conclusion: Although TV insufficiency is not a risk factor for death, moderate or greater preoperative TV insufficiency is associated high reoperation rate on the TV. The majority of patients with no or mild preoperative TV insufficiency are free from TV surgery up to 25 years.

5:15 pm **Adjourn**

MONDAY AFTERNOON, MAY 1, 2017

2:00 pm – 5:15 pm **General Thoracic Surgery** Room 302/304, Hynes
Simultaneous Scientific Session:
Management of Early Stage Lung Cancer
8 minute presentation, 10 minute discussion

Moderators: *Scott J. Swanson and *Michael Lanuti

21. Comparison of Morbidity of Pulmonary Segmentectomy and Lobectomy: Initial Results of a Phase III Randomized Trial of Lobectomy Versus Segmentectomy for Small (2 cm or Less) Peripheral Non-Small Cell Lung Cancer (JCOG0802/WJOG4607L)

Kenji Suzuki[1], Hisashi Saji[2], Shunichi Watanabe[3], *Morihito Okada[4], Junki Mizusawa[3], Ryu Nakajima[5], Masahiro Tsuboi[3], Shinichiro Nakamura[6], Kenichi Nakamura[3], Tetsuya Mitsudomi[7], Hisao Asamura[8]

[1]Juntendo University Hospital, Tokyo, Japan; [2]St. Marianna University, Kanagawa, Japan; [3]National Cancer Center Hospital, Tokyo, Japan; [4]Hiroshima University, Hiroshima, Japan; [5]Osaka City General Medical Center, Osaka, Japan[6]West Japan Oncology Group, Osaka, Japan; [7]Kinki University Faculty of Medicine, Osaka, Japan; [8]Keio University School of Medicine, Tokyo, Japan

Invited Discussant: *Nasser K. Altorki

Objective: Few multi-institutional randomized trials are available regarding surgical morbidity of segmentectomy compared with lobectomy for non–small cell lung cancer (NSCLC).

Methods: Postoperative complications, one of the secondary endpoints, were analyzed in patients who were intraoperatively randomized to lobectomy (Group A) and segmentectomy (Group B) for a surgery of small-sized NSCLC, excluding radiologically determined noninvasive cancer. The aim of this trial is to confirm the non-inferiority in overall survival (OS) of segmentectomy compared with lobectomy. If the non-inferiority of segmentectomy is confirmed and the superior postoperative pulmonary function of segmentectomy is shown, segmentectomy will be a

standard surgery in this population. Sample size was determined to be 1,100 with one-sided alpha of 5%, power of 80% and a non-inferiority margin of 5% assuming 5-year OS of 90% in the lobectomy arm. Surgical complications was evaluated by the mode of surgery with an intention-to-treat analysis. As to a mode of surgery, segmentectomy was categorized into typical and atypical: resection of the right or left S6, the left superior, and the lingular segment was defined as typical. Multivariate logistic regression model including the mode of surgery as explanatory variables was used to evaluate complications with as-treated analysis. Complications were evaluated with CTCAE v3.0. This trial is registered with the UMIN-CTR (UMIN000002317).

Results: Between August 2009 and October 2014, 1,106 patients (Group A: 554, Group B: 552) were enrolled. Segmentectomy was converted to lobectomy in 22 patients, and 1 patient was excluded due to wide wedge resection, which finally result in 576 lobectomies and 529 segmentectomies. Operative mortality was 0% in both groups. Postoperative complications (grade ≥ 2) occurred in 142 (26%) and 148 (27%), in Group A and B (p = 0.68).

Table: Overall Patients

Characteristics		Group A Lobectomy Arm (n = 554)	Group B Segmentectomy Arm (n = 552)	P-value in Wilcoxon-Rank Sum Test*, Fisher's Exact Test†
Men		293 (52.9%)	290 (52.5%)	
Age, range (median) 35–85 (67)		35–85 (67)	32–83 (67)	
Maximum tumor diameter on thin-section CT (cm), range (median)		0.6–2.0 (1.6)	0.6–2.0 (1.6)	
Consolidation tumor ratio (C/T)	0.25<, ≤0.5	62 (11.2%)	73 (13.2%)	
	0.5<, ≤1	491 (88.6%)	479 (86.8%)	
Mediastinal Nodal dissection		544 (98.2%)	534 (96.7%)	
Blood loss (ml), range (median)		0–900 (44.5)	0–800 (50)	0.012*
Duration of chest tube placement (day), range (median)		1–29 (4)	2–35 (4)	0.62*
Postoperative reinsertion of chest tube		8 (1.4%)	21 (3.8%)	0.015†

Postoperative pneumonia (grade ≥ 2) occurred 4 (0.7%) and 9 (1.6%), in group A and B (p = 0.18). Alveolar fistula was detected in 21 (3.8%) and 36 (6.5%), in Group A and B (p = 0.04). No bronchopleural fistulas were found. Multivariate analysis revealed a predictor of postoperative complications (grade ≥2) to be pack-year (PY) smoking >20 (vs none) (OR: 1.54 [1.03–2.29], p = 0.035). Predictors of pulmonary complications, including alveolar fistula and empyema (grade ≥2), were typical segmentectomy (vs lobectomy) (OR: 2.07 [1.11–3.88], p = 0.023), and PY >20 (vsnone) (OR: 2.61 [1.14–5.97], p = 0.023) on multivariate analysis.

Conclusion: Segmentectomy and lobectomy were feasible. Segmentectomy, however, was not shown to be less invasive than lobectomy as to blood loss and frequency of alveolar fistula. Segmentectomy will be a standard surgery if the superiority of postoperative pulmonary function of the segmentectomy and the non-inferiority of segmentectomy in OS is confirmed by the primary analysis planned in 2020.

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22. Variability in Surgical Quality in Patients with Early Stage Non-Small Cell Lung Cancer Undergoing Wedge Resection Impacts Overall Survival When Compared to Stereotactic Body Radiation Therapy

Gaurav Ajmani[1], Chi-Hsiung Wang[1], Ki Wan Kim[1], *John A. Howington[2], Seth B. Krantz[1]

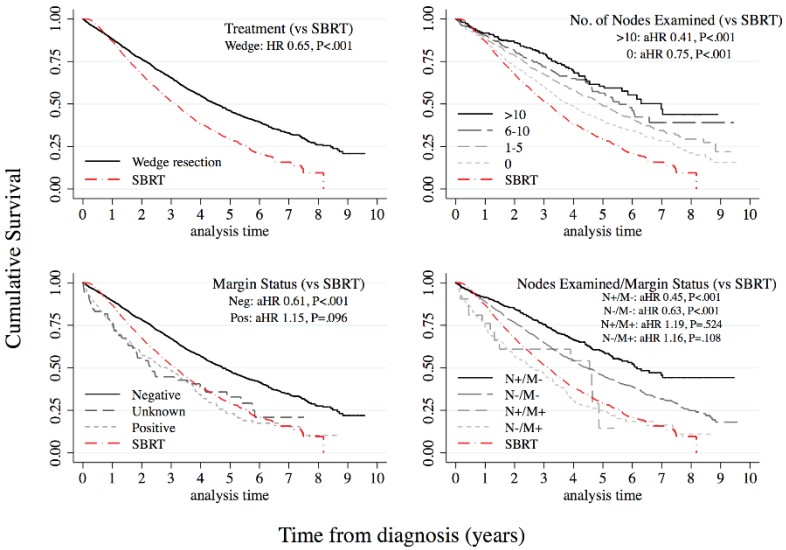
[1]NorthShore University Health System, Evanston, IL; [2]Saint Thomas Healthcare, Nashville, TN

Invited Discussant: *Benjamin D. Kozower

Objective: For patients with early stage non–small cell lung cancer (NSCLC), recent analysis suggests that a wedge resection (WR) may be superior to stereotactic body radiation therapy (SBRT). However, the role that the quality of WR plays in improved outcomes is unknown. Our objective was to assess the surgical quality in patients undergoing WR for NSCLC and determine its effects on pathologic upstaging and on overall survival, specifically as it compares to SBRT.

Methods: Patients within the National Cancer Database (NCDB) with clinical T1-T2, N0, M0 NSCLC who were treated with either WR or SBRT from 2005 to 2012 were analyzed for surgical quality markers, predictors of lymph node assessment and pathologic upstaging, and overall survival. Quality markers included the number of nodes examined and margins status. Multivariable logistic regression was used to test for clinical characteristics associated with adequate lymph node sampling and pathologic upstaging. WR patients and SBRT patients were then propensity-matched (1:1) on relevant demographic and clinical factors. Overall survival (OS) by treatment received (SBRT vs WR quality categories) was analyzed using Kaplan-Meier curves and Cox regression in the propensity-matched cohort.

Results: There were 7,337 patients who underwent WR who met inclusion criteria. Nearly half of WR patients (46.1%) had 0 LNs examined, 37.1% had 1–5 examined, and 16.8% had more than 5 nodes examined. Significant predictors of having at least 5 nodes examined included younger age, fewer comorbidities, T2 tumors, and obtaining negative margins. Negative margins were obtained in the vast majority of WR patients (91.9%). Nodal upstaging was seen in 4.1% and was correlated with the number of LNs examined: 1–5 LNs examined (4.2% upstaged); 6–10 LNs (6.6% upstaged); >10 LNs (6.5% upstaged). For patients undergoing WR, increased LNs examined and negative margin status were associated with significantly better OS. In a propensity-matched cohort, patients receiving WR had significantly better survival compared to those receiving SBRT (HR: 0.65, $P < .001$, Figure). The magnitude of the difference was affected by surgical quality; however, even WR patients with 0 LNs examined still had significantly better survival than SBRT patients (adjusted HR: 0.75, $P < .001$). Wedge resection patients with a positive margin showed equivalent survival to SBRT (adjusted HR for WR: 1.15, $P = 0.96$).



Conclusions: In patients undergoing wedge resection for NSCLC, LNs examined and margin status are associated with significant differences in Overall Survival. High-quality WR appears to confer a significant survival advantage compared to SBRT; however, low-quality WR loses much of that survival advantage. Every effort should be made to obtain negative margins and to sample regional lymph nodes in order to maximize the benefit of a therapeutic wedge resection compared with SBRT.

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23. Endosonographic Mediastinal Lymph Node Staging in Positron Emission Tomography and Computed Tomography Negative Non-Small Cell Lung Cancer

Pravachan Hegde[1], Vicky Thiffault[1], Adeline Jouquan[1], Vipul Jain[2], Akshatha Gowda[2], *Pasquale Ferraro[1], *Moishe Liberman[1]

[1]University of Montreal, Montreal, QC, Canada; [2]University of California, San Francisco, CA

Invited Discussant: *Kazuhiro Yasufuku

Objective: Positron emission tomography (PET) with computed tomography (CT) is routinely utilized to investigate lymph node(LN) metastases in non–small cell lung cancer. However, it is less sensitive in normal-sized LNs. This study was performed in order to define the prevalence of mediastinal LN metastases discovered on endosonography in radiologically normal patients.

Methods: This study consists of a retrospective, single-institution, tertiary care referral center review of a prospectively maintained database. Patients were identified from a cohort between January 2009 and December 2014. Consecutive patients with non–small cell lung cancer were identified in whom both the pre-endosonography CT and PET-CT were negative for mediastinal LN metastases.

Patients were staged if they had central tumor, tumor size >3 cm, N1 lymph node involvement on PET-CT/CT, or if there was low SUV in the primary tumor. Combined endosonography (EBUS+EUS-FNA) was performed in all patients. Chi-square test was used for statistical analysis.

Results: A total of 161 consecutive patients were included. Twenty-two out of 161 patients with radiologically normal mediastinum were positive on combined EBUS/EUS staging. Out of 21 patients upstaged, 15 (71%) had tumor size >3 cm, 6 (28%) had N1 disease, 13 (61%) had N2 disease, and 2 (9%) had adrenal involvement. None of the patients that were upstaged had N1 LN involvement on PET-CT or CT scan.

A total of 416 lymph nodes were biopsied in the 161 patients by combined endosonography, 147 by EBUS and 269 by EUS. Mean and median number of lymph nodes biopsied per patient using combined EBUS/EUS was 2.5 and 3, respectively (EBUS: 0.91 and 2.5; EUS: 1.6 and 3). Twelve patients were upstaged with EBUS and 10 patients were upstaged with EUS. Combined endosonographic staging upstaged 22 patients (14%) with radiologically normal lymph nodes in the mediastinum ($p < 0.01$).

Conclusions: Given the significant rate of unsuspected lymph node metastases, combined endosonographic lymph node staging should be routinely performed in staging of non–small cell lung cancer in high-risk patients even in the presence of radiologically normal mediastinal lymph nodes.

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24. Declining Use of Surgical Therapy for Early Stage Non-Small Cell Lung Cancer in the United States

Kathryn E. Engelhardt, Joseph M. Feinglass, *Malcolm M. DeCamp, Karl Y. Bilimoria, David D. Odell

Northwestern University, Chicago, IL

Invited Discussant: *Keith S. Naunheim

Objectives: While surgery remains the standard of care for resectable non–small cell lung cancer (NSCLC), several competing nonsurgical options have become available. However, the impact of these treatment modalities on the proportion of patients receiving surgery is poorly described. Our objective was to examine whether surgical therapy was being supplanted by other treatment modalities.

Methods: Patients with early-stage NSCLC (Stage IA to IIA) diagnosed from January 1, 2004 to December 31, 2013 were identified in the National Cancer Data Base. The Cochrane-Armitage trend test was used to evaluate the change in proportion of patients undergoing surgery over time.

Results: Of 195,938 eligible patients from 1,278 hospitals, the mean age at diagnosis was 69 years (±10.5). Overall, 64.0% (n = 145,066) patients underwent surgery. The rate of surgical resection decreased over time from 76.4% to 70.5% (12,530/16,405 to 15,797/22,411, $p < 0.001$). This trend is driven largely by a decrease in surgery for stage IA (80.1% to 70.5% [6,429/8,024 to 8,272/11,733], $p < 0.001$) and IIA (76.5% to 68.9% [851/1,113 to 2,840/4,123], $p < 0.001$) disease. In this time

period, the rate of radiation treatment with or without chemotherapy in the non-surgical cohort increased from 57.0% to 71.7% (2,208/3,875 vs 4,741/6,614). The most common treatment for patients not undergoing surgery was radiation alone (51.4% [26,127/50,872]), followed by radiation and chemotherapy combined (13.5% [6,889/50,872]). Few (3.6% [1,843/50,872]) underwent chemotherapy alone and 30.0% (35,689/50,872) of the nonsurgical cohort did not have any curative treatment. Based on the information available, 19.8% (10,085/50,872) did not have surgery because it was contraindicated due to patient risk factors, whereas 5.1% (2,616/50,872) did not have surgery because the patient or family refused.

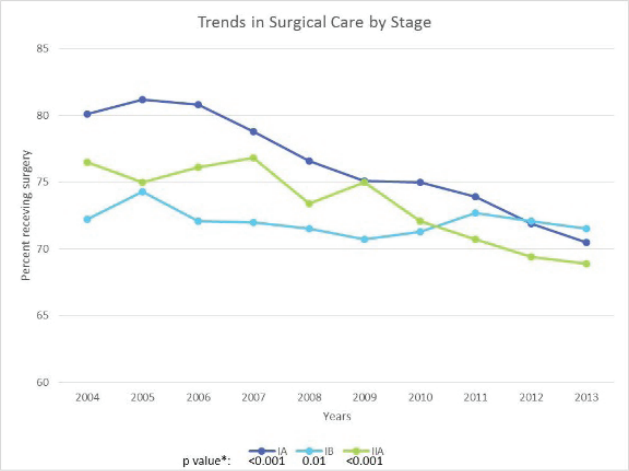

Figure 1: National trend in surgical management of non-small cell lung cancer by stage IA-IIA from 2004 to 2013.
*Cochrane Armitage trend test

Conclusions: Our data demonstrate an overall decrease in the use of surgical therapy for lung cancer in early stage disease. Most notably, there has been a 12% decrease in surgical therapy for Stage IA NSCLC from 2004 to 2013. As resection remains the standard of care for most patients with early stage disease, these data indicate a potentially significant quality gap in the treatment of NSCLC. Further investigation is needed to assess the reasons for this quality gap in patients with early stage disease.

3:20 pm – 3:55 pm **Coffee Break in the Exhibit Hall**

Moderators: *Malcolm M. DeCamp, Jr. and *Joseph B. Shrager

25. Predictors of Distant Recurrence Following R0 Lobectomy for pN0 Lung Adenocarcinoma

Ilies Bouadallah, Whitney Brandt, Kay See Tan, *Bernard J. Park, *Prasad S. Adusumilli, *Valerie W. Rusch, Daniela Molena, *Manjit S. Bains, *James Huang, *Robert J. Downey, James M. Isbell, Matthew Bott, *David R. Jones

Memorial Sloan Kettering Cancer Center, New York, NY

Invited Discussant: *Michael Lanuti

Objective: Adjuvant therapies following resection for lung adenocarcinoma are offered for node-positive disease to decrease distant recurrence (DR) and improve disease-free (DFS) and overall survivals (OS). Although local recurrence following limited resection has been the focus of intense investigation, the risk of DR following a lobectomy in pathologic node-negative (pN0) lung adenocarcinoma has not been extensively examined. The objective of this study was to investigate factors predictive of DR following a R0 lobectomy for pN0 lung adenocarcinoma.

Methods: We performed a retrospective analysis (2000–2016) of a prospectively maintained database for patients with cT1-3N0M0 (7^{th} edition) lung adenocarcinoma who had a R0 lobectomy. Exclusion criteria were: prior lung cancer, sublobar resection, any pN involvement, R1 or R2 resection, induction or adjuvant therapy, and new lung primary on follow-up. The primary outcome of interest was DR and the secondary endpoint was DFS. DR was analyzed using a competing risk approach with locoregional recurrence (LR) and death without DR considered competing events. DR included any distant disease exclusive from LR only. The cumulative incidence of distant recurrence (CIR-distant) was used to estimate the probability of DR. The association between DR and variables was estimated using the Fine and Gray model. DFS and OS were estimated using Kaplan-Meier method and Cox proportional hazards models.

Results: Among 2,056 patients with cT1-3N0M0 lung adenocarcinoma, 1,033 patients with pT1-3N0MO disease met inclusion criteria. Median age was 69 years (62–75) with 37% males and 63% females. One hundred forty-three patients (13.8%) had any recurrence: 38 (3.7%) with LR and 105 (10.2%) with DR. Among patients with DR, 14 (1.4%) had LR + DR and 91 (8.8%) had DR only. Follow-up was 44 months (range: 1–200). The median OS was 115 months (95% CI [107–123]). DR rates based on Tsize were 5%, 7%, 16%, 27%, and 35% for T1a, T1b, T2a, T2b, and T3 tumors, respectively. The 5-year CIR-distant was 14.2% (95% CI [11.5–16.9%]). SUVmax (HR: 1.04, *p = 0.034*) and tumor size (pT2a—HR: 2.39, *p* = 0.01; pT2b—HR: 5.88, *p = 0.0005*; pT3—HR: 6.22, *p = <0.0001*) were significantly associated with worse CIR-distant on multivariable analysis (Table). DFS was associated with age >70 years (HR: 1.73; *p = 0.0001*), SUVmax (HR: 1.03; *p = 0.044*), tumor size (pT2a—HR: 1.89, *p = 0.0004*; pT2b—HR: 3.52, *p = 0.001*; pT3—HR: 3.38, *p = <0.0001*), and vascular invasion (HR: 1.40, *p = 0.022*).

Table 1. Multivariable competing risk analysis for hazard of distant recurrence

Variable	Hazard Ratio	95% Confidence Interval	*p-value*
Age > 70	1.30	0.84, 2.02	*0.2*
SUVmax Primary	**1.04**	**1.00, 1.09**	***0.034***
pT1b (vs 1a)	1.19	0.57, 2.50	*0.6*
pT2a (vs 1a)	**2.39**	**1.23, 4.65**	***0.010***
pT2b (vs 1a)	**5.88**	**2.17, 15.92**	***0.0005***
pT3 (vs 1a)	**6.22**	**2.77, 13.96**	***<0.0001***
Solid (vs not)	1.23	0.69, 2.17	*0.5*
Vascular invasion (vs none)	1.36	0.87, 2.14	*0.2*
Visceral pleural invasion (vs none)	1.28	0.72, 2.28	*0.4*

Conclusion: In patients with pN0 lung adenocarcinoma resected by lobectomy the CIR-distant is associated with tumor SUVmax and T stage. In addition to these factors, older age and vascular invasion are associated with decreased DFS. The high incidence of DR and low DFS for pT2N0 and pT3N0 tumors provides initial evidence for inclusion of these tumors into clinical trials examining adjuvant targeted or immunotherapies.

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26. Differential Impact of Operative Complications on Survival Following Surgery for Primary Lung Cancer

*Felix G. Fernandez[1], Andrzej S. Kosinski[2], *Anthony P. Furnary[3], *Mark Onaitis[4], Sunghee Kim[5], Robert H. Habib[6], Betty C. Tong[2], Patricia Cowper[5], *Daniel Boffa[7], *Jeffrey P. Jacobs[8], *Cameron D. Wright[9], *Joe B. Putnam[10]

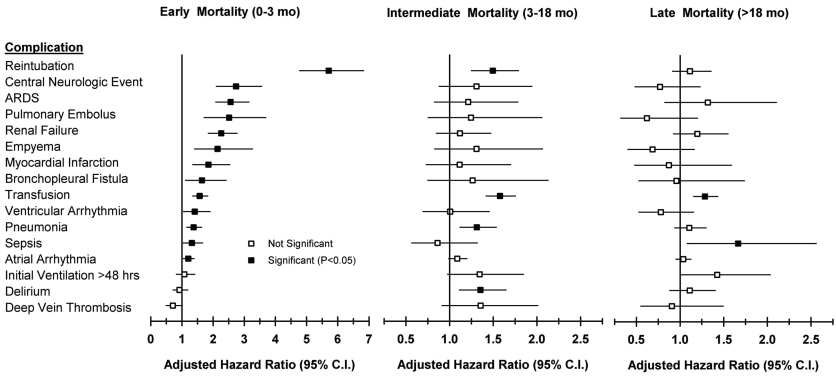
[1]Emory University, Atlanta, GA; [2]Duke University, Durham, NC; [3]Starr-Wood Cardiothoracic Group, Portland, OR; [4]University of California, San Diego, CA; [5]Duke Clinical Research Institute, Durham, NC; [6]Society of Thoracic Surgeons Research Center, Chicago, IL; [7]Yale University, New Haven, CT; [8]Johns Hopkins All Children's Hospital, St. Petersburg, FL; [9]Massachusetts General Hospital, Boston, MA; [10]Baptist MD Anderson Cancer Center, Jacksonville, FL

Invited Discussant: *Sudish C. Murthy

Objective: Operative complications adversely affect survival following lung cancer surgery. The Society of Thoracic Surgeons (STS) risk prediction and performance models for lung cancer surgery empirically assign equal weights to major complications. We aimed to test the hypothesis that the impact of complications following lung cancer surgery on survival varies substantially across the spectrum of postoperative complications.

Methods: The STS – General Thoracic Surgery Database (GTSD) was linked to Medicare data for lung cancer resections from 2002 to 2013 using a deterministic matching algorithm, as previously reported. Successful linkage was achieved in 29,899 lung cancer resection patients. A long-term survival model was created including operative complications as explanatory variables in addition to adjusting for all relevant baseline covariates. Due to violation of the proportional hazard assumption, we used time-varying coefficient Cox modeling for the complication variables.

Results: Median age was 73 years (IQR: 68,78), and 48% of the patients were male. Procedure performed was lobectomy in 69%, wedge resection in 17%, segmentectomy in 7%, bilobectomy in 3%, pneumonectomy in 3%, and sleeve lobectomy in 1%. Pathologic stage distribution was the following: 69% stage I, 18% stage II, 11% stage III, and 2% stage IV. Rates of the most frequent complications were: atrial arrhythmia 14% (4,166), pneumonia 4.3% (1,285), reintubation 3.8% (1,134), delirium 2% (597), and renal failure 1.4% (417). The Cox model (Figure) demonstrates differential impact of complications over time. In the early time period of 0–90 days, 13 complications were associated with worse survival. From 3 to 18 months after surgery, the pattern of operative complications that impact survival changes. Delirium becomes significant in addition to perioperative blood transfusion, reintubation, and pneumonia, which are also significant in the early time period. After 18 months, the hazard of operative complications diminishes, with only sepsis and perioperative blood transfusion being associated with a significant late hazard.



Conclusions: The adverse effects of operative complications on survival following lung cancer surgery are predominantly manifest in the first 18 months following the operation and dissipate thereafter. Our analysis confirmed the presence of differential (magnitude) and time-varying effects on survival of individual complications following lung cancer surgery. We conclude that the derived time-dependent hazard ratios can serve as objective weights in future STS-GTSD models that enhance performance measurement, and focus attention on the prevention and management of the most impactful complications.

27. Genetic Variants in Cytokine Signaling Pathways Are Associated with Survival in Surgically Resectable Non-Small Cell Lung Cancer

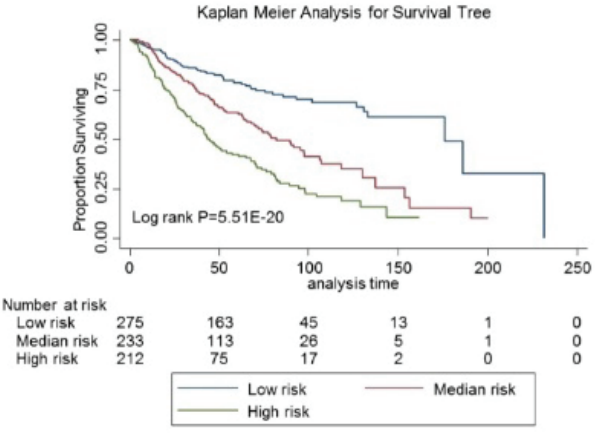
Boris Sepesi, Yuanquing Ye, Liren Zhang, Jianchun Gu, Lin Ji, Mara Antonoff, *Wayne L. Hofstetter, *David Rice, *Reza Mehran, *Garrett L. Walsh, *Ara A. Vaporciyan, *Stephen G. Swisher, *Jack A. Roth, Wu Xifeng

MD Anderson Cancer Center, Houston, TX

Invited Discussant: Bryan M. Burt

Objective: A single nucleotide polymorphism (SNP) is a variation in a single nucleotide that occurs at the specific position in the genome. The purpose of this study was to examine the role of genetic variants in cytokine signaling genes and compare them with clinical outcomes in surgical patients with non–small cell lung cancer (NSCLC). We specifically tested whether an individual or a combination of genetic variants in cytokine signaling pathway are associated with survival.

Methods: Genomic DNA and SNP analyses of the cytokine signaling pathway was performed from extracted peripheral blood from 722 patients who underwent resection for lung cancer between 1995 and 2009. Cox proportional hazard model analyses were performed to identify significant SNPs that correlated with overall (OS) and disease free survival (DFS). We also performed internal validation using bootstrap analysis 100 times and selected those SNPs that had more than 90 times p value < 0.01 for unfavorable genotype and survival-tree analysis. Median follow-up time was 71 months.



Results: Seventeen SNPs were selected for OS and 9 SNPs were selected for DFS based on bootstrap analyses results. SNPs associated with OS included interleukin enhancer binding factor 2 (HR: 1.69), bone morphogenic protein 2 (HR: 0.66), interferon regulatory factor 2 (HR: 1.26), interferon kappa precursor (HR: 1.35), lymphotoxin beta (HR: 1.47), interleukin 31 (HR: 1.79), interleukin 17 (HR: 0.68), CCATT binding protein (HR: 1.56), interleukin 1 (HR: 1.88), transforming growth factor beta (HR1.50), colony stimulating factor (HR: 1.74), oncostatin M (HR: 1.27), STAT 1 (HR: 1.38), interleukin 5 (HR: 0.70). After controlling for age, gender, smoking status, clinical stage, and treatment, patients with ≥9 unfavorable

genotypes experienced the worst OS with median of 41 months (HR: 4.3) compared to patients with 7–8 unfavorable genotypes (median OS 89 months, HR1.9), and ≤6 unfavorable genotypes (median OS 153 months, HR 1.0), log rank test p = 2.86×10^{-23}. Survival-tree analysis demonstrated 2.3-fold and 4.0-fold increased risk of death in median and high-risk groups, respectively, as compared to low-risk group, log rank test p = 5.51×10^{-20} (Figure). The best DFS was observed in patients with ≤3 unfavorable genotypes where median survival was not reached (HR: 1.0). In the group with 4–6 unfavorable genotypes median DFS was 114 months (HR: 1.9), and in patients with ≥7 unfavorable genotypes, 44 months (HR: 2.8), log rank test p = 1.3×10^{-05}.

Conclusions: Our analysis suggests that the number of unfavorable SNPs coding for cytokine signaling pathways could be predictive of survival outcomes in NSCLC patients treated with definitive surgical therapy. Further studies are necessary to elucidate our findings and translate them into clinical setting.

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28. Long-Term Outcomes from a Phase I Near-Infrared Sentinel Lymph Node Mapping Trial in Non-Small Cell Lung Cancer

Christopher S. Digesu[1], *Krista J. Hachey*[1], *Denis M. Gilmore*[2], *Onkar V. Khullar*[3], **Michael T. Jaklitsch*[1], **Yolonda L. Colson*[1] [1]*Brigham and Women's Hospital, Boston, MA;* [2]*Vanderbilt University, Nashville, TN;* [3]*Emory University, Atlanta, GA*

Invited Discussant:

Objective(s): To report the first long-term clinical outcomes of non-small cell lung cancer (NSCLC) patients undergoing near-infrared (NIR) image-guided sentinel lymph node (SLN) mapping and to determine if pathologic node negative (pN0) SLN patients display disease-free and overall survival rates consistent with true pathologic N0 status.

Methods: This retrospective study included NSCLC patients enrolled in an ongoing phase 1 prospective dose-escalation trial of minimally invasive NIR SLN mapping. Patients underwent routine LAD and NIR SLN staging via transpleural or transbronchial indocyanine injection at the time of tumor resection. In this study, disease-free and overall survival were determined among patients with an NIR-identified SLN (SLN group) and compared to a control group of patients meeting identical enrollment criteria who underwent lymphadenectomy without identified SLNs (non-SLN group). Nodes were staged by routine H&E. Survival probabilities were determined by Kaplan-Meier analysis and group comparisons were made with Mann-Whitney U and Fisher's exact tests.

Results: Forty-two patients were included with a median follow-up of 31.5 months. At an optimized dose, an SLN was identified in 71% of patients with 23 patients in the SLN group and 19 in the non-SLN group. The SLN disease status was concordant with overall LAD status in all patients. Sixteen patients in the SLN group were deemed pN0 and no recurrences were identified; however, in the non-SLN group, recurrence was noted in 3/15 patients with one pN0 patient developing distant metastasis at 9 months, one with locoregional recurrence at 27 months,

and another with local recurrence at 21 months. Among pN0 cases, overall survival is 100% and 63.5% (p = 0.105) and disease-free survival at 5 years is 100% and 73.5% (p = 0.104) for SLN and non-SLN groups, respectively (Figure). In node-positive patients (pN+; n = 11), the SLN correctly identified disease in all cases (n = 7) with recurrence noted in 50% of patients in both SLN and non-SLN groups.

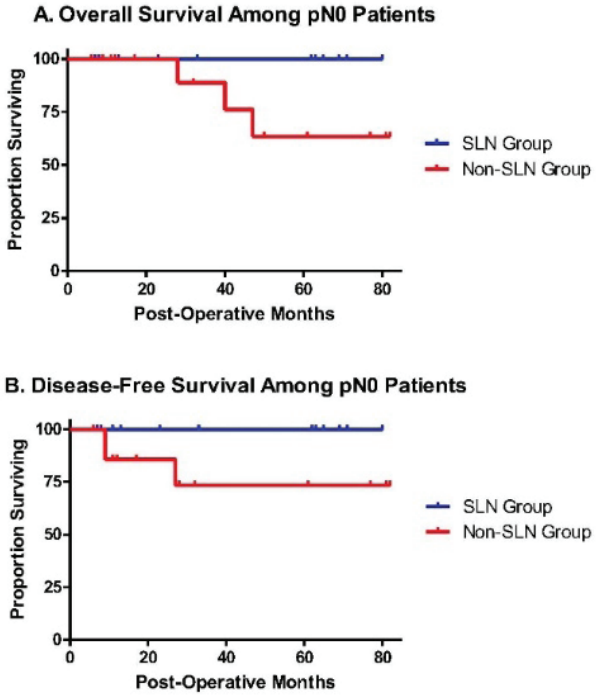

Figure 1. **A.** Kaplan-Meier estimates for overall survival among pN0 patients in SLN and Non-SLN groups (p=0.105). **B.** Kaplan-Meier estimates for disease-free survival among pN0 patients in SLN and Non-SLN groups (p=0.104).

Conclusions: Pathologic node negative patients with an NIR-identified SLN exhibited favorable disease-free and overall survival outcomes. This preliminary review of NIR SLN mapping suggests pN0 SLN may represent true node negative status in NSCLC patients. Follow-up studies and a future larger clinical trial are planned in order to validate these findings.

5:15 pm **Adjourn**

2:00 pm – 5:30 pm **Perioperative Care** Room 306, Hynes
Simultaneous Scientific Session
6 minute presentation, 8 minute discussion

Moderators: Katherine J. Hoercher and *Glenn J. Whitman

29. Early Predictors of Permanent Pacemaker Implantation After Surgical Aortic Valve Replacement in High Risk Patients

Alejandro Suarez-Pierre, Todd C. Crawford, Mohammad F. Usmani, J. Trent Magruder, Thomas S. Metkus, *Jennifer S. Lawton, *Duke E. Cameron, *John V. Conte, *Glenn J. Whitman

Johns Hopkins University, Baltimore, MD

Invited Discussant: *Ourania Preventza

Objective: Latrogenic damage to the cardiac conduction system after AVR is a recognized complication requiring a permanent pacemaker (PPM). We sought to identify predictors of the need for PPM in this population.

Methods: We retrospectively reviewed our institutional database from July 2011 to July 2016 including only isolated AVR or AVR in combination with CABG, mitral valve surgery, or tricuspid valve surgery. High-risk patients were separated into four groups defined by POD 1 cardiac conduction system abnormalities: Group 1—epicardial pacing with complete heart block (CHB), Group 2—epicardial pacing with unknown underlying rhythm, Group 3—sustained junctional rhythm, and Group 4—sinus bradycardia. We reviewed every ECG performed in our institution from 60 days pre-op to 5 days post-op. Exploratory univariable regression analysis was performed and covariates associated with PPM ($p < 0.2$) were included in a multivariable (MV) logistic regression analysis to determine independent predictors of PPM implantation.

Results: 1,263 patients were included in this study, in whom 254 manifested early injury to their electrical conduction system, the high-risk population. 19% of high-risk patients (48/254) required PPM implantation at a median time of 6 days (4–7) from surgery. A breakdown of high-risk patients included Group 1: 51/254 (20%) with CHB; Group 2: 85/254 (34%) with epicardial pacing with unknown underlying rhythm; Group 3: 61/254 (24%) with junctional rhythm; and Group 4: 57/254 (22%) with sinus bradycardia. Need for PPM by group was determined (Figure). Nine covariates met criteria for inclusion in the final MV model. Covariates independently associated with PPM implantation included CHB immediately after surgery (OR: 5.96, 95% CI [2.7–13.1], $p < 0.01$) and prolonged CPB time (OR: 1.01 [1.00–1.01], $p = 0.04$). Protective variables were older age (OR: 0.97 [0.94–0.99], $p = 0.03$) and increased post-op ventricular rate (OR: 0.98 [0.96–0.99], $p = 0.05$). Area under the ROC curve was 0.77. Subgroup analysis of CHB patients revealed that patients older than 60 required a PPM 40% of the time, whereas those under 60 required PPM 75% of the time.

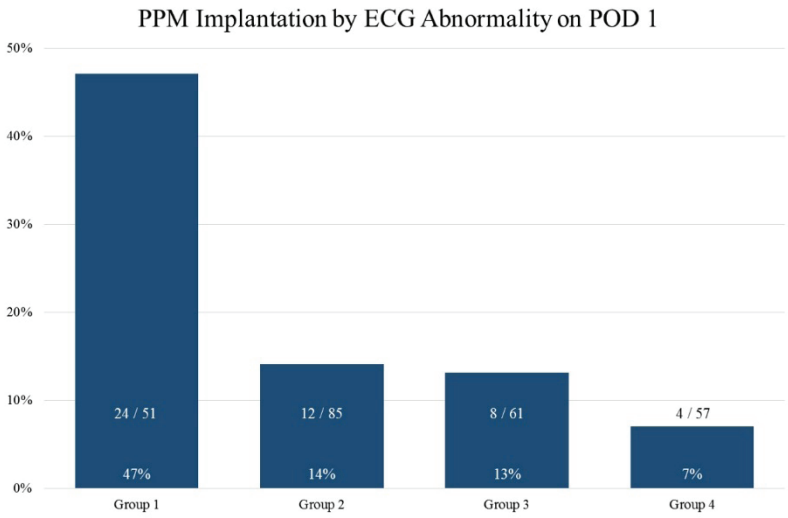

Figure 1. Groups are 1) epicardial pacing with complete heart block, 2) epicardial pacing with unknown underlying rhythm, 3) sustained junctional rhythm, and 4) sinus bradycardia

Conclusions: Our study demonstrated that in a heterogeneous population of AVR patients with early conduction system abnormalities, 1) Patients with early CHB, had the highest PPM rate; 2) Older age and increased post-op ventricular rate were associated with increased conduction system recovery; 3) CHB and prolonged CPB time increased the risk of PPM implantation; 4) In Group 1, patients with less than 60 years had almost twice the need for PPM than patients older than 60; 5) In postoperative AVR surgery, understanding the need for PPM should allow earlier decision making, with decreased LoS, cost, and possible morbidity.

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30. Predicting Readmission After Cardiac Surgery: Insights from a State-Level Analysis

J. Trent Magruder, Arman Kilic, Todd C. Crawford, Joshua C. Grimm, Sharon G. Owens, Maryhelen Miller, Lynn Desrosiers, *Glenn J. Whitman

Johns Hopkins University, Baltimore, MD

Invited Discussant: Domenico Pagano

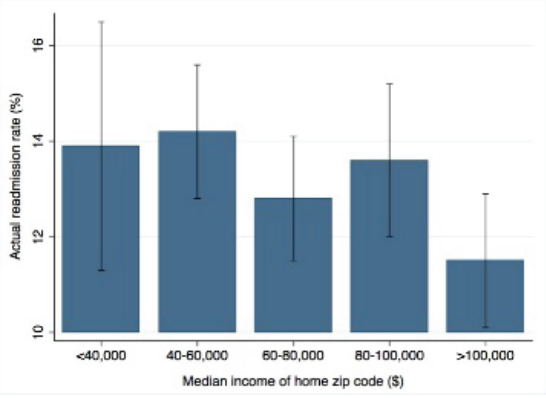
Objective: Readmission rates following cardiac surgery are scrutinized metrics, yet identification of accurate rates as well as patients at high risk has proven difficult. Using a state-wide database, we sought to better define readmission rates and associated prognostic factors.

Methods: We merged data regarding adult cardiac surgery patients at our institution from January 2013 to March 2015 with state-level data on 30-day readmission to any hospital in Maryland. Socioeconomic data was added based on home zip code. A multivariable model was used to derive a risk score.

Results: We included 2,481 cardiac surgery patients who underwent cardiac surgery at our institution, of whom 322 (13.0%) were readmitted to a Maryland hospital within 30 days of discharge (41% to another hospital). The most common readmission diagnoses according to billing data were pulmonary including pleural effusion and pneumonia (21.9%), wound infection (16.3%), arrhythmia (11.7%), and heart failure symptoms (10.2%). Significant multivariable associations with readmission are shown in the Table (final model c-statistic = 0.68). Education, poverty rate, or language were not independently associated with readmission, though we noted a modest relationship between a ZIP code's median income and readmission risk (see Figure). Our risk score categorized patients as low, moderate, or high risk for readmission, with observed (predicted) risks of 8.2% (8.1%), 14.5% (14.5%), and 26.5% (28.5%) ($R^2 = 0.94$, $p < 0.001$).

Table: Risk Score Factors and Risk Tertiles.

Risk Factor	OR (95% CI), p-Value	Points Assigned		Risk Tertile	Predicted Readmission Risk
EF ≤30%	2.31 [1.02–5.26], p = 0.04	3		Low (0–2 points)	8.1%
Endocarditis	2.08 [1.24–3.51], p = 0.01	3			
Combined CAB+valve procedure	1.85 [1.13–3.04], p = 0.02	3			
Discharge Hb <8 mg/dL	1.69 [1.16–2.46]), p = 0.01	2		Moderate (3–7)	14.5%
Non-STS index procedure	1.54 [1.09–2.18], p = 0.01	2	Score totals:		
Public health insurance	1.52 [1.10–2.09], p = 0.01	2			
Chronic lung disease	1.46 [1.09–1.96], p = 0.01	2		High (8+)	28.5%
Diabetes	1.35 [1.01–1.82], p = 0.04	2			
Discharge on Coumadin	1.35 [1.01–1.81], p = 0.04	2			



*AATS Member ◆AATS New Member

Conclusions: Single-institution readmission data appears to miss more than 40% of readmissions within 30 days of discharge after cardiac surgery. Discharge hemoglobin <8 mg/dL is independently associated with readmission. However, despite the use of statewide readmission data and the examination of heretofore unused socioeconomic variables, our final readmission risk model's discriminative ability was no better than other published data. The relative inability to predict readmission following cardiac surgery makes it a poor measure of hospital-specific quality.

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31. A Novel Risk Score to Predict New Atrial Fibrillation After Isolated Coronary Artery Bypass Grafting

Sophie Lin, Todd C. Crawford, Alejandro Suarez-Pierre, J. Trent Magruder, Joshua C. Grimm, *Jennifer S. Lawton, *Glenn J. Whitman, *Duke E. Cameron, *William A. Baumgartner, Kaushik Mandal

Johns Hopkins University, Baltimore, MD

Invited Discussant: *Filip P. Casselman

Objective: Atrial Fibrillation (AF) is common after cardiac surgery and contributes to increased morbidity and mortality. Currently, a universal risk model for AF after coronary artery bypass grafting (CABG) does not exist. Our objective was to derive and validate a predictive model for AF after CABG in patients with no prior history of dysrhythmia using a novel echocardiographic measurement.

Methods: This was a single-center, retrospective study of patients who underwent isolated CABG from 2011 to 2015. Patients with a preexisting history of dysrhythmia were excluded. The primary outcome was new onset AF lasting >1 hour or requiring medical treatment. Only patients with a preoperative transthoracic echocardiographic measurement of left atrial diameter were included in the development of the risk model. Patients were randomly divided into derivation (80%) and validation (20%) cohorts. The Predictors of AF after CABG (PAFAC) score was derived from a multivariable logistic regression model. Adjusted odds ratios for significant variables ($p < 0.05$) in the model were multiplied by a factor of 4 to derive an integer point system and points were then summated to create the risk score.

Results: 1,307 patients without a history of dysrhythmia underwent isolated CABG over the study period. 762/1307 patients had a preoperative left atrial diameter measurement and comprised the final study population. 209/762 patients (27%) developed new onset AF including 165 (29%) in the derivation cohort. Using multivariable logistic regression analysis to control for confounders, we identified four risk factors independently associated with postoperative AF that comprised the PAFAC score: age >60 years (5 points), White race (5 points), baseline GFR <90 mL/minute (4 points), and left atrial diameter >4.5 cm (4 points) (**Table**). Scores ranged from 0 to 18. The PAFAC score was validated in the remaining 20% of patients and was a reliable predictor of new onset AF. Predicted incidence of AF in the validation cohort strongly correlated with observed incidence ($R = 0.92$).

Table:

PAFAC Score	
Age >60	5
White race	5
GFR<90 mL/min	4
Left atrial diameter >4 cm	4
Total	18

Conclusion: The PAFAC score is easy to calculate and can be used upon ICU admission to reliably identify patients at high risk of developing AF after isolated CABG.

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32. Preoperative Left Ventricular Diastolic Dysfunction Predicts Postoperative Atrial Fibrillation After Aortic Valve Replacement for Aortic Valve Stenosis

Yoshihisa Morimoro, Takaki Sugimoto, Keigo Fukase, Fumiya Haba, Mari Hamaguchi
Awaji Medical Center, Hyogo, Sumoto, Japan

Invited Discussant: *Michael Argenziano

Objective: Atrial fibrillation (Af) is a common complication after cardiac surgery. Our goal was to investigate whether preoperative left ventricular diastolic dysfunction in patients with aortic valve stenosis increases the risk of postoperative Af.

Methods: Patients were those who underwent complete left ventricular diastolic function assessment before aortic valve surgery between January 2009 and December 2015. All had sinus rhythm and no history of Af, a pacemaker, mitral stenosis, or congenital heart disease. Diastolic function was graded using echocardiographic Doppler variables designated as normal, mild (grade I; i.e., impaired relaxation pattern), moderate (grade II; i.e., pseudonormal pattern), or severe dysfunction (grade III; i.e., restrictive filling pattern). Postoperative Af was defined as any episode of Af within 30 days after surgery.

Results: Postoperative Af occurred in 29 of 76 patients (38%). Patients with postoperative Af had greater BSA (25 ± 4 vs 20 ± 5, $p = 0.05$), were more likely to have diabetes ($p = 0.001$), had greater systolic pulmonary arterial pressure ($p = 0.039$), and were more likely to have abnormal diastolic function ($p < 0.0001$). The rate of postoperative Af increased exponentially with diastolic function grade severity ($p = 0.017$). Multivariate analysis indicated diastolic dysfunction as the only independent predictor of postoperative Af (OR: 3.96, $p = 0.037$).

Conclusions: Preoperative left ventricular diastolic dysfunction is a powerful, independent predisposing factor for the initiation of postoperative Af.

33. Utilizing Observed to Expected 30-Day Mortality As a Benchmark for Transcatheter Aortic Valve Replacement Programs: Outliers and Potential Implications for Reimbursement

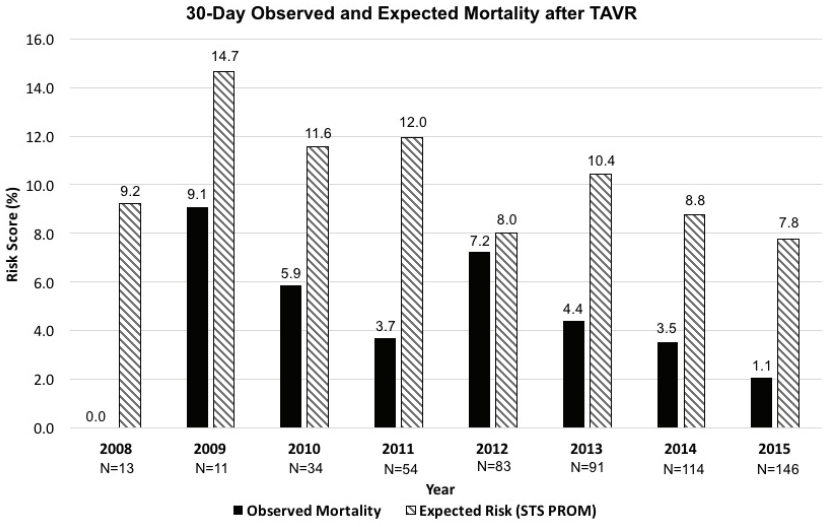
Matthew C. Henn[1], Alan Zajarias[1], Nishath Quader[1], Marc Sintek[1], Brian R. Lindman[1], John M. Lasala[1], Kelly Koogler[1], Marci S. Damiano[1], Puja Kachroo[1], D. Craig Miller[2], Spencer J. Melby[1], *Marc R. Moon[1], *Ralph J. Damiano, Jr.[1], *Hersh S. Maniar[1]

[1]Washington University, Barnes-Jewish Hospital, St Louis, MO; [2]Stanford University Medical School, Palo Alto, CA

Invited Discussant: *Michael E. Halkos

Objective: Observed to expected (OE) mortality is a standard metric by which transcatheter aortic valve replacement (TAVR) trials have been evaluated. Early TAVR trials consistently demonstrated an OE 30-day mortality of less than 0.6 after TAVR when based upon the Society for Thoracic Surgery Predicted Risk of Mortality (STS-PROM). Recent published results from the Transcatheter Valve Therapy registry have demonstrated an OE 30-day mortality of 1.0 after TAVR. Patient selection, site experience, or changes to the STS risk calculator have all been suggested as reasons for the diminished survival benefit seen after commercialization of TAVR. We evaluated our own OE 30-day mortality for TAVR over the past seven years to investigate this issue.

Methods: Data were prospectively collected on TAVR patients from 2008 through 2015 (n = 546) and were retrospectively reviewed. The STS-PROM for patients was calculated and compared to observed mortality. OE 30-day ratios were calculated and compared over a variety of subgroups.



Results: For the entire group (n = 546) the OE ratio for 30-day mortality was 0.4. The OE relationship remained less than 0.5 for low (STS-PROM <4), moderate (STS-PROM 4–8) and high-risk (STS-PROM >8) patients. The OE ratio for 30-day mortality was lowest for transfemoral TAVR patients, (OE = 0.2) and highest for transapical patients (OE = 0.8). The OE 30-day mortality for each year of the study is shown (Figure) and was less than 0.6 for all years with the exception of 2012; a year in which the greatest number of transapical procedures were performed (n = 36). Lastly, OE 30-day mortality remained less than 0.6 for both commercial (OE = 0.5) and clinical trial (OE = 0.3) patients.

Conclusions: The STS-PROM consistently overestimated 30-day mortality after TAVR. Achieving an OE 30-day mortality of less than 0.6, when based upon the STS-PROM, is a realistic goal for all TAVR programs when treating either commercial or clinical trial patients. The Centers for Medicare and Medicaid Services have suggested that centers with inferior results may not be eligible for reimbursement after TAVR. Although an accurate and specific risk calculator for 30-day mortality after TAVR remains to be established, our data suggests that programs with an OE mortality greater than 0.6 based upon the STS-PROM should reevaluate either patient selection or procedural processes in order to obtain optimal patient results and ensure procedural reimbursement.

Late-Breaking Clincial Trial

LB2. Use of a Novel Hemoadsorption Technology to Reduce Plasma Free Hemoglobin During Complex Cardiac Surgery: Results from the Randomized Controlled Safety and Feasibility REFRESH I Trial

*Joseph Zwishenberger[1], *Thomas Gleason[2], *Michael Argenziano[3], *Joseph Bavaria[4], Lauren Kane[5], *Joseph Coselli[6], *Richard Engelman[7], Kenichi Tanaka[8], Ahmed Awad[9], Michael Sekela[1]

[1]University of Kentucky, Lexington, KY; [2]University of Pittsburgh, Pittsburgh, PA; [3]Columbia University, New York, NY; [4]University of Pennsylvania, Philadelphia, PA; [5]University Texas Children's Hospital, Houston, TX; [6]Texas Heart Institute, Houston, TX; [7]Basystate Medical Center, Springfield, MA; [8]Univeristy of Maryland, Baltimore, KY; [9]Cooper University Hospital, Camden, NJ

Invited Discussant: *Frank W. Sellke

3:30 pm – 4:05 pm **Coffee Break in the Exhibit Hall**

34. Propensity and Impact of Autologous Platelet Rich Plasma Utilization in Acute Type A Dissection

Harleen K. Sandhu, Shruti N. Dahotre, Kristofer M. Charlton-ouw, Charles C. Miller, III, Roy K. Sheinbaum, *Hazim J. Safi, *Anthony L. Estrera, Shao Feng Zhou

McGovern Medical School, UTHealth at Houston, Houston, TX

Invited Discussant: *Himanshu J. Patel

Objective: Coagulopathy due to alteration of hemostasis in patients undergoing open repair of acute type A aortic dissection (ATAAD) utilizing cardiopulmonary (CPB) and profound hypothermic circuit arrest (PHCA) is a common complication. Autologous Platelet Rich Plasma (aPRP) is an intraoperative blood conservation technique, which promotes and facilitates hemostasis. A reduction of blood product transfusions has been demonstrated by utilizing this technique during elective aortic surgery. The purpose of this study is to evaluate the effectiveness of aPRP as a blood conservation technique during open surgical repair of type A aortic dissection.

Methods: We review d all ATAAD cases of requiring ascending aorta and transverse arch repair using PHCA. Perioperative transfusion requirements and clinical outcomes were analyzed. The end points analyzed included; early mortality, postoperative stroke, renal dysfunction, prolonged ventilation, coagulopathy and length of postoperative intensive care unit stay. Propensity score was calculated for PRP use and all outcomes were propensity-adjusted.

Results: Between 2003 and 2014, 85/391 ATAAD repairs utilized aPRP. Mean age 58 ± 15 years, 70% were males. Obstructive sleep apnea (22 vs 13%, p = 0.04) and baseline ejection fraction (57 ± 6.7% vs 55 ± 10%, p = 0.014) was higher in aPRP group. Propensity for PRP was influenced by gender, ejection fraction, and obstructive sleep apnea. Intraoperative propensity adjusted blood products (2 units fewer PRBC [p = 0.001], 4 units fewer FFP [p = 0.001], 6 units fewer platelets [p = 0.001], 1.3 units fewer cell-savers [p = 0.002], 5 units fewer cryoprecipitate [p = 0.001]), as well as operative time (13-minutes shorter [p = 0.006]) were significantly reduced by aPRP use. There was significant reduction in postoperative reoperation for bleeding (8% vs 17%, p = 0.046) and transfusion need within 72-hours following aPRP use (2 units fewer PRBC [p = 0.04], 4 units fewer FFP [p = 0.001], 5 units fewer platelets [p = 0.001]). Ventilation time was reduced by 15-hours (p = 0.002) and intensive-care length of stay was reduced by 18-hours (p = 0.05) after intraoperative aPRP use, although no difference in early or overall mortality was seen.

Conclusions: Utilization of aPRP in patients undergoing open repair of ATAAD was associated with a significant reduction in perioperative blood transfusions and early postoperative morbidity.

35. Partial Thromboplastin Time Is More Predictive of Bleeding than Heparin Levels in Heparinized Pediatric Patients Following Cardiac Surgery

Olubunmi Oladunjoye, Asha Nair, Lynn Sleeper, Christina VanderPluym, John Kheir, ◆Sitaram Emani

Boston Children's Hospital, Boston, MA

Invited Discussant: *David M. McMullan

Objective: Anticoagulation with unfractionated heparin (UFH) following pediatric cardiac surgery may be monitored using either partial thromboplastin time (PTT) or unfractionated heparin level (UFHL). However, correlation between clinical outcomes of bleeding or thrombosis and laboratory values has not been established. We sought to determine the correlation between bleeding events and PTT and UFHL in patients undergoing anticoagulation after cardiac surgery.

Methods: A prospective observational study was performed on 175 consecutive patients who received UFH after cardiac surgery over a 3-month period. Patients were excluded if they required extracorporeal membrane oxygenation (ECMO). Patients were classified into those receiving UFH>10 U/kg/hr (Group 1) and those receiving UFH ≤ 10 U/kg/hr (Group 2). Primary outcome was major bleeding event, defined as bleeding requiring blood transfusion or surgical exploration. Highest PTT and UFHL within 24 hours prior to the event and highest values obtained on non-bleeding days were used for analysis. Statistical analysis was performed using Poisson regression and repeated measures (generalized linear model) logistic regression.

Results: Of the 175 patients, 34 patients were in Group 1. By multivariable analysis, patients in Group 1 were 1.80 times more likely to bleed than those in Group 2 ($p < 0.001$). Paired PTT/UFHL values (N-290) obtained from Group 1 patients were compared and 188 (64.8%) were found to be discordant. The most common type of discordance (43.6%) was supratherapeutic PTT value with a subtherapeutic UFHL. Logistic regression showed PTT is significantly associated with the risk of a major bleeding: odds of bleeding increasing 1.27 times for every 20-second increase in PTT ($p = 0.004$). However, the risk of bleeding was not significantly associated with UFHL (OR: 1.15, $p = 0.08$).

Conclusion: The incidence of major bleeding is higher in post-cardiotomy patients receiving UFH >10 units/kg/hr compared to those receiving a lower dose of heparin. Significant discrepancy exists between PTT and UFHL in these patients. Elevated PTT is associated with an increased risk of bleeding, whereas bleeding did not correlate with UFHL. Randomized trials are warranted to determine optimal laboratory method of UFH monitoring in this patient population.

36. Estimation of Achievable Oxygen Consumption Following Transfusion with Rejuvenated Red Blood Cells

Amudan J. Srinivasan[1], Kyle Kausch[2], Collin Inglut[2], Alan Gray[2], Matthew Landrigan[2], Ian J. Welsby[1]

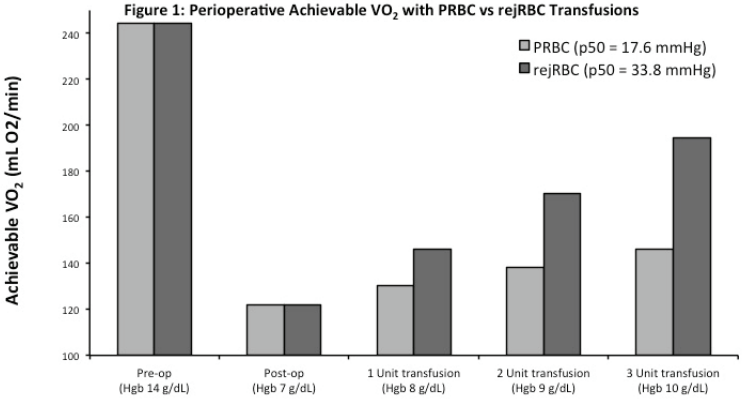
[1]Duke University, Durham, NC; [2]Zimmer Biomet, Warsaw, IN

Invited Discussant: *Richard D. Weisel

Objective: Red cell storage induces a non-physiological increase in hemoglobin-oxygen affinity (quantified by a low p50) which can be restored by biochemical rejuvenation (Szymanski 2001). The objective is to develop a mathematical model to estimate the impact of transfusing up to three standard allogeneic units (PRBCs) or rejuvenated units (rejRBCs) on achievable oxygen consumption (VO_2).

Methods: Oxygen dissociation curves (ODC) (Hemox Analyzer, TCS Scientific) were generated from standard AS-1 PRBC units (n = 5) before and after rejuvenation following manufacturer's instructions using an FDA-approved rejuvenation solution (sodium pyruvate, inosine, phosphates, and adenine). The ODC for each sample was used to determine p50 (the oxygen partial pressure at 50% hemoglobin saturation) and the red cell oxygen release capacity to reflect oxygen consumption (VO_2) (Li 2016). We constructed a mathematical model to determine achievable VO_2 changes after blood loss and transfusion of PRBCs and rejRBCs, assuming a 5 L total circulating blood volume and a cardiac output (CO) of 5 L/min. The model used a postoperative transfusion trigger of 7 g/dL and a transfusion sequence of up to three units to restore the hemoglobin concentration to 10 g/dL.

Results: Rejuvenation increased the p50 from 17.6 ± 1.5 mm Hg (PRBCs) to 33.8 ± 1.5 mm Hg (rejRBCs) ($p < 0.001$). Fresh whole blood had a p50 of 27.8 resulting in a calculated baseline achievable VO_2 of 244 mL O_2/min (Hb 14g/dl) and post-blood loss achievable VO_2 of 122 mL O_2/min (Hb 7g/dl). As illustrated in the Figure, the potential VO_2 was calculated as 146 mL O_2/min after 3 units of PRBCs compared to 195 mL O_2/min after 3 units rejRBCs.



Conclusions: It has been shown that RBC unit age correlates with hemoglobin p50 decreases following pediatric cardiac surgery (Hasan 1994), and that adults undergoing major surgery have significant decreases in 2,3-DPG and p50 that take days to recover (Scott 2016). Previous investigations with high p50 RBCs demonstrated an improved cardiac index, oxygen availability, and a greater arteriovenous content difference (Dennis 1978). The method of rejuvenation used in this study almost doubled the *in vitro* p50 of RBC units stored for 21 days. The transfusion model estimated a 33% improvement in potential VO_2 after a three-unit transfusion with rejRBCs compared to standard PRBCs. Model limitations include assumptions of no additional blood loss after transfusion and that one transfused unit correlated to a 1 g/dL increase in Hb. Although we assumed a constant CO for the data shown in the Figure, the capacity to increase CO after cardiac surgery may be limited. This model shows that maintaining a constant VO_2 after transfusion with 3U PRBCs would require a CO of 8.4L/min whereas transfusion with 3U rejRBC would only require a CO of 6.3 L/min. Transfusing rejRBCs in the setting of a limited CO offers an advance in the perioperative care of the cardiac surgical patient.

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37. The Impact of Prolonged Intensive Care Stay on Quality of Life, Recovery and Clinical Outcomes: A Prospective Study

Mohammad S. Diab[1], Rajdeep Bilkhu[1], Gopal Soppa[1], Oswaldo Valencia[1], Johan Heiberg[2], Colin Royse[2], *Marjan Jahangiri[1]

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Invited Discussant: *Douglas R. Johnston

Objective: To examine the impact of prolonged intensive care unit (ICU) stay on quality of life (QoL), of both physical and mental components, rate of recovery, and morbidity and mortality following adult cardiac surgery.

Methods: 608 consecutive patients (mean age: 69.8 ± 11; 441 [72.4%] males; mean EuroSCORE II 2.9 ± 3.7) undergoing all cardiac surgical procedures, between October 2013 and September 2014, were studied prospectively. Multiple time-point follow-ups were completed at 1, 3, 14 days, and 3, 6, and 12 months. Demographics, comorbidities (Table) and outcomes were collected. QoL data was recorded using Short Form 36 Health-Survey (SF-36®). Rate of recovery in cognitive, emotive, nociceptive, and activities of daily living domains were recorded using the Postoperative Quality of Recovery Scale (PostopQRS®) tool. Prolonged ICU was defined as ≥3 days, with patients divided into 2 groups: Group 1: ICU stay 0–2 days; Group 2: ICU stay ≥ 3 days. Propensity score matching as well as logistic regression analyses were used. The impact of prolonged ICU stay over the specified time points were examined on: QoL, rate of recovery, and survival. Analysis was performed using Kaplan-Meier, repeated measure ANOVA, and Chochran-Mantel-Haenszel test. Binary logistic regression analysis was used to investigate predictors of prolonged ICU.

Results: Follow-up was completed at all time points for 95% of patients as well as at one year for 532 (95%) patients. QoL in both the physical and mental component summary scores were significantly lower in patients with prolonged ICU stay at all follow-ups intervals ($p < 0.01$). The results were similar in the propensity matched groups. Overall recovery scores were lower in the prolonged ICU stay group ($p = 0.02$); however, this did not reach statistical significance in the propensity matched groups ($p = 0.06$). Emotive and activities of daily living domains of recovery were worse in prolonged ICU stay group in both the overall and propensity matched groups ($p = 0.01$ and $p < 0.001$, respectively) at all follow-up intervals. In patients with ICU stay ≥3 days, the occurrence of MACCE ($p < 0.01$), 30-day mortality ($p < 0.01$); acute kidney injury ($p < 0.01$), and length of ward stay (9 ± 7 days vs 24 ± 29 days; $p < 0.01$) were higher compared to the ICU <2 days group. Predictors of prolonged ICU stay were EuroSCORE II >3 (OR: 1.25, 95% CI [1.17–1.34], $p < 0.01$); MI within 30 days (OR: 1.7, CI [1.15–2.52], $p < 0.01$) and cardiopulmonary bypass time >2 hours (OR: 2.34, CI [1.59–3.43], $p < 0.01$]

Table 1. Characteristics and operative details of patients undergoing cardiac surgery

	Overall series			Propensity score-matched pairs		
	0 to 2 days at ICU n = 429	*3 days or more at ICU n = 179*	*P-value*	*0 to 2 days at ICU n = 106*	*3 days or more at ICU n = 106*	*P-value*
Age (years)*	69.0 ± 11.1	71.6 ± 10.6	0.01	70.6 ± 10.2	71.3 ± 10.6	0.61
Male sex, n (%)	309 (84)	134 (73)	0.77	77 (73)	75 (71)	0.36
Body mass index (kg/m²)	28.0 ± 4.6	27.3 ± 5.3	0.09	28.1 ± 4.0	27.6 ± 5.6	0.48
EuroSCORE II*	2.1 ± 2.4	4.8 ± 5.28	<0.01	2.9 ± 3.5	3.4 ± 3.9	0.32
MI within 30 days, n (%)*	137 (32)	77 (43)	0.01	49 (46)	41 (39)	0.15
Left ventricular function, %*	58 ± 9	54 ± 13	<0.01	55 ± 9	56 ± 11	0.57
Left main stem disease, %	81 (19)	34 (19)	0.97	21 (20)	20 (19)	0.71
Atrial fibrillation, n (%)	54 (13)	36 (22)	0.17	19 (18)	21 (20)	0.73
COPD, n (%)*	20 (5)	22 (12)	0.00	5 (5)	12 (11)	0.28
Pulmonary hypertension*						
Mild (25 - 40 mmHg), n (%)	5 (1)	2 (1)	<0.01	1 (1)	2 (2)	0.94
Moderate (41 – 55 mmHg), n (%)	32 (7)	28 (16)		14 (13)	13 (12)	
Severe (> 56 mmHg), n (%)	9 (2)	12 (7)		4 (4)	4 (4)	
Renal disease, n (%)*	34 (8)	35 (20)	<0.01	12 (11)	12 (11)	0.89
Diabetes mellitus, n (%)	112 (26)	43 (24)	0.59	26 (25)	25 (25)	0.70
Type of surgery*						
CABG, n (%)	222 (52)	70 (40)	<0.01	49 (46)	51 (48)	0.96
Valve surgery, n (%)	56 (13)	10 (6)		10 (9)	8 (8)	
Combined procedures, n (%)	20 (5)	6 (3)		5 (5)	5 (5)	
Aortic surgery, n (%)	88 (21)	60 (34)		28 (26)	30 (28)	
Other, n (%)	43 (19)	33 (18)		14 (13)	18 (17)	
Cardiopulmonary bypass time, min*	109 ± 48	143 ± 68	<0.01	123 ± 50	121 ± 52	0.79

Data reported for the overall series of patients and for the propensity score-matched pairs. Data are presented as means ±standard deviations or absolute numbers and percentages of patients.
Variables marked with an asterisk (*) are included in the regression model to calculate propensity scores.
Left main stem disease refers to stenosis of more than 50%, and renal function is defined according to the RIFLE criteria.
IHD, ischemic heart disease; MI, myocardial infarction; COPD, chronic obstructive pulmonary disease; GI, gastrointestinal; LAD, left descending artery; CABG, coronary artery bypass grafting.

Conclusions: Patients with prolonged ICU stay achieve an acceptable overall physical component of QoL and rate of recovery but an inferior mental recovery compared with patients who spend less time on ICU. This study also highlights that ICU stay greater than three days has a higher incidence of morbidity and mortality.

38. Preoperative Beta-Blocker Use Correlates with Worse Outcomes in Patients Undergoing Valve Surgery

Sarah A. Schubert[1], Robert B. Hawkins[1], J. Hunter Mehaffey[1], Clifford E. Fonner[2], Jeffery B. Rich[2], *Alan M. Speir[3], Mohammed Quader[4], *Irving L. Kron[1], Leora T. Yarboro[1], *Gorav Ailawadi[1]

[1]University of Virginia, Charlottesville, VA; [2]Virginia Cardiac Services Outcomes Initiative, Falls Church, VA; [3]Inova Fairfax Hospital, Falls Church, VA; [4]Virginia Commonwealth University, Richmond, VA

Invited Discussant: *Frank A. Baciewicz, Jr.

Objective: Beta-blockers have been shown to decrease postoperative risk of cardiac complications in patients undergoing noncardiac surgery. Moreover, preoperative beta-blocker administration is a quality metric for coronary artery bypass grafting (CABG), although its protective effect has been challenged. We sought to determine the impact of preoperative beta-blocker administration prior to cardiac valve surgery.

Methods: A total of 17,298 patients undergoing isolated valve repair or replacement operations from 2001 to 2016 were extracted from a multi-institutional Society of Thoracic Surgeons (STS) database. Patients were stratified by preoperative beta blocker administration. To account for baseline differences, patients were propensity matched across 40 preoperative variables. The effects of preoperative beta-blockers on risk-adjusted outcomes were assessed by hierarchical regression modeling accounting for STS-predicted risk of mortality, hospital, and year.

Results: Of the 17,298 patients, 58.2% received a preoperative beta-blocker. Unmatched patients who received preoperative beta-blockade had a greater STS Predicted Risk of Mortality (3.3% vs 2.5%, $p < 0.0001$). After 1:1 propensity matching, a total of 11,380 patients were well matched with minimal baseline differences between groups. Within the matched cohort, the unadjusted operative mortality rate was similar between groups (4.0% vs 4.2%, $p = 0.6713$) as well as the rate of major morbidity (19.5% vs 18.6%, $p = 0.1889$). Although the risk-adjusted odds of mortality was not significantly different ($p = 0.3098$) between the groups, preoperative beta-blocker use was associated with greater postoperative major morbidity (OR: 1.13, $p = 0.003$) and other postoperative complications (Table). Specifically, rates of pRBC transfusions (37.6% vs 33.6%, $p < 0.0001$) were increased in the group receiving preoperative beta-blockers, and there was a trend toward increased reoperation for bleeding (3.8% vs 3.2%, $p = 0.07$). Additionally, the rate of postoperative atrial fibrillation was higher in patients receiving preoperative beta-blockers (27.6% vs 23.7%, $p < 0.0001$).

Table 1: Characteristics and outcomes of matched patients receiving beta-blocker and those who did not receive a preoperative beta-blocker prior to valve surgery.

Outcomes	Preoperative beta-blocker (n=5,690)	No preoperative beta-blocker (n=5,690)	p value
STS morbidity or mortality	1178 (20.7%)	1119 (19.7%)	0.1681
Permanent stroke	110 (1.9%)	99 (1.7%)	0.4440
Atrial fibrillation	1570 (27.6%)	1348 (23.7%)	**<0.0001**
Prolonged ventilation	751 (13.2%)	722 (12.7%)	0.4222
Renal failure requiring dialysis*	133 (2.3%)	112 (2%)	0.1813
Transfusion, any	2566 (45.3%)	2459 (43.4%)	**0.0448**
Transfusion, pRBC	1985 (37.6%)	1718 (33.6%)	**<0.0001**
Reoperation for bleeding	216 (3.8%)	181 (3.2%)	0.0746
Readmission	571 (10.4%)	541 (10%)	0.4139
Discharge to facility	1223 (22.6%)	1039 (20%)	**0.0009**

* Renal failure defined as either new dialysis requirement or increase in serum creatinine of >0.5 mg/dl to 3 time baseline or >4mg/dl.

Conclusions: Preoperative beta-blocker administration does not improve outcomes after cardiac valve surgery but instead may increase postoperative morbidity. Patients on preoperative beta-blocker therapy undergoing valve surgery should be carefully evaluated to determine if perioperative beta-blockade is necessary.

5:30 pm **Adjourn**

TUESDAY MORNING, MAY 2, 2017

7:00 am – 8:25 am **AATS/TSRA Preparing Yourself for an Academic Career Breakfast Session** Constitution AB, Sheraton

7:00 am – 8:25 am **Cardiac Surgery Forum** Room 310, Hynes
5 minute presentation, 5 minute discussion
Moderators: *Paul W. Fedak and *Craig H. Selzman

F1. Overexpression of MicroRNA-30a Contributes to the Aortic Dissection via Down-Regulation of Lysyl Oxidase

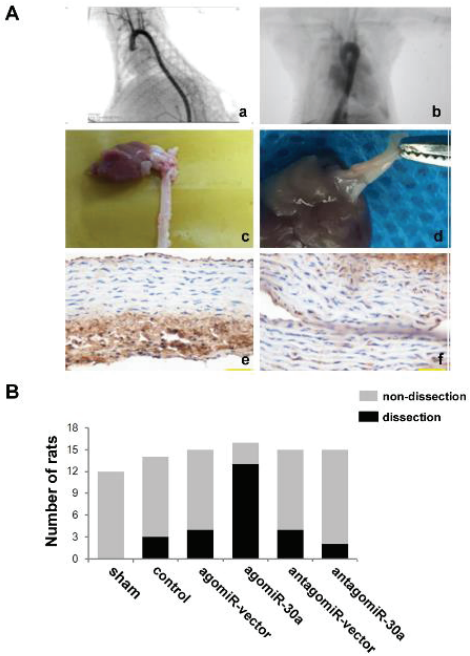
Tianxiang Gu, Yang Yu, Enyi Shi
The First Hospital of China Medical University, Shenyang, China

Invited Discussant: *Leora B. Balsam

Objective: The mechanobiological processes of acute aortic dissection are still not fully understood. As a negative regulator of gene expression by modulating the stability and/or the translational efficiency of target messenger RNAs, microRNAs (miR) may be involved in the development of aortic dissections. Lysyl oxidase (LOX) is essential in the process of forming proper elastic lamellae and collagen fibers and maintaining the functional structure of the aortic media. With the help of bio-informatics-based databases, miR-30a is indicated to be an endogenous regulator of LOX. The current study was conducted to measure the expressions of miR-30a and LOX in patients with acute aortic dissection and explore the possible role of miR-30a in the development of aortic dissections as an endogenous regulator of LOX in cultured aortic smooth muscle cells and a rat model.

Methods: Human aortic specimens of aortic dissections and aortic aneurysms were harvested during operations. Aortic specimens from donors for heart transplantation were used as normal controls. Rat aortic smooth muscle cells were transfected with agomiR-30a or antagomiR-30a by lentivirus vectors *in vitro* and cells incubated with vehicle were used as controls. SD rats were pretreated with lentivirus vectors containing agomiR-30a or antagomiR-30a (5×10^7 TU/every 3days intravenous infusion, for 4 weeks), whereas vehicle were infused to the control rats. Acute aortic dissection was induced by subcutaneous infusion of AngII (1μg/kg/min for 24 h) and was evaluated by angiography and autopsy. Histologic examination was performed for human and rat aortic specimens. Expressions of LOX, elastin and miR-30a were measured in cultured aortic smooth muscle cells, human and rat aortic specimens by western blot and quantitative real-time polymerase chain reaction.

Results: Expression of miR-30a of patients with aortic dissections was much higher than that of normal controls ($P < 0.01$), whereas expressions of LOX and elastin of patients with aortic dissections were significantly lower ($P < 0.01$, respectively). Transfection of agomiR-30a markedly down-regulated the luciferase activity of LOX in rat aortic smooth muscle cells of wild type but not in cells of LOX-3'UTR mutant. In cultured rat aortic smooth muscle cells, transfection of agomiR-30a dramatically enhanced the expression of miR-30a and down-regulated the expressions of LOX and elastin ($P < 0.01$ vs controls, respectively). Pretreatment with agomiR-30a also enhanced the expressions of miR-30a and down-regulated the expressions of LOX and elastin in rat aortas. Compared with control animals, the radio of dissection in rats pretreated with agomiR-30a was much higher ($P < 0.01$).



Conclusions: Overexpression of miR-30a contributes to the development of aortic dissection, possibly by down-regulation of LOX.

F2. Circulating Endothelial Specific Exosome Profiles Enable Noninvasive Diagnosis of Aortic Aneurysm Disease

Laxminarayana Korutla[1], Andreas Habertheuer[1], Sanjana Reddy[1], Eric Lai[1], *Joseph Bavaria[1], Reed Pyeritz[1], Giovanni Ferrari[1], Antonio Frasca[1], Sudhish Sharma[2], Sunjay Kaushal[1], Kariana Milewski[1], Prashanth Vallabhajosyula[1]

[1]University of Pennsylvania, Philadelphia, PA; [2]University of Maryland, Baltimore, MD

Invited Discussant: *Gorav Ailawadi

Objective: There is a critical need for development of biomarker platforms for non-invasive diagnosis and monitoring of aortic aneurysm disease. Exosomes are tissue specific nanoparticles carrying protein and RNA cargoes that are released by many tissue types, including endothelial cells, in a condition specific manner into the circulation. We hypothesized that the endothelial cellular pathophysiology associated with aortic aneurysm disease would be reflected in their exosomes released into circulation. Therefore, profiling of plasma endothelial specific exosomes and their cargoes would serve as a noninvasive biomarker for aortic aneurysm disease. We studied this novel concept in the context of ascending aortic aneurysm disease.

Methods: Presurgical plasma samples from patients with ascending aortic aneurysm disease (Aneurysm group (n = 35): Marfan syndrome n = 25, bicuspid aortic valve syndrome n = 10), and control subjects without aortic disease (Control group, n = 20) were obtained from institutional biobank and NIH GenTAC registry. Plasma exosomes were isolated by chromatography and ultracentrifugation, and endothelial specific exosomes (ESEs) from the total plasma pool were characterized on nanoparticle detector using endothelial specific surface marker, VE-cadherin. Protein and RNA cargoes of ESEs were profiled using hybrid mass spectrometry and microarray profiling.

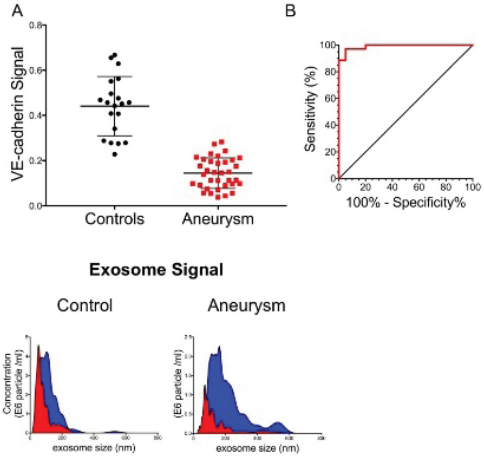


Figure 1. Circulating endothelial specific exosome profiles predict aortic aneurysm disease. (A) Scatter plot of VE-cadherin positive exosome signal, representing ESEs, is shown for Aneurysm and Control groups. ESE signal was significantly lower in the Aneurysm group patients ($p=2x10^{-15}$). Representative exosome signal plots for Aneurysm and Control groups are shown below (red: ESE signal, blue: total plasma exosome signal). (B) Receiver operating characteristic curve for ESE signal showed area under curve of 0.99±0.01, with sensitivity of 97% and specificity of 95%.

*AATS Member ◆AATS New Member

Results: ESE signal was reliably detected in all Control group patients (mean: 0.44 ± 0.13). But in Aneurysm group patients the ESE signal was significantly decreased compared to the control subjects (mean: 0.14 ± 0.07, $p < 0.000001$) (Figure 1A). Receiver operating characteristic curve showed that ESE signal threshold of ≤0.2741 predicts aneurysm disease with a sensitivity of 97% and specificity of 95% (area under curve 0.99 ± 0.01) (Figure 1B). Proteomic and microRNA cargoes of ESEs were also markedly altered between the two groups. Hybrid mass spectrometry and microarray profiles of ESE proteins and microRNAs from Marfan syndrome aneurysm samples versus Control showed differential regulation of multiple proteins and microRNAs. Pathway analysis showed that microRNAs enriched in Marfan aneurysm ESEs were associated with connective tissue disorders. Further, Marfan aneurysm ESEs (n = 5) showed significantly decreased angiogenesis potential compared to Control ESEs (n = 5) on endothelial tube formation assay ($p = 0.04$).

Conclusions: Circulating endothelial specific exosome profiling enables noninvasive diagnosis of aortic aneurysm disease with high accuracy. Pathway analysis of ESE cargoes and their differential effects on endothelial cell angiogenesis suggest a functional role for ESEs in aneurysmal pathophysiology. These findings warrant a larger investigation into the diagnostic and functional implications of plasma ESEs in aneurysm biology.

F3. Model Bicuspid Aortic Valve by Knocking Out NOTCH1 Gene in Patient's Induced Pluripotent Stem Cells with CRISPR/Cas9

Bo Yang[1], JIao Jiao[2], Weihua Tian[3], Ping Qiu[1]

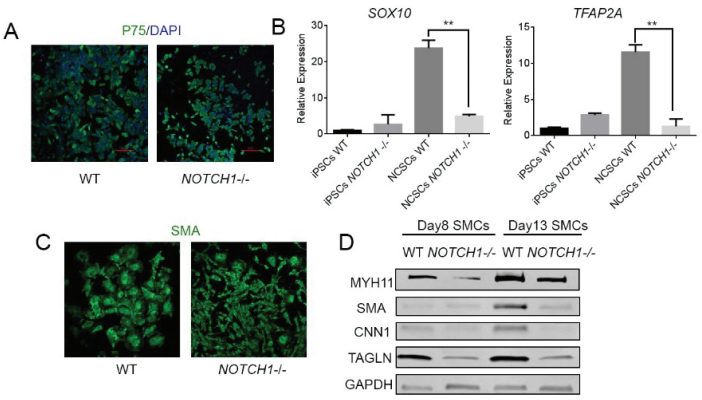
[1]University of Michigan, Ann Arbor, MI; [2]Ganlee Corp, Beijing, China; [3]University of Copenhagen, Copenhagen, Denmark

Invited Discussant: *Paul W. Fedak

Objective: The mechanism of thoracic aortic aneurysm in bicuspid aortic valves (BAV) is unknown. The *NOTCH1* gene mutation is the first gene mutation identified in BAV patients' families. It is desired to know whether *NOTCH1* mutation is related to thoracic aortic aneurysm formation in BAV patients.

Methods: Induced pluripotent stem cells (iPSCs) were derived from a patient's mononucleocytes isolated from the patient's blood, who had a normal tricuspid aortic valve and normal aorta, with an episomal vector containing *OCT4, SOX2, C-MYC, and KLF4*. The *NOTCH1* gene was targeted in iPSCs with CRISPR/Cas9 with *NOTCH1* sgRNA, whose sequence is GAGGTGGCTGCGCAGCGACAAGG. Transfected iPSCs were subcloned and targeted site of *NOTCH1* was amplified from each clone and sequenced. After confirmation of the knockout of the *NOTCH1* gene, the *NOTCH1*$^{-/-}$ and isogenic control iPSCs were differentiated into neural crest stem cells (NCSCs) with 3 μM CHIR99021, 10 μM SB481542 and 200 ng/mL Noggin, and cardiovascular progenitor cells (CVPCs) with 25ng/mL BMP4 and 6μM CHIR99021. The NCSCs were then treated with 2 ng/mL TGF-β1 to differentiate into smooth muscle cells (SMCs). The CVPCs were cultured in endothelial cell medium containing 50 ng/mL VEGF to differentiate into endothelial cells (ECs). The mRNAs expression of cell specific genes was examined with quantitative PCR (qPCR). The corresponding protein levels were detected by Western blotting, immunostaining and flow cytometry.

Results: The *NOTCH1*$^{-/-}$ iPSC clone was selected from screening by Sanger sequencing. The undetectable expression of *NOTCH1* in *NOTCH1*$^{-/-}$ iPSCs and NCSCs was confirmed by Western blotting. The expression of neural crest stem cell markers (*SOX10* and *TFAP2A)* was significantly lower in *NOTCH1*$^{-/-}$ NCSCs than wildtype NCSCs. The SMCs derived from *NOTCH1*$^{-/-}$ NCSCs showed obviously immature morphology with smaller size and decreased expression of SMC contractile protein, including smooth muscle cell myosin heavy chain 11, actin, calponin and SM22α by Western blot at differentiation day 8 and day 13. In *NOTCH1*$^{-/-}$ CVPCs, the expression of *ISL1, NKX2*.5 and MYOCD was significantly lower than that in isogenic control CVPCs by qPCR, indicating impaired differentiation from iPSCs to CVPCs. Furthermore, the *NOTCH1*$^{-/-}$ ECs derived from CVPCs demonstrated significantly lower expression of CD105 and CD31 in both mRNA and protein level, indicating a defective differentiation process.



Conclusion: Taken together, our results indicated that *NOTCH1* is critical in SMC and EC differentiation from iPSCs through NCSCs and CVPCs respectively. A *NOTCH1* mutation may cause thoracic aortic aneurysm in BAV by affecting the differentiation of SMCs.

F4. Donor Heart Specific Exosome Profiling enables Noninvasive Monitoring for Early Allograft Rejection in a Mouse Heterotopic Heart Transplantation Model

Andreas Habertheuer, Susan Rostami, Laxminarayana Korutla, Sanjana Reddy, Brigitte Köberlein, Ali Naji, Prashanth Vallabhajosyula

University of Pennsylvania, Philadelphia, PA

Invited Discussant: *Pavan Atluri

Objective: In heart transplantation, there is a critical need for biomarker development for noninvasive monitoring of allograft rejection. Exosomes are nanoparticles released into the circulation in a condition specific manner by many tissue types, including cardiac myocytes. We hypothesized that rejection would lead to early changes in exosomes released by donor heart, and therefore, its profiling would constitute a noninvasive biomarker for monitoring rejection. We studied this novel concept in a mouse heterotopic heart transplant model.

Methods: There were two study arms: Rejection and Maintenance. In Rejection arm, Balb/c (H2-K^d strain) hearts were transplanted heterotopically into C57BL/6 (H2-K^b strain) mice across full major histocompatibility complex (MHC) mismatch, which leads to acute rejection with allograft asystole by day 10–14. In Maintenance arm, Balb/c hearts were transplanted into C57BL/6 SCID (B6.CB17-Prkdc^{scid}/SzJ) immunodeficient recipients, which accept allografts over long term. Recipients were sacrificed (5–8 animals per time point for Rejection arm, 4 per time point for Maintenance arm) and their plasma harvested for exosome analysis at following time points post-transplant: pre-transplant, day 1, 2, 3, 4, 5, 7, 9, 11, 15, and 30 (62 animals in Rejection arm; 28 animals in Maintenance arm). As exosomes express identical MHC profile as their tissue counterparts, donor heart exosome signal was profiled using anti-H2-K^d antibody-quantum dot on nanoparticle detector. Time specific differences in exosome signal within group were calculated using Student's t-test and ANOVA.

Results: In Maintenance arm, cardiac allografts were functional at all time points, without any rejection by clinical exam and histology (Figure). Donor heart exosome signal was detectable in all recipients starting day 1 and remained stable through all time points (Figure 1; p = 0.54 by ANOVA). In the Rejection arm, donor heart exosome signal was also detectable in recipients by day 1 compared to pre-transplant control ($p < 0.0001$), but the signal significantly decreased by day 2 ($p = 0.0002$), continuing into day 3 ($p < 0.0001$), and then remaining low through the rejection process (Figure). By clinical exam, median time for allograft failure was day 11. Histology for days 1, 2, and 3 showed no allograft rejection without any CD3 T cell infiltration (Figure). A signal threshold of ≤0.259 was 100% sensitive and specific for predicting rejection.

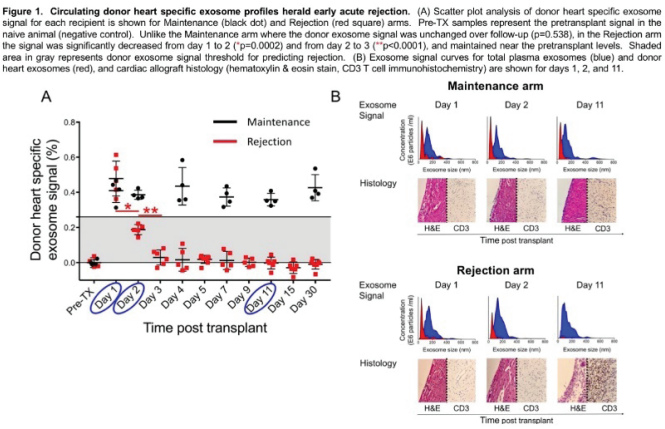


Figure 1. Circulating donor heart specific exosome profiles herald early acute rejection. (A) Scatter plot analysis of donor heart specific exosome signal for each recipient is shown for Maintenance (black dot) and Rejection (red square) arms. Pre-TX samples represent the pretransplant signal in the naive animal (negative control). Unlike the Maintenance arm where the donor exosome signal was unchanged over follow-up (p=0.538), in the Rejection arm the signal was significantly decreased from day 1 to 2 (*p=0.0002) and from day 2 to 3 (**p<0.0001), and maintained near the pretransplant levels. Shaded area in gray represents donor exosome signal threshold for predicting rejection. (B) Exosome signal curves for total plasma exosomes (blue) and donor heart exosomes (red), and cardiac allograft histology (hematoxylin & eosin stain, CD3 T cell immunohistochemistry) are shown for days 1, 2, and 11.

Conclusion: Transplanted heart releases donor MHC specific exosomes into recipient circulation that can be reliably tracked and characterized noninvasively. Donor specific exosome profiles herald early acute rejection, well before histological and clinical manifestations. Transplant heart specific exosome characterization has potential to serve as a novel noninvasive biomarker platform for monitoring cardiac allograft rejection.

F5. Angiogenesis and Arteriogenesis Precede Cardiomyocyte Migration in the Regeneration of Mammalian Hearts

Arnar B. Ingason, Andrew B. Goldstone, Michael J. Paulsen, Bryan B. Edwards, Anahita Eskandari, Vi Truong, Alexandra T. Bourdillon, Tanner Bollig, Amanda N. Steele, *Y. Joseph Woo

Stanford University, Stanford, CA

Invited Discussant: Bradley G. Leshnower

Objective: Although the capacity for the mammalian heart to fully regenerate is debated, its potential to extensively repair itself is gaining support. We hypothesized that mammlian heart regeneration relies upon rapid angiogenesis to support myocardial regrowth. We sought to develop a distinct timeline for angiogenesis and cell proliferation in regenerating mammalian hearts as well as confirm its transient regenerative potential.

Methods: CD-1 mice 1-day after birth (P1, N = 60) underwent either apical resection or sham surgery. Hearts were explanted at serial time points from day 0 through day 30 post-resection and examined with immunohistochemistry to visualize vessel ingrowth and cardiomyocyte migration into the resected region. To label proliferating cells within the heart, EdU injections were performed 12 hours before explant; EdU positive cells were counted in both the apex and remote areas of the heart. Fibrosis and scar formation was assessed with Masson's trichrome staining.

Results: Hearts of animals undergoing apical resection regenerated with minimal fibrosis by 30 days post-resection (dpr) (Figure A). From 3 dpr to 14 dpr, apical resection stimulated proliferation of pre-existing cardiomyocytes in both the periapical and remote regions of the heart to significantly greater levels than that of sham animals (Figure B). Migrating capillaries were observed within the apical thrombus as early as 2 days post-resection (dpr), and mature arteries—characterized by a surrounding layer of smooth muscle cells—developed within the thrombus by 5 dpr. As evidenced by lectin injection, blood vessels within the thrombus were not perfused until 5 dpr. When quantified, the capillary density ($p < 0.001$), maximal vessel diameter ($p = 0.02$), and arterial density ($p = 0.05$) significantly increased within the resected region over 21 days (Figure C). Vessel ingrowth always preceded cardiomyocyte migration, and the majority of the processes of migrating cardiomyocytes coaligned with ingrowing vessels (Figure D).

Conclusion: Endothelial cells invade the apical thrombus early after resection and develop into functional, mature arteries that precede cardiomyocyte ingrowth during mammalian heart regeneration. The endogenous neonatal response emphasizes the importance of rapid and robust angiogenesis required for remuscularization.

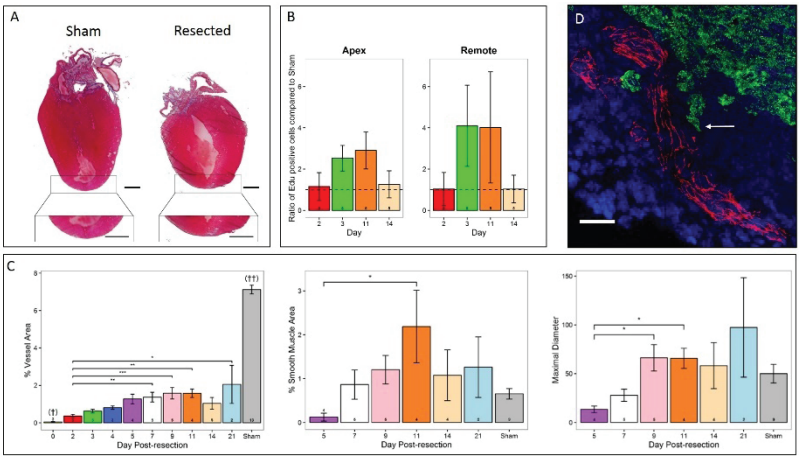


Figure. A) Masson's trichrome staining of resected and sham-operated hearts at 30 dpr. Neonatal hearts regenerated with minimal fibrosis following apical resection. Scale bar represents 1 mm. **B)** Ratio of EdU positive cells in apex and remote area compared to sham operated hearts. **C)** Representative image of the regenerating apex 7 dpr. Vessel ingrowth preceded cardiomyocyte migration with the majority of cardiomyocyte processes travelling along vessels (arrow). Blue = DAPI, green = α-actinin, red = SMA. Scale bar represents 25 μm. **D)** Vascular density, arterial density and maximal diameter all increased significantly over the time period. All data are presented as mean ± SEM. * = p<0.05, ** = p<0.01, *** = p<0.001.

F6. Regeneration of a Neoartery Through a Completely Autologous Acellular Conduit in a Minipig Model

Xuefeng Qiu[1], Tao Wang[2], Sze Yue Wong[3], Wen Zhao[4], ◆Nianguo Dong[2], Song Li[1]

[1]University of California, Los Angeles, CA; [2]Huazhong University of Science and Technology, Wuhan, Hubei Province, China; [3]University of California, Berkeley, CA; [4]Northwestern Polytechnical University, Xi'an, Shaanxi, China

Invited Discussant: *Kenneth G. Warner

Objective: To regenerate a neoartery *in situ* from an autologous acellular conduit produced by *in vivo* vascular tissue engineering in a minipig model.

Methods: Teflon tubing molds (diameter 3.9 mm) were implanted into the subcutaneous pouches in the abdominal wall of minipigs. At 4 weeks, the implants were removed and the outer tubular connective tissue layers were detached from the Teflon tube mandrel. These autologous semi-finished vascular grafts were decellularized in a series of detergents to leave only the extracellular matrix, followed by conjugation with heparin. Histological analysis and mechanical testing were performed before and after decellularization. Eight autologous acellular conduits were transplanted as interposition grafts into the left common carotid artery of the same minipig in which they were grown, and were harvested at 1 month (n = 5) and 2 months (n = 3) for histological analysis after detecting blood flow and patency using Doppler ultrasound.

Results: At 4 weeks, autologous connective tissue tubes were formed well around the Teflon tubing molds and could be easily harvested with little adhesion. Fibroblasts were the dominant cells in the connective tissue tubes. Histological analysis indicated that decellularization by 3-[(3-cholamidopropyl) dimethylammonio]-1-Propanesulfonate (CHAPS) left extracellular matrix proteins like collagen but not elastin, while successfully removing cells when comparing samples before and after decellularization. The decellularization process did not significantly alter the ultimate tensile strength (3.16 ± 0.30 MPa vs 2.41 ± 0.22 MPa), burst pressure (3696.2 ± 194.1 mmHg vs 3157.4 ± 216.7 mmHg) and the suture retension (4.97 ± 0.55 N vs 3.94 ± 0.46 N). There were no significant difference ($P > 0.05$) in mechanical properties between non-decellularized and decellularized tissue conduits (n = 6). The patency rate was 100% (5/5) at 1 month and 66.7% (2/3) at 2 months. Histological staining confirmed successful cell infiltration, and collagen and elastin deposition in 2-month samples. A monolayer of endothelial cells was observed along the inner lumen, whereas smooth muscle cells were dominant in the graft wall.

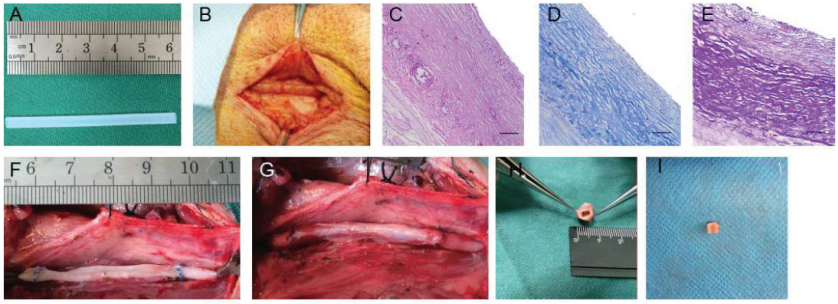


Figure 1. *In situ* regeneration of a neoartery through a completely autologous acellular conduit. (A) Teflon tubing mold before implantation. (B) The gross appearance of the autologous connective tissue tube before explantation. (C) H&E staining for the autologous acellular conduit after decellularization with a loss of nuclei. Histology of the autologous acellular conduit by Masson's trichrome staining (D) demonstrating preservation of collagen (blue) throughout the matrix, and Verhoeff's staining (E) demonstrating no elastin throughout the matrix. Scale bars: 25 μm. (F-G) The autologous acellular conduit was transplanted as an interposition graft into the the left common carotid artery of the same minipig in which it was grown. (H, I) The samples were explanted at 1, 2 months respectively.

Conclusions: A completely autologous acellular conduit can be remodeled into a neoartery in a minipig model. This proof-of-concept study in the large animal model is very encouraging and indicates that this is a highly feasible idea worthy of further study in nonhuman primates before clinical translation.

F7. Prolonged Treatment with S-Nitroso Human Serum Albumin Is More Effective and Prevents Inflammatory and Oxydative Effects Compared to Inhaled Nitric Oxide in Experimental Congenital Pulmonary Arterial Hypertension

Alessio Rungatscher[1], Seth Hallström[2], Daniele Linardi[1], Livio San Biagio[1], Christine Renate Rossmann[2], ◆Giovanni Battista Luciani[1], *Giuseppe Faggian[1]

[1]University of Verona, Verona, Italy; [2]Medical University of Graz, Graz, Austria

Invited Discussant: *James S. Tweddell

Objective: Inhaled nitric oxide (iNO) is approved for use in persistent pulmonary hypertension of the newborn but its toxicological effects including lung inflammation and oxidative damage are well known. We have previously reported that intravenous S-nitroso human serum albumin (S-NO-HSA) has superior hemodynamic effects than iNO in pulmonary hypertension. The present study aimed to compare the chronic overall hemodynamic and inflammatory and oxidative stress effects of intravenous S-NO-HSA infusion and iNO in a chronic left-to-right shunt-induced pulmonary arterial hypertension model.

Methods: Rats with chronic exposure to left-to-right shunt by surgical creation of aorto-caval fistula (Qp/Qs> 2.0) developed pulmonary arterial hypertension. After 20 weeks, they were randomly treated with iNO (20 ppm; n. 30) or S-NO-HSA (0.5 µmol/kg/h; n. 30) or for 24 hours.

Results: Both S-NO-HSA and iNO led to a significant reduction in right ventricular afterload expressed by effective pulmonary arterial elastance (Ea) (from 1.4 ± 0.2 to 0.6 ± 0.2 and 0.4 ± 0.1, respectively; $P < 0.001$). Only S-NO-HSA significantly improved right ventricle diastolic function (slope of end-diastolic pressure-volume relation) and contractility indicated by end-systolic elastance (Ees). Therefore, significant increase in the efficiency of ventricular-vascular coupling (Ees/Ea) occurred after S-NO-HSA but not iNO treatment. S-NO-HSA compared to iNO improved right ventricle phosphocreatine content and myocardial energy charge. Nitrotyrosine (marker of peroxynitrite-mediated reactions), TNF-α, IL-1, expression of nitric oxide synthases 2 and apoptosis were increased in right ventricle and lung tissue in rats treated with iNO but not S-NO-HSA. Furthemore lung wet/dry ratio was higher in iNO treated rats with higher degree of perivascular inflammation.

Conclusions: Prolonged treatment with S-NO-HSA is more effective than iNO in pulmonary hypertension with improvement in right ventricle diastolic and systolic function and right ventricular-arterial coupling and with a positive effect on energetic reserve in myocardium. Moreover S-NO-HSA does not produce inflammatory and oxidative effects caused by iNO.

8:25 pm Adjourn

7:00 am – 8:25 am **General Thoracic Surgery Forum** Room 306, Hynes
5 minute presentation, 5 minute discussion

Moderators: *Marc DePerrot and *Harvey I. Pass

F8. Therapeutic Targeting of Tumor-Promoting Macrophages in EGFR Mutant Lung Adenocarcinoma with Trabectedin

Hyun-Sung Lee, David Yoon, Yanlan Dong, Hee-Jin Jang, Jignesh Patel, Ori Wald, *David J. Sugarbaker, Bryan M. Burt

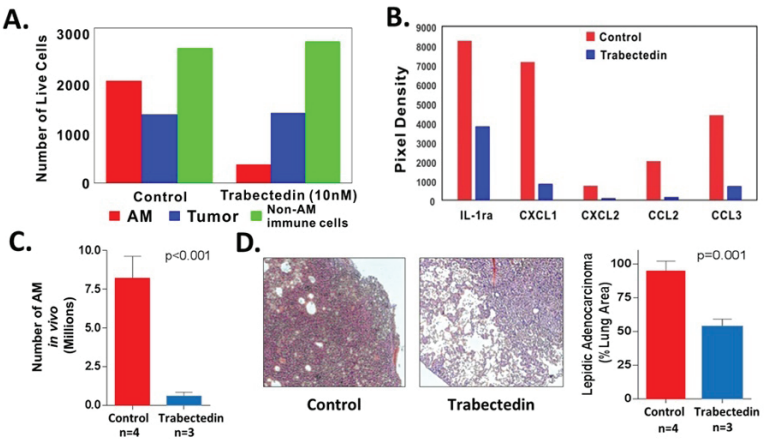
Baylor College of Medicine, Houston, TX

Invited Discussant: *David S. Schrump

Objective: EGFR mutant NSCLC is an increasingly recognized variant of lung cancer. Whereas these tumors are initially susceptible to therapy with targeted EGFR inhibitors, virtually 100% of patients will progress through these drugs, and improved systemic therapy is required to impact the survival of these patients. We have recently discovered that initiation and progression of EGFR mutant lung adenocarcinoma is driven by alveolar macrophages (AMs). We hypothesized that targeting AMs by the novel, recently FDA-approved immunotherapeutic, Trabectedin, believed to initiate apoptosis in tumor-associated macrophages, would facilitate potent antitumor immunity in this disease.

Methods: We utilized a genetically engineered bi-transgenic mouse model of EGFR mutant lung adenocarcinoma in which mice express a lung-specific mutant human EGFR gene governed by a tetracycline operator promoter that is activated by doxycycline administration. Flow cytometry was used to test the specificity of Trabectedin in targeting AM (CD45+F4/80+CD11c+Ly6G–) *in vitro* and *in vivo*. Multiplex protein detection assays were used to quantify changes in the cytokine/chemokine milieu in response to this drug. Trabectedin (3 mg i.v.) was delivered to tumor-bearing mice once per week for 3 weeks and tumor burden was quantified by H&E staining by measuring the area of lung that was involved by lepidic adenocarcinoma.

Results: Culture of single lung cell suspensions from tumor-bearing mice with Trabectedin for 24 hours resulted in significantly decreased numbers of AM without effecting the number of other lung immune cells (CD45+F4/80-CD11c- cells) or the number of tumor cells (CD45-EGFR+ cells) (Figure A). The addition of Trabectedin to the cultures of lung cells isolated from tumor-bearing mice resulted in decreased production of cytokines and chemokines involved in macrophage recruitment and activation including IL-1ra, CXCL1, CXCL2, CCL1, and CCL2 (Figure B). To determine if Trabectedin had an effect on AM *in vivo*, tumor-bearing mice were treated systemically with this agent. Trabectedin resulted in significant depletion of the absolute number of AM *in vivo*, compared with untreated tumor-bearing animals (Figure C). Histologic evaluation of the lungs of tumor-bearing mice receiving Trabectedin revealed a significant decrease in tumor burden compared with untreated mice (Figure D).



Conclusions: Trabectedin is a novel immunotherapeutic agent that specifically targets and depletes tumor-promoting macrophages in EGFR mutant lung adenocarcinoma and mitigates tumor progression in this disease. These data provide rationale for further study of macrophage targeting immunotherapy in EGFR mutant NSCLC.

F9. A Tumor Immune Microenvironment Signature Predicts Response to Immune Checkpoint Blockade in Malignant Pleural Mesothelioma

Hyun-Sung Lee, Hee-Jin Jang, David Yoon, Yanlan Dong, Jignesh Patel, Ori Wald, Thomas M. Wheeler, Veronica V. Lenge De Rosen, Jun Zhang, *David J. Sugarbaker, Bryan M. Burt

Baylor College of Medicine, Houston, TX

Invited Discussant: *Raphael Bueno

Objective: Immune checkpoint inhibitors are changing the landscape of treatment for patients with solid tumors. Malignant pleural mesothelioma (MPM) is an aggressive tumor of the pleura with dismal prognosis, and for which effective systemic therapy is needed to meaningfully impact survival. Early experience with checkpoint blockade immunotherapy in MPM suggests that some patients have striking responses to these drugs, and some patients do not. We hypothesized that a signature characterizing the tumor immune microenvironment (TiME) could predict response to immune checkpoint inhibitors in MPM.

Methods: Time-of-Flight Mass Cytometry (CyTOF) using 35 antibodies was performed on the tumors of 12 MPM patients to comprehensively characterize TiME (Figure A) into cohorts with favorable and unfavorable immune characteristics. mRNA transcriptome arrays and mass spectrometry were performed to develop a clinically relevant gene signature that represented each cohort. This signature was tested for its ability to predict response to checkpoint inhibitor therapy in a mouse MPM subcutaneous tumor model (AB1 cell line, GSE63557), and in 9 patients with

unresectable MPM. This signature was then validated in a cohort of advanced melanoma patients undergoing checkpoint blockade (GSE78220).

Results: Unsupervised clustering of CyTOF data identified two distinct subsets with immunogenic or immunotolerant characteristics (Figure B). The immunogenic (good TiME) cohort contained more partially exhausted tumor-infiltrating cytotoxic T cells (CD45+CD3+CD8+PD1+CTLA4+) (known to respond favorably to immunotherapy), more activated plasmacytoid dendritic cells (pDCs), and more HLA-DR positive tumor cells than the immunotolerant (bad TiME) cohort. In contrast, the bad TiME cohort contained more regulatory T cells, naïve T cells, and more cancer stem cells (CD45-panCK-CD200-CD44+CD24+EPCAM+). Based upon these data, we developed a TiME signature of 139 genes whose expression at both the mRNA and protein level was differentially expressed between good and bad TiME cohorts (Figure B). In the mouse MPM model, the good TiME pattern of gene expression identified responders to anti-CTLA4 therapy (AUC = 0.99, $p < 0.001$) (Figure C). In 9 patients with unresectable MPM whom we treated with anti-PD1 therapy, the good TiME cohort strongly correlated with dramatic responses ($P = 0.016$; Figure D). The applicability of this signature to other tumor types was the tested in a cohort of patients with advanced melanoma who were treated with anti-PD1 therapy, where the TiME signature predicted response to therapy (AUC = 0.8, $p = 0.01$).

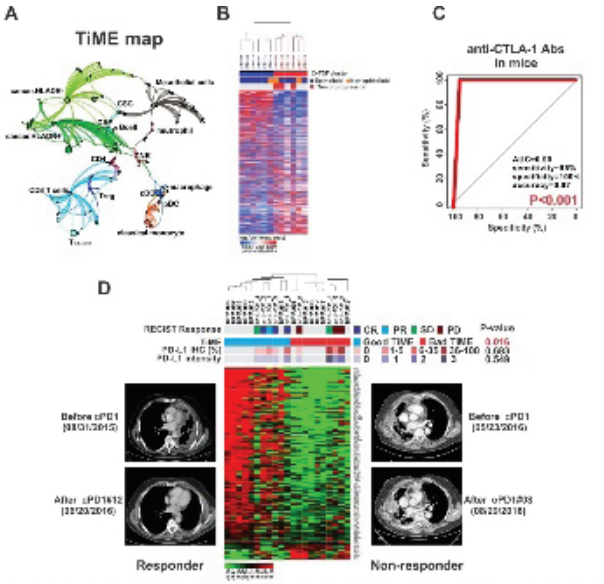


Figure 1. A Tumor Immune Microenvironment Signature Predicts Response to Immune Checkpoint Blockade in Malignant Pleural Mesothelioma.
A. A schematic map of tumor immune microenvironment (TIME) in MPM. B. Heatmap of unsupervised clustering of CyTOF cells. C. Receiver Operating Characteristic (ROC) curve of TiME signature to predict the response to anti-CTLA4 therapy in mouse MPM model. D. Prediction of response to anti-PD1 therapy in MPM patients treated with anti-PD1 blockade and their CT findings. Tumor volumes in chest CT before and after the treatment are measured to decide tumor response.

Conclusions: Dissection of the tumor immune microenvironment in MPM can provide insight into response to immune checkpoint inhibitors. The TiME signature has promise in appropriately selecting patients with a high likelihood of achieving a clinical response to immune checkpoint blockade.

F10. Asbestos Up-Regulates EZH2 to Mediate Epigenetic Repression of the INK4a/ARF Gene Locus in Normal Human Mesothelial Cells

Eden C. Payabyab, Sichuan Xi, David M. Straughan, Emily S. Reardon, Mary Zhang, Julie A. Hong, R. Taylor Ripley, Chuong D. Hoang, *David S. Schrump

National Cancer Institute, Bethesda, MD

Invited Discussant: *Prasad Adusumilli

Objectives: The INK4a/ARF gene locus (chromosome 9.p21–22) encodes two proteins (p16INK4a and p14ARF) via different promoters and alternative splicing which are critical mediators of Retinoblastoma (Rb) and p53 tumor suppressor pathways governing cell cycle progression, senescence and apoptosis. Whereas the majority of MPM exhibit loss of p16INK4a and p14ARF, the mechanisms and timing of INK4A/ARF silencing during mesothelioma development have not been fully elucidated. In the present study, an *in vitro* model was utilized to characterize the effects of asbestos on p16INK4a/p14ARF expression in normal mesothelial cells.

Methods: Normal human mesothelial cells (LP9 and LP3) were cultured in normal media with or without crocidolite asbestos fibers (1 ug/cm^2 or 2 ug/cm^2) for up to 10 days. Messenger RNA, microRNA (miR) and protein levels were assessed by qRT-PCR and immunoblot techniques. Methylation-specific PCR, pyrosequencing, and quantitative chromatin immunoprecipitation (q-ChIP) techniques were used to correlate changes in gene expression with epigenetic alterations in the respective promoters.

Results: Asbestos mediated time and dose dependent repression of p16INK4a as well as p14ARF in normal mesothelial cells; this phenomenon coincided with up-regulation of DNA methyltransferase 1 (DNMT1) as well as increased expression of EZH2, the catalytic core component of Polycomb Repressive Complex-2 (PRC2), which previously has been shown to be an epigenetic driver of malignancy in pleural mesotheliomas. Up-regulation of EZH2 coincided with repression of miR26A and miR101, which target the 3'UTR of the EZH2 transcript. Silencing of p16INK4a as well as p14ARF coincided with recruitment of EZH2 to the respective promoters with concomitant increases in the PRC-2 mediated repressive histone mark, H3K27Me3, and decreased H3K9Ac (histone activation mark) within these promoter regions. Under these exposure conditions, asbestos did not alter DNMT or DNA methylation levels within the INK4a/ARF locus.

Conclusions: Asbestos induces rapid inactivation of the Rb and p53 tumor suppressor pathways via polycomb-mediated repression of the INK4a/ARF locus in normal human mesothelial cells. Collectively these findings suggest that this in-vitro model may prove useful for delineating additional early epigenetic mechanisms contributing to MPM, and support the evaluation of EZH2 inhibitors as potential chemopreventive agents in individuals at high risk of developing MPM.

F11. Naturally-Occurring IgG Antibodies for the Treatment of Human Non-Small Cell Lung Cancer

Hyun-Sung Lee, Hee-Jin Jang, David Yoon, Mayra Hernandez Sanabria, Duy Tri Le, Jansen Smith, Sung Yun Jung, Ori Wald, *David J. Sugarbaker, Silke Paust, Bryan M. Burt
Baylor College of Medicine, Houston, TX

Invited Discussant: *Alexander S. Krupnick

Objective: We have recently discovered that therapeutic strategies employing non-self (allogeneic) IgG antibodies (alloIgG) in the presence of a dendritic cell stimulant (PolyI:C) eradicates tumors in a variety of mouse tumor models, including Lewis lung carcinoma. Allogeneic antibody therapy is a potentially powerful immunotherapeutic strategy for the clinic; however, the feasibility and efficacy of this approach in human malignancy is unknown. Our objective was to determine whether naturally occurring alloIgG antibodies recognize human NSCLC tumor cells and can facilitate effective antitumor immune responses against human NSCLC.

Methods: Single-cell suspensions were prepared from resected tumors of patients with stage I NSCLC. AlloIgG was isolated from serum of 10 healthy donors and pooled. Intravenous immunoglobulin (IVIG), a commercially available preparation of IgG from >10,000 donors and a rapidly translatable IgG formulation, was tested. Flow cytometry was used to measure binding of alloIgG and autologous IgG (autoIgG) antibodies to human NSCLC cells ($CD45^{-}SSC^{high}$), and mass spectrometry was utilized to identify the antigens recognized by alloIgG. Intratumoral immune responses were comprehensively characterized by time-of-flight mass cytometry (CyTOF; 37 marker panel) by culturing NSCLC single-cell suspensions overnight with IVIG + PolyI:C. The antitumor efficacy of IVIG + PolyI:C was tested in a patient-derived xenograft (PDX) model of human adenocarcinoma.

Results: AlloIgG antibodies had greater tumor binding capacity to NSCLC cells than autoIgG antibodies (Figure A). Mass spectrometry on 2 NSCLC tumors showed that alloIgG preferentially enriched 52 proteins not enriched by autoIgG. Gene ontology analyses of cellular components revealed that proteins bound by alloIgG were more commonly associated with the plasma membrane and cytoskeleton than those bound by autoIgG (Figure B). CyTOF analyses of human NSCLC single cell suspensions demonstrated that only the combination of IVIG+PolyI:C resulted in upregulation of costimulatory molecules (CD40, CD86) and pro-inflammatory cytokines (TNF-α, IL-6) on dendritic cells; and upregulation of activation markers (HLA-DR, CD38) and inflammatory cytokines (IFNγ, TNF-α, IL-17) on T cells, as well as decreased numbers of regulatory T cells (CD4+FoxP3+) (Figure C). In a PDX model of fresh human lung adenocarcinoma, weekly (x3) intratumoral injection of IVIG+PolyI:C resulted in eradication of xenografts (Figure D) and striking expansion of human CD8 tumor cells within treated xenografts (Figure E).

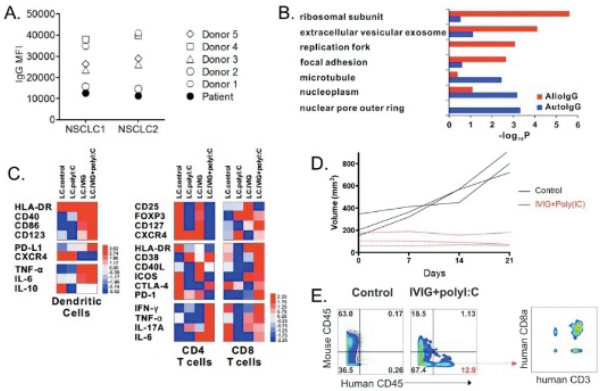


Figure 1. (A) The binding of patient-derived or healthy donor serum IgG to NSCLC tumor cells (CD45^{-}SSC^{high}) in single cell suspensions from tumors of 2 patients. (B) Immunoprecipitation of proteins from NSCLC tumor lysates (n=2) that were bound by alloIgG (IgG pooled from 10 healthy donors) or autologous IgG was subjected to mass spectrometry to identify the protein antigens recognized by alloIgG. Gene ontology analyses of cellular components is shown. (C) Human NSCLC single cell suspensions were cultured overnight with IVIG, PolyI:C, or IVIG+PolyI:C, and mass cytometry was performed. Activation of dendritic cells and T cells is shown. (D) Patient-derived xenografts were established from the tumor of a patient with lung adenocarcinoma. When tumors were palpable, they were treated with 3 weekly intratumoral injections of IVIG+PolyI:C and tumor size was measured. (E) Flow cytometry of treated and untreated PDX tumors demonstrated expansion of human CD8 T cells within treated tumors.

Conclusions: Human NSCLC tumor cells are recognized by alloIgG antibodies and therapeutic alloIgG strategies facilitate potent antitumoral immune responses in preclinical human NSCLC models. Our data support alloIgG therapy as a promising novel immunotherapy for NSCLC that should be considered for early phase clinical trials.

F12. The Impact of Early Oral Feeding on Proinflammatory Cytokines After McKeown Minimally Invasive Esophagectomy for Cancer

Yin Li, Hai-Bo Sun, Xian-Ben Liu, Rui-Xiang Zhang, Zong-Fei Wang, Shi-Lei Liu, Yan Zheng, Xian-Kai Chen, Jian-Jun Qin

The Affiliated Cancer Hospital of Zhengzhou University, Zhengzhou, China

Invited Discussant: *Wayne Hoffstetter

Objective: The aim of current study was to investigate the impact of early oral feeding (EOF) on proinflammatory cytokines after McKeown minimally invasive esophagectomy (MIE) for cancer.

Methods: This study was based on a single-center randomized, controlled trial in Henan Cancer Hospital (NCT01998230). Patients with esophageal cancer who received McKeown MIE were randomly allocated to a group starting EOF on post-operative day (POD) 1 and another group that remained nil by mouth until 7 days after surgery (late oral feeding [LOF] group). A total of 280 patients were included in this study. We chose 46 patients including 25 patients in EOF group and 21 patients in LOF group to test proinflammatory cytokines (tumor necrosis factor-a, TNF-α; monocyte chemotactic protein-1, MCP-1; Interleukin-6, IL-6; and interleukin-8, IL-8). Blood samples were obtained before, and at POD1, POD3, and POD5. Proinflammatory cytokines changes between the two groups and within groups were evaluated.

Results: EOF group and LOF group exhibited similar preoperative TNF-α, MCP-1, IL-6 and IL-8 levels. The level of four proinflammatory cytokines increased significantly at POD1 and POD3 compared with preoperative level (all $P < 0.01$). At POD5 the level of all four proinflammatory cytokines decreased compared with POD1 and POD3. At PODs 3 and 5, the levels of IL-6 and IL-8 in the EOF group were significantly lower than those in the LOF group (all $P < 0.05$). At POD 5, the levels of TNF-α and MCP-1 in the EOF group were significantly lower than those in the LOF group (all $P < 0.05$).

Conclusions: Compared to conventional rehabilitation program, EOF could decrease proinflammatory cytokines after McKeown MIE.

F13. *In Vivo* Development of Transplant Arteriosclerosis in Humanized Mice Reflects BOS in lung Transplant Recipients and Is Controlled by Autologous Regulatory T Cells

Thierry Siemeni, A.K. Knöfel, Fabio Lus, K. Jansson, Jawad Salman, Wiebke Sommer, Murat Avsar, Igor Tudorache, Christian Kühn, *Axel Haverich, Gregor Warnecke
Hannover Medical School, Hannover, Germany

Invited Discussant: *Daniel Kreisel

Objective: The major obstacle to prolonged survival following lung transplantation is chronic allograft rejection, manifesting as bronchiolitis obliterans syndrome (BOS). Here, we studied correlations between BOS after clinical lung transplantation and leukocyte-mediated development of transplant arteriosclerosis in a humanized mouse model.

Methods: The pericardiophrenic artery was procured from surplus tissue of donor lungs transplanted in our clinical program and was implanted into the abdominal aorta of immune deficient mice. Seventeen lung recipients were divided into two groups. Six patients (35%) developed BOS 22 ± 5 months after lung transplantation. The remaining eleven patients (65%) did not develop BOS within 26 ± 5 months after lung transplantation. Experimental mice were divided into four groups. Negative control mice received no human leukocyte reconstitution (neg. co). PBMC BOS+ group mice received 5 x 10^6 allogeneic human peripheral blood mononuclear cells (PBMC) from recipients with BOS, whereas PBMC BOS– group mice received PBMC from patients without BOS. Two further groups of animals were reconstituted with the respective PBMC additionally enriched with autologous CD4+CD25high cells (putative regulatory T cells, Treg) from either recipients with BOS (PBMC+Treg BOS+ group) or without PGD (PBMC+Treg BOS- group). Human leukocyte engraftment was monitored by FACS.

Results: The neg. co group showed only mild thickening of the intima (9.3 ± 9%). In the PBMC BOS+ group, intimal thickening obliterating the vessel lumen was significantly more severe than in the PBMC BOS– group (37.9 ± 11% vs 15.6 ± 4%, p = 0.015). Then, intimal thickening was significantly inhibited in the PBMC+Treg BOS+ group as compared to the PBMC BOS+ group (0.3 ± 4% vs 37.9 ± 11%, p = 0.01). In the experiments using PBMC from lung recipients without BOS, enriching Treg also further suppressed the development of transplant arteriosclerosis (0.6 ± 7% PBMC PGD– vs 15.6 ± 4% PBMC+Treg PGD–, p = 0.007).

Conclusions: Lung transplant recipients, who later develop BOS, have peripheral leukocytes already at the time of transplant that transfer pro-inflammatory properties leading to transplant arteriosclerosis into a humanized mouse model. Transplant arteriosclerosis remains sensitive to inhibition by autologous regulatory T cells, suggesting a cell therapy-based approach for the prevention and treatment of BOS after lung transplantation.

F14. Matrix Metalloproteinase 12 Promotes Tumor Propagation in the Lung

Ezra Ella[1], Yaniv Harel[1], Michal Abraham[1], Hanna Wald[1], Ofra Benny[2], Adi Karsch-Bluman[2], Vincent Dive[3], Laurent Devel[3], Uzi Izhar[4], *Oz M. Shapira[4], David Yoon[5], Hyun-Sung Lee[5], *David J. Sugarbaker[5], Bryan M. Burt[5], Amnon Peled[1], Ori Wald[5]

[1]Hadassah Hebrew University Hospital, Jerusalem, Israel; [2]The Hebrew University, Jerusalem, Israel; [3]CEA Saclay, Saclay, France; [4]Hadassah Hebrew University Hospital, Jerusalem, Israel; [5]Baylor College of Medicine, Houston, TX

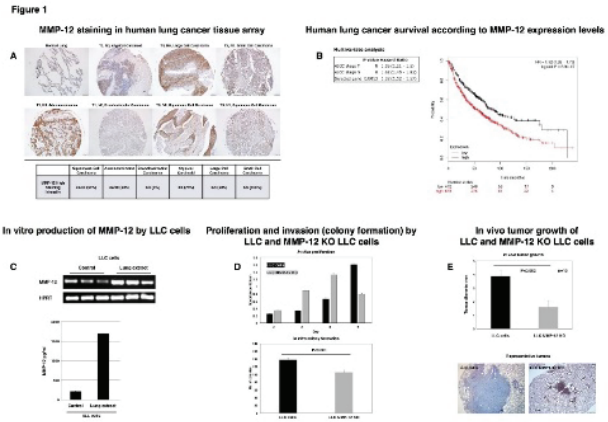
Invited Discussant: *Yolonda L. Colson

Objective: MMP-12 has previously been reported to be over-expressed both in human lung cancers and in murine models of the disease. Yet controversy exists regarding the role of MMP-12 in lung tumorigenesis. Specifically, evidence from human and murine studies indicate that immune derived MMP-12 may slow pulmonary tumor growth, whereas epithelial overexpression of MMP-12 may actually be pro-tumorigenic. Remarkably, however, the effect of MMP-12 on lung tumorigenesis was never tested using animal models that maintain a native lung microenvironment and that accurately recapitulate human lung-cancer disease propagation. We have recently reported that stereotactic-guided injection of minute number of lung cancer cells directly to the lung generates a solitary pulmonary nodule that is surrounded by normal lung parenchyma and that over time grows in a manner similar to human lung cancer. We herein take advantage of this novel methodology to thoroughly dissect the role of immune and tumor derived MMP-12 in lung tumorigenesis.

Methods: MMP-12 expression, tissue localization and association with prognosis were tested in a human lung cancer tissue array and in published databases. Next, the induction and production of MMP-12 by human (H460) and murine (LLC) lung cancer cells was measured *in vitro* and *in vivo*. Subsequently, we generated a MMP-12 KO (knock-out) LLC cell line and compared its *in vitro* growth and invasiveness to that of LLC cells. Finally, the *in vivo* growth of LLC and MMP-12 KO LLC cells in control and in MMP-12 KO mice was evaluated and tumor morphology and elastin degradation documented.

Results: Tumor cells of a variety of human lung cancers including: adeno, squamous, large-, and small-cell carcinomas positively stained for MMP-12 (Figure A). Moreover, high MMP-12 mRNA levels in human lung cancer were found to be associated with reduced overall survival (Figure B). Interestingly, H460 and LLC cells produced low baseline levels of MMP-12; however, upon exposure to lung tissue extract (Figure C) or upon implantation in the lung, these cells highly up-regulated MMP-12 mRNA expression and protein production. Remarkably, when tested *in vitro*, the invasiveness of MMP-12 KO LLC cells was significantly reduced as compared to LLC cells while their proliferation rate remained the same (Figure D).

In line with these observations, we report that compared to LLC cells, MMP-12 KO LLC cells generated *in vivo* significantly smaller and less invasive tumors (Figure E). Notably, when LLC cells were implanted in control and in MMP-12 KO mice tumors of similar size were generated.



Conclusions: Our findings suggest that the lung microenvironment may foster MMP-12 production by tumor cells and in turn enhance their growth and invasiveness. We also show that KO of host MMP-12 does not affect tumor growth. Consequently, we argue that MMP-12 is a potential novel therapeutic target in the context of lung tumorigenesis.

F15. Meta-Analysis Identifies a Novel Anti-Apoptotic Gene and Potential Therapeutic Target in Malignant Pleural Mesothelioma

Li Zhang, Anand Singh, Nisan Bhattacharyya, R. Taylor Ripley, *David S. Schrump, Chuong D. Hoang

National Institutes of Health, Bethesda, MD

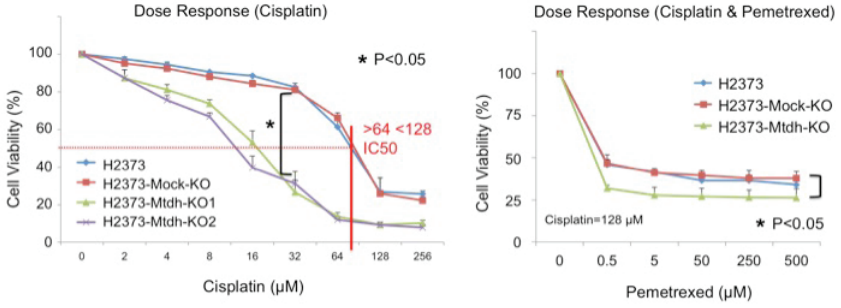
Invited Discussant: *Jessica S. Donington

Objective: Malignant pleural mesothelioma (MPM) molecular mechanisms remain incompletely characterized and underlie the lack of effective treatment. Genomic meta-analysis strategies may lead to novel mechanistic insights. Herein, we propose to understand the biologic role of a newly discovered MPM-gene by meta-analysis known as Metadherin (MTDH).

Methods: We used a meta-analysis algorithm combining size-effects and p-values to leverage public gene expression MPM human data sets. In total, 146 tumor specimens and 67 controls (non-malignant lung or pleura) were analyzed. Among several differentially expressed novel genes, we selected MTDH for further characterization in MPM based on its pleiotropic role in modulating many cancer traits

like chemoresistance, metastasis, and inflammation. We used our own samples ([Epi] epithelial = 19; [Bi] biphasic = 3; [Sarc] sarcomatoid = 3; nonmalignant pleural = 6) to confirm *in silico* results. Appropriate MPM cell lines were used for multiple assays under both conditions of MTDH overexpression by lentiviral transduction and of MTDH knockdown by CRISPR/Cas system. Both Met-5A and LP9 mesothelial cell lines were used as *in vitro* controls. A human monoclonal antibody detected the 80 kDa isoform of MTDH protein in immunoblotting experiments. Cisplatin and pemetrexed were used in chemoresponse assays.

Results: MTDH emerged as a significant gene with 2.5-fold overexpression in tumors from our broad survey of MPM public data. By qRT-PCR, we confirmed MTDH mRNA levels were elevated by 2.0 fold ($p < 0.05$) in MPM tumor tissues versus normal pleura. We also observed concurrent overexpression of MTDH protein levels in tumors. After stable overexpression of MTDH in MPM cell lines (Epi, Bi, Sarc) with low basal expression, we observed consistent increase in cell proliferation rate, motility (scratch assay), and invasiveness (Boyden chamber) as compared to the parental cell lines. By Annexin V flow cytometry, these MTDH-overexpressing cell lines displayed an anti-apoptotic phenotype. In chemoresponse assays, MTDH-overexpressing cell lines were significantly more resistant to treatment by cisplatin and pemetrexed. Next, we determined the effects of MTDH gene knockdown in MPM cell lines with high basal expression. We observed consistent opposite effects of decreased cell proliferation rate, foci formation in 2D culture, motility, invasiveness, and anchorage-independent growth (soft agar assay). MTDH-knockdown (KO) cell lines displayed a pro-apoptotic phenotype compared to their parental cell line counterparts; and they were significantly more sensitive to chemotherapy agents (cisplatin ± pemetrexed, Figure).



Conclusion: MTDH is a novel overexpressed gene that appears to contribute to the malignant phenotype of MPM. Importantly, suppressing MDTH improved chemotherapy response. MTDH is a promising new candidate for therapeutic targeting in MPM.

8:25 pm **Adjourn**

7:00 am – 8:25 am **Adult Cardiac Emerging Technologies and Techniques/Case Video Forum** Room 311, Hynes

5 minute presentation, 5 minute discussion

Moderators: *T. Sloane Guy, *Wilson Y. Szeto, *Song Wan

T1. Transcarotid TAVR: A Comparison of In-Hospital and Intermediate Term Outcomes with Transapical and Transaortic Access

*Keith B. Allen[1], Adnan Chhatriwalla[1], *David J. Cohen[1], Sanjeev Aggarwal[1], Zuhair Hawa[1], Anthony J. Hart[1], Suzanne J. Baron[1], J. Russell Davis[1], Alex F. Pak[1], Zafir Hawa[2], Jim Mitchell[2], *A. Michael Borkon[1]

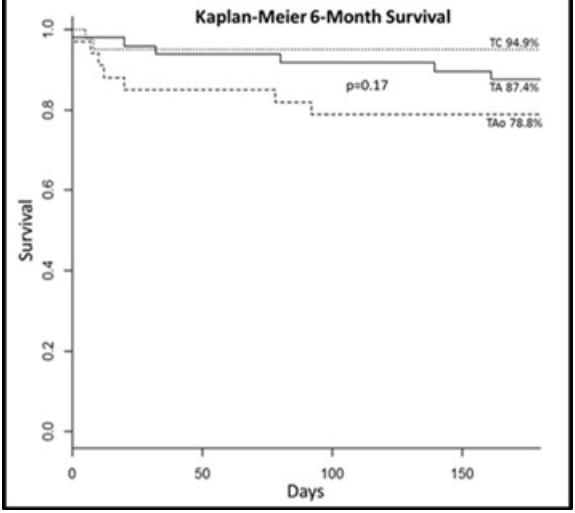
[1]St. Luke's Mid American Heart Institute, Kansas City, MO; [2]North Kansas City Hospital, North Kansas City, MO

Objective: TAVR using non-femoral access is characterized by a higher-risk population and is associated with a higher mortality and morbidity. Transcarotid (TC) access may be a less-invasive alternative to transapical (TA) or transaortic (TAo) and may lead to better outcomes. The purpose of this study was to compare outcomes following TAVR using TC, TA, and TAo access in patients unsuitable for TF TAVR.

Methods: From January 2012 through May 2016, 123 patients underwent non-femoral TAVR using TC (n = 42), TA (n = 48), and TAo (n = 33) access at two hospitals. Groups were compared and risk stratified using preoperative demographics and The Society of Thoracic Surgeons (STS) and Transcatheter Valve Therapy (TVT) mortality risk calculators. In-hospital, 30-day, and 6-month outcomes were analyzed along with length of stay (LoS) and discharge status.

Results: The three groups were similar in baseline characteristics including TVT and STS predicated mortality (Table). In-hospital and 30-day mortality were similar with a trend (p = 0.17) toward improved Kaplan-Meier survival at 6-months following TC TAVR (Table). After adjusting for risk, 6-month survival remained similar between groups (p = 0.21) with severe lung disease having the strongest correlation to predicating 6-month mortality (HR: 2.3 [.82, 6.4], p = 0.1). TC access compared to TA and TAo resulted in a shorter LoS (3 days vs 7 days vs 8 days; p = <0.001) and significantly more patients being discharged directly to home (90.5% vs 50.0% vs 45.5%; p < 0.001). Among TC patients, both right (20) and left (22) carotid access was utilized for delivery of balloon-expandable (n = 38) or self-expanding (n = 4) transcatheter aortic valves. Procedural success with TC access was 100% and no patient required femoral to carotid shunting.

TABLE 1	Transapical n=48	Transaortic n=33	Transcarotid n=42	p-value
Age	76.8 ± 21.8	78.0 ± 24.9	80.5 ± 7.5	0.7
STS Risk (Median (IQR))	9.1 (7.0, 11.7)	10.0 (8.5, 13.0)	10.0 (8.3, 12.0)	0.2
TVT Risk (Median (IQR))	8.8 (6.8, 10.7)	10.0 (8.3, 12.1)	9.3 (7.2, 12.7)	0.09
Ejection Fraction	56.9 ± 11.4	51.8 ± 16.2	54.0 ± 15.1	0.3
Diabetes	17 (35.4%)	12 (36.4%)	21 (50.0%)	0.3
Severe Lung Disease	9 (18.8%)	12 (36.4%)	16 (38.1%)	0.4
Home Oxygen	4 (8.3%)	2 (6.1%)	7 (16.7%)	0.4
Peripheral Vascular Disease	24 (50.0%)	12 (36.4%)	24 (57.1%)	0.3
Porcelain Aorta	8 (16.7%)	5 (15.2%)	8 (19.0%)	0.9
Prior Sternotomy	18 (37.5%)	9 (27.3%)	12 (28.6%)	0.5
Pre Op creatinine	1.4 ± 0.9	1.4 ± 0.8	1.5 ± 1.0	0.9
Cerebral Vascular Disease	2 (4.2%)	4 (12.1%)	4 (9.5%)	0.3
In-Hospital Mortality	1 (2.1%)	2 (6.1%)	1 (2.4%)	0.7
In-Hospital/30 Day Mortality	3 (6.3%)	5 (15.2%)	2 (4.8%)	0.3
LOS (Median Days (IQR))	7.0 (5.0, 10.0)	8.0 (5.0, 10.0)	3.0 (2.0, 4.0)	<0.001
Discharged to Home	24 (50.0%)	15 (45.5%)	38 (90.5%)	<0.001



Conclusions: Transcarotid access in patients unsuitable for TF TAVR is associated with a shorter length of stay and more frequent discharge to home with a trend toward towards improved 6-month survival compared to TA and TAo access.

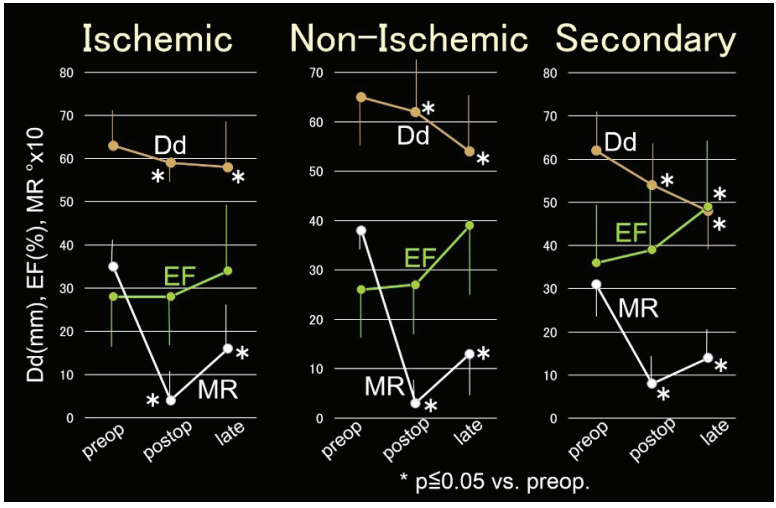
T2. Surgical Treatment May Enhance Reverse Remodeling of the Ventricle in Patients with Functional Mitral Regurgitation

*Masashi Komeda[1], Takashi Kusunose[1], Hideki Kitamura[2], Toshimi Ujiie[1]

[1]Iseikai Hospital, Osaka, Japan; [2]Nagoya Heart Center, Nagoya, Japan

Objective: In the treatment of dilated cardiomyopathy (DCM), the presence of functional mitral regurgitation (FMR) is a major predictor of poor outcomes. Catheter intervention is aimed at valvular, but not ventricular, treatment. In this study, we reviewed the results of mitral valve repair using aggressive, but physiological, reconstruction of subvalvular apparatus in patients with FMR of different etiologies.

Methods: We assessed 47 patients who underwent surgery for FMR in the past 6 years (age, 68 ± 13 years; 32 males). During the operation, the anterior and posterior heads were connected in each papillary muscle (PM), which mimics the normal geometry in systole; they were then relocated to the mid-anterior mitral annulus. This simulates the natural stress line between the PM and annulus (papillary head optimization (PHO), a modification of Kron's relocation). Annuloplasty was performed when indicated using a complete ring with the size of the anterior leaflet. The patients were divided into three groups according to etiology and were analyzed for the following: FMR due to ischemic DCM (Ischemic Group), FMR caused by non-ischemic DCM (Non-Ischemic Group), and FMR due to DCM secondary to aortic valvulopathy (Secondary Group). In Secondary Group, aortic valve replacement was also done.



Results: There was no hospital death and freedom from cardiac death 4 years postoperatively was 92 ± 6% (follow-up of 906 ± 555 days). One patient with huge LV in Non-Ischemic Group recurred FMR and required MVR 6 months postoperatively. Late postoperatively, in Ischemic Group (15 patients), the degree of FMR was well controlled (p = 0.001 vs preoperative value), whereas the LV diastolic diameter (Dd), ejection fraction (EF), and estimated right ventricular pressure (RVP) were maintained (Figure. MR1, trivial; MR2, mild; MR3, moderate; MR4, severe).

In Secondary Group (14 patients), FMR was well controlled and Dd, EF, and RVP improved close to near-normal ranges or normalized (p = 0.001, 0.025, 0.05, and 0.015, respectively). In Non-Ischemic Group (18 patients), FMR, Dd, EF, and RVP were fairly well controlled somewhere in between the results of the other two groups (p = 0.001, 0.008, 0.08, and 0.05, respectively). Pressure gradient across the mitral valve was within a normal range in all three groups, which suggested no diastolic tethering.

Conclusions: Surgical treatment using PHO relocation method for FMR due to DCM provided promising late survival rates and good FMR control for patients in all treatment groups. It also maintained LV function in Ischemic Group and helped reverse LV remodeling in Non-Ischemic and Secondary groups. Thus, surgery may improve the valve and ventricle in patients with FMR, which may compensate the pitfalls of catheter intervention strategy.

T3. Transcaval Transcatheter Aortic Valve Replacement: No Patient Left Behind!

*Talal Al-Atassi, David G. Cervantes, *Vasilis Babaliaros, *Ronnie Ramadan, *Vinod Thourani

Emory University, Atlanta, GA

Objective: Describe a transcaval transcatheter aortic valve replacement (TAVR) case as an alternative to transfemoral TAVR in a patient with no other alternative access options.

Case Video Summary: This is a case of a 95-year-old male with progressive shortness of breath on exertion (NYHA III) and a diagnosis of severe aortic stenosis. He has a complex past medical history including a history of CABG, severe COPD, and peripheral arterial disease (PAD). His Society of Thoracic Surgery (STS) score is 15%. His PAD precludes femoral, subclavian and carotid access. Previous sternotomy and COPD precludes transapical and transaortic options. In this patient with no access options for TAVR, transcaval access was the only feasible choice. Preoperative planning for transcaval TAVR including the identification of a crossing level where the aorta is soft with sufficient distance from the renal arteries and aortic bifurcation is paramount. After obtaining access to the common femoral veins bilaterally and common femoral artery on the left side using the Seldinger technique, simultaneous aortography and venacavography is obtained in biplane views using two 6F pigtail cathters. The left arterial pigtail is switched to an internal mammary (IM) guide catheter through which a 20 mm gooseneck snare was advanced to the crossing level. The venous pigtail catheter was switched to a 6F 55 cm JR4 guide catheter. A 0.014" wire was advanced inside a 0.035" wire converter piggyback catheter, which is advanced inside a 0.037" support catheter. Using electrocautery set to cut at 50 W, the 0.014” wire is advanced through the IVC wall and the aortic wall in 2 steps. The snare is used to bring the wire up to the proximal descending aorta. Then the piggyback and support catheters are advanced consecutively over the 0.014" wire into the descending aorta. The piggyback catheter and 0.014" wires are then removed and exchanged with a Lunderquist wire. Then the support and JR4 catheters are removed and a 16F sheath is advanced through the IVC and into the Aorta. Following that, the valve implantation part is performed as usual. In this case, a 29 mm balloon expandable valve is implanted. Closure of the aorta is then

achieved using an 8/10 patent ductus occluder device. Aortography demonstrates an Aorto-Caval fistula with some extravasation. A 20 mm balloon was then inflated at the level of the closure device for 5 minutes to tamponade the bleeding and allow better apposition of the occluder. Finally, an aortogram demonstrates an aorto-caval fistula with resolution of extravasation.

Conclusion: In patients with no femoral artery or traditional alternative access options (carotid, subclavian, aortic, or apical), transcaval TAVR is a safe and feasible treatment option. With increased experience and dedicated aortic closure devices, transcaval TAVR may become the alternative access of choice, avoiding any surgical incisions.

T4. Sutureless Aortic Valve Replacement in High Risk Patients Neutralizes Expected Worse Hospital Outcome: A Clinical and Economic Analysis

Emmanuel Villa, Margherita Dalla Tomba, Antonio Messina, Andrea Trenta, Federico Brunelli, Marco Cirillo, Zean Mhagna, Giovanni Troise

Poliambulanza Foundation Hospital, Brescia, Italy

Objective: Aortic Valve Replacement (AVR) by sutureless prosthesis is changing surgeons' arsenal. Its usefulness in various settings has been reported, but data from randomized studies comparing sutured and sutureless devices are lacking. Consequently, what type of patient benefits most is unknown. Furthermore, the economic impact of this new technology is unclear.

Methods: At our Institution, a private nonprofit hospital reimbursed by the national insurance system, we reserved sutureless prostheses, more expensive than the sutured ones, for patients deemed at high surgical risk. In this way, two groups of patients were available for a retrospective analysis of outcome and resource consumption from the hospital's point of view (study period 1/2013–6/2015). To favor the comparison, only patients with the characteristics required by the instructions for use of the sutureless device were reviewed. Inclusion criteria: age >65 yrs, AVR with bioprosthesis +/– CABG, PFO closure, or myectomy. Exclusion: bicuspid aortic valve, combined valve, or aortic surgery. Costs were retrieved for each patient and calculated on a daily basis including preoperative diagnostic tests, operating room costs (hourly basis), disposables, drugs, blood components, as well as costs for personnel.

Results: The sutureless group (Group A) had a higher risk profile than the sutured one (Group B) (Table). Intraoperative course: CPB and cross-clamp times were significantly shorter in Group A (isolated AVR: cross-clamp 52.9 ± 12.6 vs 69 ± 15.3 min, $p < 0.001$; CPB 79.4 ± 20.3 vs 92.7 ± 18.2, $p < 0.001$). Concomitant procedures were performed in 35.4% (40/113) vs 36.4% (43/118), $p = 0.869$. Postoperative results: hospital mortality 0.9% in Group A and nil in Group B, $p = 0.489$; intubation time 7 hours (IQR: 5–10.7) and 7 hours (IQR: 5–9), $p = 0.785$; stroke or transient neurologic deficit 2.7% (3/113) and 0.8% (1/118), $p = 0.361$; ICU stay 1 day (IQR: 1–1) and 1 day (IQR: 1–1), $p = 0.258$; ward stay 5.5 days (IQR: 4–7) and 5 days (IQR: 4–6), $p = 0.002$; creatinine peak 1.12 mg/dl (IQR: 1.02–1.22) and 1.06 mg/dl (IQR: 0.86–1.39), $p = 529$; new permanent pacemaker 5.7% (6/106) and 0.9% (1/109), $p = 0.063$, respectively. Median overall hospital cost (excluding the prosthesis) was $12,825 (IQR: 11,733–15,334) for patient in Group A and $ 13,386 (IQR: 11,217–14,230) in Group B, $p = 0.055$.

Table: Pre-Op Variables

	Group A (113 pts.) Sutureless	Group B (118 pts.) Sutured	p-Value
Age (years)	80.1 ± 5.5	75.5 ± 5.6	<0.001
Female	65.5% (74)	32.2% (38)	<0.001
BMI	27.4 ± 5.1	26.7 ± 3.8	0.297
Diabetes	31% (35)	16.9% (20	0.013
Creatinine (mg/ml)	0.98 (IQR: 0.8–1.19)	0.94 (IQR: 0.8–1.14)	0.508
Hb (g/dl)	12 ± 1.5	12.5 ± 1.5	0.015
PAPs (mmHg)	30 (IQR: 29.5–40)	25 (IQR: 25–40)	0.011
STS score (%)	3.55 (IQR: 2.02–5.75)	2.03 (IQR: 1.54–3.21)	<0.001
EuroSCORE II (%)	3.9 (IQR: 2.2–7.1)	2.3 (IQR: 1.4–3.6)	<0.001

Conclusions: Despite a higher operative risk in the sutureless group, hospital mortality did not differ. CPB and cross-clamp times were lower with the sutureless device and this improvement may have influenced favorably many postoperative endpoints, but with some exceptions. A worse economic impact was expected for sutureless patients according to their risk profile, but resource consumption did not differ. Finally, a higher price for new AVR technology is justified but how much is to be paid depends on the appraisal in each center and on the operative risk of each patient cohort.

T5. Aortic Valve Repair for Aortic Insufficiency Associated with Ascending Aortic Aneurysms using Geometric Ring Annuloplasty

Marek J. Jasinski[1], *J. Scott Rankin[3], R. Gocol[2], D. Hudziak[2], Adam R. Kowalowka[2], *Marek A. Deja[2]

[1]Wroclaw Medical University, Wroclaw, Poland; [2]Silesian Heart Centre, Katowice, Poland; [3]West Virginia University, Morgantown, WV

Objective: Patients with aortic insufficiency (AI) associated with ascending aortic aneurysms constitute one-third of the AI population. With normal sinus dimensions, reimplantation procedures are inappropriate, and prosthetic valve replacement subjects the patients to valve-related complications. Subcommissural annuloplasty has been prone to failure, and a more stable method of valve repair would be ideal**.**

Case Video Summary: The patient was a 63-year-old female with mild congestive heart failure, a 56 mm ascending aortic aneurysm, Grade 2 AI, and sino-tubular junction (STJ) and sinus diameters of 41 and 44 mm, respectively. The aortic annulus was 27 mm, and the patient was recommended elective ascending aortic aneurysm resection and aortic valve repair. The aortic annulus was dilated with lack of central leaflet coaptation, but the leaflets looked good. The leaflets sized to a 23 mm geometric annuloplasty ring, which was positioned with the minor axis post beneath the posterior left/non-coronary commissure. All 3 subcommissural posts were sutured to the commissures with Cabrol-like stitches. The ring was passed beneath the valve, and the holder was removed. Two looping sutures were passed around each sinus portion of the ring and brought up through the annulus, 2 mm

deep to the leaflet-aortic junction. The annular sutures were tied tightly over fine Dacron pledgets with 8 knots. One needle was passed downward through the central lateral pledget, tied with 6 more knots, and the sutures were cut short. This directed the knot towers laterally and out of contact with the leaflets. After all sutures were tied, the leaflets coapted nicely in the midline, with good effective height and coaptation area, creating a fully competent valve supported long-term by the ring. The leaflets opened well, and the ring was not visible from above the valve. Using a Dacron tube graft 5–7 mm larger than the ring, the supra-coronary ascending aorta was replaced. Post-bypass, the leaflets opened well to a good vertical position, and there was no residual leak.

Conclusions: Isolated ascending aortic aneurysms with AI constitute one-third of the AI population. The AI is most commonly due to a combination of both STJ and annular dilatation. Valve reimplantation procedures or prosthetic valve replacement are not ideal. Ascending aortic aneurysm resection with aortic valve repair using geometric ring annuloplasty is a simple and effective approach to this clinical problem.

T6. Hemodynamic Follow-Up After Valve-in-Valve TAVI for Failed Aortic Bioprosthesis

Konstantin Alexiou[1], Manuel Wilbring[2], Sebastian Arzt[1], Utz Kappert[1], Sems Malte Tugtekin[1], Klaus Matschke[1]

[1]University Heart Center, Dresden, Germany; [2]University Heart Center Halle, Germany

Objective: Valve-in-valve TAVI has advanced to an accepted treatment option in patients presenting with deteriorated aortic valve bioprosthesis. Nonetheless, only little knowledge exists concerning hemodynamic outcomes during further follow-up.

Methods: Since 2010, a total of 48 patients underwent valve-in-valve TAVI for failed aortic bioprosthesis. Mean age was 83.2 ± 3.4 years. Predominantly, a transapical approach was performed (64.6% vs 35.4% transfemoral). Maximum velocity, maximum, and mean transvalvular pressure gradients were collected preoperatively, predischarge, and during follow-up. Follow-up ranged up to 5.8 years with a mean follow-up period of 3.5 ± 1.0 years.

Results: Labeled sizes of previously implanted aortic bioprostheses were 21 (30.4%), 23 (43.5%), 25 (17.4%), 27, 29, and 31 mm (2.2% each). Mechanism of failure was regurgitation in 20.8% and stenosis in 79.2%. Mean preoperative maximum velocity was 413 ± 73 cm/s, corresponding mean $dP_{max/mean}$ 71 ± 25/42 ± 16 mmHg. Predischarge echocardiography demonstrated significant reduction of maximum velocity (286 ± 52cm/s; $p < 0.01$) and pressure gradients ($dP_{max/mean}$ 33 ± 12/19 ± 11 mmHg; $p < 0.01$) in all patients. To latest follow-up, the collected hemodynamic parameters showed a slight, but statistically not significant increase (maximum velocity 295 ± 93 cm/s; $dP_{max/mean}$ 42 ± 15/25 ± 9 mmHg; p = n.s.). VARC-2 criteria for device success was met in 52.1% of the patients. Particularly, bioprostheses with labelled sizes 21 and 23 were associated with significantly less VARC-2 device success, mainly driven by increased transvalvular pressure gradients. Kind of deteriorated prosthesis (porcine or pericardial) or used transcatheter valve was not associated with VARC-2 device success (p = n.s.).

Conclusions: Valve-in-valve TAVI is a feasible and safe option in selected patients. Nonetheless, deteriorated bioprosthesis with labeled sizes 21 and 23 mm are associated with inferior VARC-2 device success. Hence, indication for valve-on-valve TAVI or biological aortic valve replacement in patients younger 60 years during first surgery must be assessed thoroughly.

T7. Robotic Hybrid Coronary Bypass Grafting

Gianluca Torregrossa, *John Puskas
Mount Sinai Hospital, New York, NY

Objective: Coronary artery bypass grafting is considered the gold standard for management of patients with complex multivessels coronary artery disease. The unparalleled patency of the left internal mammary artery to the left anterior descending artery graft is thought to be largely responsible for the long-term advantage of CABG over percutaneous intervention. Currently, PCI with drug eluting stents (DES) is appealing as a less-invasive means of revascularization, with faster recovery and less short-term morbidity. Current restenosis and in-stent thrombosis rates of DES are similar to the reported failure rates of SVGs, making PCI a potentially valid alternative for revascularization of non-LAD targets. Hybrid coronary revascularization aims to combine the durability of LIMA to LAD bypass grafting with PCI for non-LAD lesions. The use of the surgical robot allows the surgical portion of this combined procedure to be performed in a truly minimally invasive approach, reducing time to recovery without compromising the quality of the anastomosis. This technique is still performed in relatively few centers; the technical demands of the procedure may be the major factor limiting broader adoption. With this video, we aim to present a safe and reproducible step-by-step guide for a successful Robotic CABG procedure.

Case Video Summary: We present a case of a 58-year-old male Jehovah's Witness admitted at our institution with unstable angina for the previous 2 weeks. He had a past medical history positive for hypertension, hyperlipidemia, and previous testicular cancer treated with resection and chemotherapy about 15 years earlier. At admission, a TTE showed preserved EF with no regional wall motion abnormalities or valve disease. A left heart catheterization was performed, revealing 2-vessel disease including an ostial LAD stenosis and a focal lesion in the right coronary artery. After discussion with the patient, primary physician, and interventional cardiologist, an informed consent was obtained for a hybrid revascularization including robotic CABG LIMA to LAD followed by a percutaneous coronary intervention on the right coronary lesion with a DES stent. This narrated video demonstrates a safe and simple approach to robotic harvest of the LIMA and minimally invasive grafting of the LAD. Technical tips are presented and pitfalls are discussed.

Conclusions: Robotic CABG is technically more demanding than traditional CABG through median sternotomy. It requires a steep learning curve for both the surgeon and the OR team, including cardiac anesthesia and the OR nurses. Moreover, safe and reproducible robotic CABG is feasible in patients with a favorable anatomy and represents a growing niche for surgical coronary revascularization.

T8. Computational Fluid Dynamics Assessment of Type-B Dissections As Tool to Predict Evolution of the Disease and Indicate Treatment Strategies

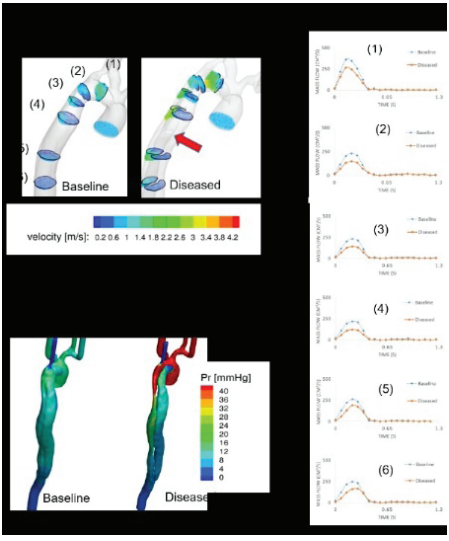
Domenico Calcaterra[1], Liza Shrestha[2], Sarah Vigmostad[2], Robert Saeid Farivar[1], Kevin Harris[1]

[1]Minneapolis Heart Institute, Minneapolis, MN; [2]University of Iowa, Iowa City, IA

Objectives: Patients with uncomplicated type-B dissections undergo long-term follow-up to assess for progression of the disease, which may expose to risk of life threatening complications. Despite adequate anti-impulsive therapy, up to 30 to 50% of patients with uncomplicated type-B dissection will develop delayed complications. Identifying the patients at higher risk of aortic enlargement would define the strategy for follow-up and possibly allow to establish a preventive treatment. Using computational fluid dynamics assessment of wall stress distribution.

Methods: In a review of 74 consecutive patients surgically treated for acute type-A aortic dissection in an 8-year period, we identified 62 patients (83.7%) with distal aortic involvement (DeBakey type 1). All survived patients were followed with serial radiologic imaging to monitor for aortic degeneration.

Results: At a mean follow-up of 40 months, one patient (1.6%) required reoperation of total arch replacement and 4 patients (6.5%) required distal aortic replacement showing that the disease of the distal aorta is subject to a significant rate of progression. Performing computational hemodynamic assessment of one of the type-B dissection that required surgical intervention for later degeneration, we measured mass flux distribution and hemodynamic stress in false and true lumen compared to the same idealized aortic model without dissection in order to find a correlation between the hemodynamic stress produced by the dissection and the evolution of the disease. Quantification of mass flux and pressure distribution in the dissected aorta showed significant alteration of hemodynamic parameters compared to the nondissected aortic model with increase of average pressure in the region proximal to the dissection and unbalanced pressure and mass flux distribution between the true and false lumen (Figure).



Conclusions: Computational fluid dynamics can provide accurate aortic hemodynamic stress assessment which can be utilized in the real word as a noninvasive tool to identify patients with type-B dissection who present conditions of intra-aortic hemodynamic stress favoring the occurrence of complications. Identifying these patients may warrant early transcatheter interventions with the objective of preventing the progression of the disease and the need of delayed surgical interventions which are associated with significant morbidity and mortality.

8:25 am **Adjourn**

TUESDAY MORNING, MAY 2, 2017

7:00 am – 8:25 am **Congenital Emerging Technologies and Techniques/Case Video Forum** Room 312, Hynes

6 minute presentation, 6 minute discussion

Moderators: *Kristine J. Guleserian and *David M. McMullan

T9. Primary Repair of Total Anomalous Pulmonary Venous Connection with Sutureless Strategy

*Yiqun Ding

Shenzhen Children's Hospital, Shenzhen, China

Objective: This case video aims to demonstrate primary repair of infracardiac total anomalous pulmonary venous connection (TAPVC) with sutureless strategy and to explore the safeguards and pitfalls of this technique.

Case Video Summary: The patient was a 6-day-old boy with diagnosis of infracardiac total anomalous pulmonary venous connection with pulmonary venous obstruction, patent ductus arteriosus (PDA) and patent foreman ovale (PFO). Because of low blood pressure and extremely low arterial saturation, the patient underwent emergent TAPVC repair. A standard median sternotomy was performed followed by initiating cardiopulmonary bypass with aortic cannulation and single right atrial cannula. After the patent ductus arteriosus was ligated, the patient's core temperature was cooled down to 18°C. After aortic cross-clamp and antegrade infusion of cardioplegia, the circulation was arrested. The patent foreman ovale was closed with primary closure via a right atrial incision. After opening the right thoracic cavity, the heart was rotated and put into the right thoracic cavity to expose the pulmonary veins and the vertical vein. After opening the pericardium and the vertical vein, the incision of the vertical vein was extended into each individual pulmonary vein and the vertical vein beyond stenotic segments to fully relieve any preoperative pulmonary venous obstruction. Another incision was made on the posterior wall of the left atrium longitudinally, the right end of which reached the interatrial septum. The left atrial incision and the pericardial incision were anastomosed together with running sutures. Most of the sutures did not touch the pulmonary venous wall to avoid injury to the venous intima, which could have triggered fibrous proliferative response and further led to new-onset obstruction. However, at the apex of the triangle zone between two individual pulmonary incisions, one stitch should suspend the pulmonary venous flap up to the pericardium and the left atrium to prevent the flaps from dropping down into

the lumen. After finishing the anastomosis and closing the right atrial incision, the cardiopulmonary bypass resumed, and the heart restarted perfusion. The patient was weaned off the cardiopulmonary bypass and the operation was successfully terminated. The patient was discharged and followed-up for 9 months. The echocardiography showed no pulmonary venous obstruction.

Conclusions: Sutureless strategy is an effective and reproducible technique for primary repair of infracardiac TAPVC. This strategy includes three important components: relieving any preoperative pulmonary venous obstruction, atrio-pericardial anastomosis and "no touch" technique.

T10. Anatomical Correction Including Aortic Root Translocation and Hemi-Senning/ Bidirectional Glenn Atrial Switch Procedure in a Patient with Congenitally Corrected Transposition of the Great Arteries, Ventricular Septal Defect, Pulmonary Stenosis and Dextro

*Eun Seok Choi, *Chang-Ha Lee, *Sungkyu Cho
Sejong General Hosptial, Bucheon, Republic of Korea

Objective: We describe anatomical correction including aortic root translocation and hemi-Senning/bidirectional Glenn atrial switch procedure in a patient with congenitally corrected transposition of the great arteries (ccTGA), ventricular septal defect (VSD), pulmonary stenosis (PS), and dextrocardia.

Case Video Summary: A 8-year-old boy was referred to our hospital for cyanosis. He was diagnosed with ccTGA, VSD, PS and dextrocardia. Anatomical correction was considered in this patient.

Standard bicaval cardiopulmonary bypass was established with moderate hypothermia. Venting was performed via left atrial auricle. Antegrade cold cardioplegia was delivered and the aorta and pulmonary trunk were transected in sequence. The coronary buttons were fashioned and the aortic root was harvested. The pulmonary annulus and conal septum were completely divided in the middle to avoid injury to conduction pathway. The harvested aortic root was half-turned and translocated posteriorly. After the posterior side of aortic root was anastomosed to the pulmonary annulus, VSD was closed with autologous pericardial patch. Anterior side of aortic root was anastomosed to the VSD patch. Hypertrophied right ventricular muscle was resected. The coronary buttons were reimplanted in the aortic root. Branch pulmonary arteries were widened with autologous pericardial patch. The ascending aorta was re-anastomosed. A hemi-Senning procedure was performed using bovine pericardium and *in situ* pericardium. The aortic cross-clamp was released and right ventricular outflow tract was reconstructed with an 18 mm tissue valved conduit on a fibrillating heart. Bidirectional Glenn was performed on a beating heart. Cardiopulmonary bypass and aortic cross-clamp time were 401 and 227 minutes, respectively.

The patient was weaned from cardiopulmonary bypass in sinus rhythm. The patient was extubated on postoperative day 4 and transferred to general ward on day 8. The patient was discharged 37 days after the operation because of prolonged pleural effusion. Postoperative echocardiography showed good both ventricular function, wide LVOT, good hemi-Senning pathway but mild AR.

Conclusions: Aortic root translocation and hemi-Senning/bidirectional Glenn atrial switch procedures are feasible treatment options for anatomical correction of ccTGA, VSD, PS and dextrocardia.

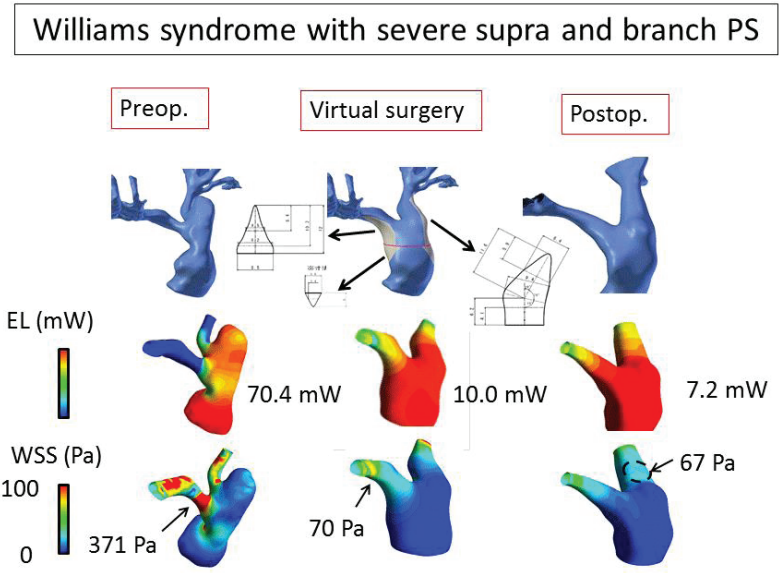
T11. Novel Surgical Strategy for Complicated Pulmonary Stenosis Using Hemodynamic Analysis Based on a Virtual Operation with Numerical Flow Analysis

*Kagami Miyaji[1], Shohei Miyazaki[1], Keiichi Itatani[2], Koichi Sughimoto[1], Tadashi Kitamura[1], Tetsuya Horai[1], Mamika Motokawa[1]

[1]Kitasato University, Sagamihara, Japan; [2]Kyoto Prefectual Universty of Medicine, Kyoto, Japan

Objective: It is very difficult to successfully complete an optimal pulmonary artery plasty for complicated pulmonary stenosis (PS). A novel surgical strategy, using hemodynamic analyses based on virtual operation with computational simulations, has been induced for this patient group. We evaluated this strategy for complicated pulmonary artery plasty.

Methods: Six patients (Rastelli type operation: 4, TOF repair and PA plasty: 1, and Williams syndrome supra-valvular and branch PS: 1,) were enrolled. Before surgery, the optimal pulmonary arteries constructed based on computational fluid dynamics (CFD) using 3D-CT. Energy loss (EL, mW) and wall shear stress (WSS, Pa) were calculated. We compared with the shapes of preoperative and optimal pulmonary arteries, and decided surgical strategy, including incision line and patch shape (virtual surgery). EL and WSS were compared between virtual and real surgery using a flow analysis. These 6 patients were compared with 5 patients who underwent pulmonary plasty using a conventional approach without virtual surgery as a control group.



Results: The result of patient with Williams syndrome is shown in the Figure. Postoperative EL and max WSS was 7.0 mW and 67 Pa, respectively, compared to 10 mW and 70 Pa in virtual surgery. Postoperative right ventricular systolic pressure was 39.0 ± 11 mmHg in all 6 patients. Preoperative EL and max WSS were 22.8 ± 27.9 mW and 112 ± 130 Pa. Virtual and postoperative EL decreased to 3.9 ± 3.6 mW and 5.1 ± 3.2 mW (P = 0.12 and P = 0.16, respectively). Virtual and postoperative max WSS significantly decreased to 23 ± 20 Pa and 30 ± 23 Pa (P = 0.028 and P = 0.047, respectively). There was no significant difference between virtual and real surgery in both EL and max WSS (P = 0.55 and P = 0.67, respectively). In control group, postoperative right ventricular systolic pressure was 49 ± 16 mmHg. Postoperative EL was 8.0 ± 4.8 mW, and max WSS was 59 ± 46 Pa. There were tendencies that EL and WSS in control group were greater than those in study group, although there were no statistically significant differences (P = 0.27 and P = 0.21, respectively).

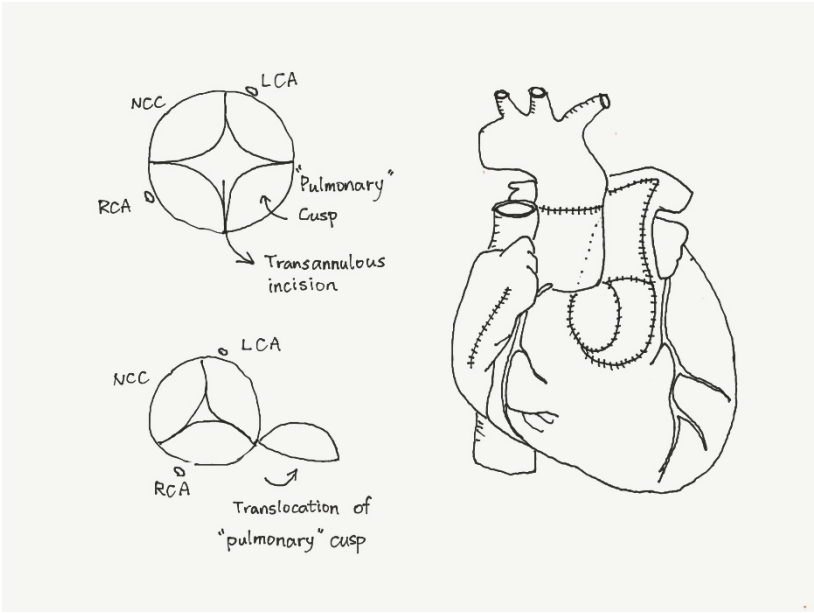
Conclusions: Pulmonary artery plasty, using hemodynamic analysis based on virtual surgery, is an efficient surgical strategy for complicated pulmonary stenosis. This novel strategy can easily and successfully provide an optimal pulmonary artery plasty, equivalent or superior to the conventional approach, which is based on the surgeons' personal experiences and judgements.

T12. Repair Quadricuspid Truncal Valve with Utilization of Pulmonary Cusp to Reconstruct RVOT, Repair without Conduit

Shu-chien Huang, Ling-Yi Wei
National Taiwan University Hospital, Taipei, Taiwan

Objective: Quadricuspid truncal valves are susceptible to regurgitation, and tricuspid configuration is considered more durable after repairing the truncal valve. We report a new method, with translocate the pulmonary cuspid and its aortic wall as an everted flap to reconstruct the right ventricular outflow tract (RVOT).

Case Video Summary: This is a 4-month-and-1-day-old male baby, who was prenatally diagnosed of truncus arteriosus. Post-natal echocardiography also showed small bilateral pulmonary arteries with severe truncal regurgitation. CT showed hairpin aorta compressing right pulmonary artery and airway. He received bilateral banding initially, and transferred to our hospital for total repair. The aorta was transected and pulmonary artery button was separated, then a trans-annular incision was carried into RVOT. We performed truncal valve repair by translocating pulmonary cusp, its annulus and wall to RVOT side and reconstruct the new-aortic valve to tricuspid. The redundant aortic posterior wall was resect to relieve the condition of hairpin aorta before re-anastomosis of ascending aorta. Ventricular septal defect was repair with Dacron patch via RVOT approach. The floor of RVOT was made by the pulmonary cusp including its wall and the resected posterior aortic wall. Then, the anterior wall was reconstructed with bovine pericardial patch with a 19 mm porcine vale. Normal sinus rhythm resumed and cardiopulmonary bypass was weaned smoothly. Post-operative echocardiography confirmed a tricuspid neo-aortic valve with trivial aortic regurgitation, no residual VSD, and a patent right ventricular outflow tract.



Conclusions: We report a surgical technique of restoring competence in truncal insufficiency with tricuspidization of truncal valve and reconstructing truncus arteriosus without using a RVOT conduit.

T13. Chimney Reconstruction of the Aortic Arch in the Norwood Procedure

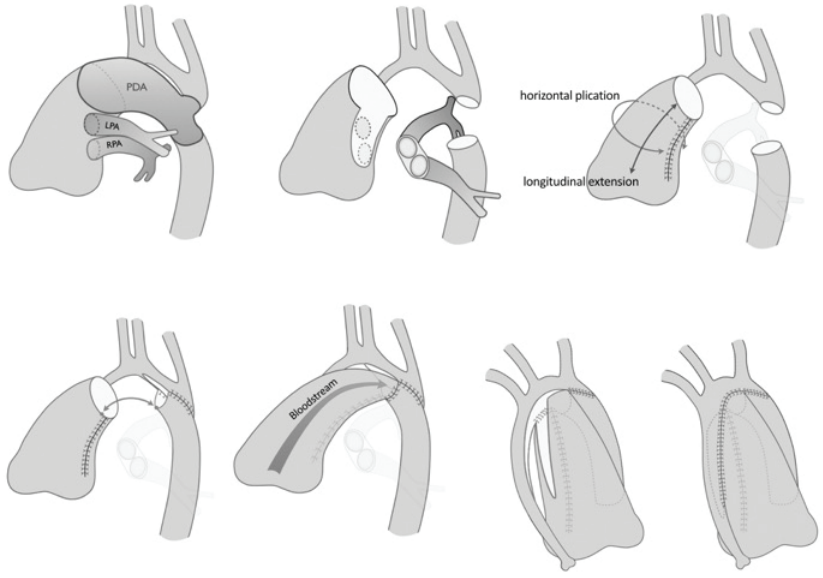
Satoshi Asada, Masaaki Yamagishi, Takako Miyazaki, Yoshinobu Maeda, Shuhei Fujita, Hisayuki Hongu, Haruka Fu, Keiichi Itatani, ◆Hitoshi Yaku

Kyoto Prefectural University of Medicine, Kyoto, Japan

Objective: The use of patch supplementation during aortic arch reconstruction in the Norwood procedure for hypoplastic left heart syndrome (HLHS) has become the norm. However, use of patch materials involves certain critical issues, such as the lack of growth, degeneration and calcification, possibly causing recoarctation. On the other hand, autologous aortic arch reconstruction theoretically increases the risk of postoperative compression of the left pulmonary artery (PA) followed by narrowing of the aorto-pulmonary space. Further, neo-aortic root dilatation and subsequent neo-aortic regurgitation is another late critical complication. In order to avoid these complications, we developed a new aortic arch reconstruction technique referred to as “Chimney reconstruction” that does not require patch supplementation.

Case Video Summary: A 2-month-old boy weighing 3.9 kg was diagnosed with HLHS with aortic and mitral atresia. After bilateral PA banding in the neonatal period as the first palliation, he underwent the Norwood operation. Cardiopulmonary

bypass was established under mild hypothermia through a median re-sternotomy and the ductal tissue was completely resected. The right and left PA orifices, which were longitudinally arranged, were detached in a U-shaped fashion from the posterior wall of the pulmonary trunk, instead of transecting the pulmonary trunk just beneath the bifurcation. The posterior U-shaped defect was closed longitudinally without any patch supplementation and was formed into a chimney-like shape. This maneuver enabled longitudinal extension and horizontal plication of the arterial trunk, resulting in an anastomosis with less tension and a wide aorto-pulmonary space. Subsequently, this arterial trunk was anastomosed to the neo-aortic arch. A modified Blalock-Taussig shunt was constructed on the right PA. Postoperative computed tomography showed a widely secured aorto-pulmonary space without aortic arch obstruction or compression of the left PA. There was no pressure gradient in the neo-aortic arch. Computational fluid dynamics analysis of this neo-aortic arch showed less turbulent flow with little wall shear stress at the isthmus, resulting in low energy-loss performance. The patient subsequently underwent the Fontan procedure at 2 years of age without developing re-coarctation, neo-aortic root dilatation or compression of the left PA.



Conclusions: We developed the novel "Chimney reconstruction" technique for aortic arch reconstruction without patch supplementation in the Norwood procedure. The procedure, which could be employed in settings of low availability of homograft, results in a wide aorto-pulmonary space, producing laminar blood flow without excessive energy loss. The technique preserves growth potential and potentially prevents future neo-aortic root dilatation.

T14. Through Tricuspid Closure for Doubly Committed Subarterial Ventricular Septal Defect with Right Vertical Subaxillary Mini-Incision: A Matched-Pair Analysis

Rui Liu, Zhongdong Hua

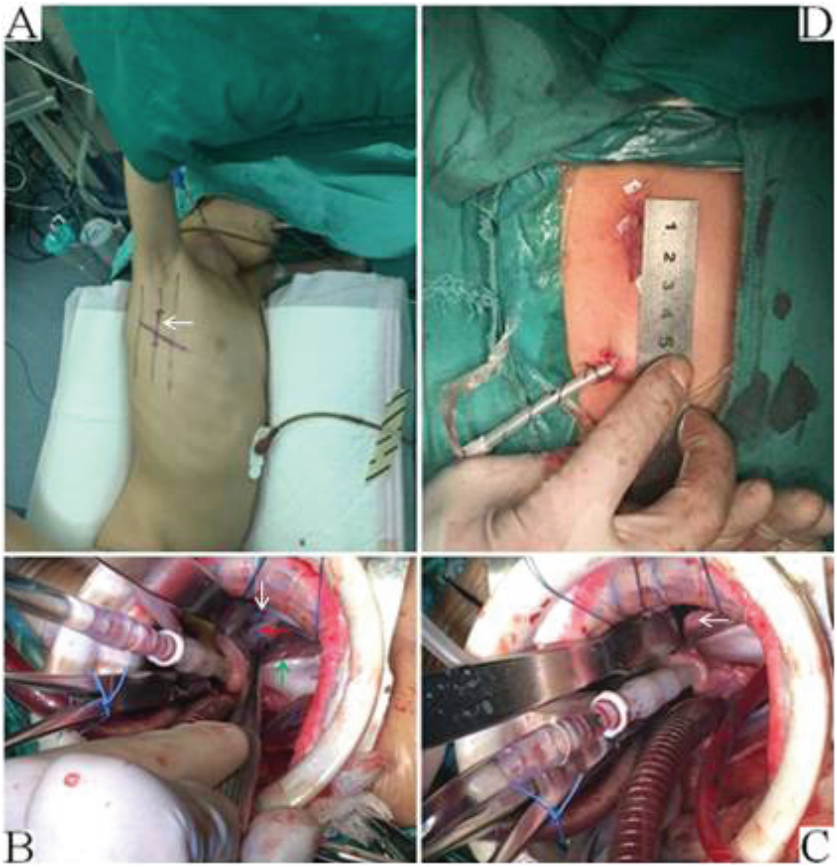
Chinese Academy of Medical Sciences & Peking Union Medical College Fuwai Hospital, Beijing, China

Objective: To evaluate the feasibility and efficacy of the right subaxillary vertical mini-incision (RAVI) used for the closure of doubly committed subarterial ventricular septal defect (SAVSD) through tricuspid approach only.

Methods: From June 2015 to September 2016, 32 SAVSD patients (mean age: 2.4 ± 1.9 years, range: 0.7–8 years) underwent surgical repair with either RAVI (incision length 3–5 cm) through tricuspid (Group A, n = 16) or conventional median sternotomy incision through the main pulmonary artery approach (Group B, n = 16). A retrospective 1:1 matched-pair analysis was performed with Group B was matched for defect size, body weight, gender, patching, and operation year.

Results: The demographics characteristics in both groups were similar. No patient died and only 1 patient in Group B needed reoperation for sternal infection. The mean cardiopulmonary bypass (CPB) time and aortic cross-clamp time was 48.6 ± 12.6 min, 29.3 ± 8.5 min in Group A and 57.8 ± 14.1 min (p = 0.03), 34.3 ± 12.1 min (p = 0.18) in Group B. There was no significant difference between the two groups in the ICU stay (17.8 ± 8.9 hours in Group A vs 18.7 ± 9.5 hours in Group B, p = 0.79), mechanical ventilation support time (2.7 ± 1.7 hours in Group A vs 3.6 ± 1.5 hours in Group B, p = 0.11), postoperative hospital stay(6.3 ± 1.5 days in Group A vs 7.4 ± 1.7 days in Group B, p = 0.06) and chest tube drainage (6.4 ± 4.3 ml/kg in Group A vs 8.5 ± 3.8 ml/kg in Group B, p = 0.16). No significant residual defects were found in both groups. The postoperation pressure gradient across the right ventricular outflow tract (RVOT) were significantly different between the two groups with 4.6 ± 1.8 mmHg in Group A and 10.0 ± 6.8 mmHg in Group B (p = 0.004) even if no significant difference was found between both groups before operation. No arrhythmia was found after operation. All the patients or the parents (100%) in Group A were satisfied with the cosmetic results, whereas the number in Group B was 7 (43.8%) in questionnaire.

Conclusions: The RAVI through tricuspid approach to repair doubly committed subarterial ventricular septal defect is a safe and feasible procedure with better hemodynamic performance of RVOT and less CPB time because of keeping pulmonary artery intact comparing to conventional approach. More important, the RAVI through tricuspid approach can be performed with favorable cosmetic results.



A. Patients are positioned with the right side. The white arrow indicates where the incision will be made. B. To explore the doubly committed subarterial ventricular septal defect. The white arrow indicates the VSD, the red arrow means the semilunar sinus and the green arrow indicates the tricuspid valve. C. Suturing the VSD. The white arrow points out the patch. D. The cosmetic surgical incision.

T15. A Successful Biventricular Repair for a Neonate with Critical Aortic Stenosis Complicated with Left Ventricular Aneurysm and Endocardial Fibroelastosis

Yujiro Ide

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

Objective: Endocardial Fibroelastosis (EFE) sometimes develops in patients with critical aortic stenosis (cAS) or hypo plastic left heart syndrome. However, its severity and influence on LV function are still unpredictable. Moreover, congenital left ventricular aneurysm (LVAn) combined in this disease has not reported before. We present our precious experience to treat this rare disease subset.

Case Video Summary: This patient was diagnosed in fetus as cAS complicated with EFE and LVAn. The patient was delivered by Cesarean at the gestational age of 38 week with 3.3 kg of birth weight. Echocardiography revealed a ductus dependent circulation (antegrade blood flow through aortic valve reached only to the first branch of the aortic arch) and a "swing-like motion" of LV wall almost without centripetal contraction (16% of LVEF). His aortic valve was bicuspid and 5.5 mm in diameter with 15 mmHg of peak pressure gradient. His mitral valve was 6.3 mm in diameter with minimum inflow. The LVAn was located on the apex and it was dyskinetic. Because he developed pulmonary over circulation on day 2, bilateral pulmonary artery banding was performed in anticipation of future univentricular palliation. After the procedure, his condition became stable under continuous prostagrandin infusion. On day 20, however, echocardiography showed different hemodynamics; LV contracted centripetally with 79% of EF and antegrade blood flow through aortic valve (peak pressure gradient was 71 mmHg) reached to the descending aorta, although there were no significant changes in EFE and LVAn. On day 21, we performed biventricular repair by surgical aortic valvotomy, division of patent ductus arteriosus, bilateral PA debanding and LV reconstruction with Dor procedure without EFE resection. In case he couldn't tolerate with post-repair, we would convert to palliative surgery (Damus-Kay-Stansel anastomosis and BT shunt placement). CPB and cross-clamp time was 136 minutes and 68 minutes, respectively. Although he was complicated with mediastinitis and required chest explorations, he was extubated finally on POD30. Postoperative catheter examination demonstrated an acceptable hemodynamics with 66/42 mmHg of systemic pressure and 3.5 L/min/m^2 of cardiac index, although mild aortic stenosis (peak pressure gradient of 32 mmHg) remained and LA pressure was relatively high (15 mmHg). Then he was discharged home on POD59. He has been followed for more than 1 year without additional surgical nor catheter interventions. The latest echocardiography revealed a successful maintenance of biventricular circulation even though diastolic dysfunction still existed.

Conclusions: A cAS neonate with EFE and LVAn showed dramatical change in his LV contractility within a short time and could achieve biventricular circulation after aortic valvotomy and exclusion of LVAn, although his LV seemed impossible to support a systemic circulation at his birth.

8:25 am Adjourn

7:00 am – 8:25 am **General Thoracic Emerging Technologies and Techniques/Case Video Forum** Room 302/304, Hynes

5 minute presentation, 4 minute discussion

Moderators: *Jay M. Lee and *Varun Puri

T16. Laparoscopic Ligation of Cisterna Chyli

Ilitch Diaz Gutierrez, *Rafael Santiago Andrade
University of Minnesota, Minneapolis, MN

Objective: To describe an alternative technique for the management of patients with chylothorax when minimally invasive and transthoracic approaches have failed or are too risky.

Case Video Summary: *Case presentation*: This is an 82-year-old female patient with history of T12 vertebral body fracture secondary to a motor vehicle collision. She underwent T10-L2 posterior spinal fusion. Four weeks after surgery she developed bilateral chylothorax refractory to medical therapy. After 7 days of conservative measures, chest tube output was consistently more than 2,000 ml a day. Embolization via interventional radiology was unsuccessful due to a left subclavian vein thrombus. Given that the suspected level of injury was at the level of T12, the decision was made to proceed with ligation of the cisterna chyli via laparoscopy.

Description of the operation: We used a standard 5-port approach for foregut surgery with a subxiphoid 5 mm incision for liver retractor. The lesser sac was entered by dividing the gastrohepatic ligament. A Penrose drain was placed around the stomach for lateral retraction. The dissection was started in the aorto-caval window just medial to the left gastric artery and the descending aorta, working toward the inferior vena cava. All fatty tissue between the aorta and inferior vena cava was divided between clips. The margins of dissection were the right side of the aorta medially, the common hepatic artery inferiorly, the lateral border of the inferior vena cava laterally and the superior recess of the omental bursa superiorly. The inferior vena cava was mobilized and the cisterna chyli was suture ligated with O-silk. At the end of the procedure, there was no evidence of lymph leak.

Postoperative period: The patient was kept on antibiotics for 48 hours. Fluid and electrolytes were replaced diligently. Oral diet was initiated and progressively advanced to regular. Total parenteral nutrition was discontinued after caloric intake was adequate. Once chest tube output decreased to less than 50 ml/24 hours, a high-fatty diet challenge was performed. Chest tubes were removed at 4 weeks after cisterna chyli ligation. A 4-month follow-up, CXR showed complete resolution of the chylothorax and no evidence of recurrence.

Conclusions: Laparoscopic ligation of cisterna chyli offers a great advantage for treatment of chylothorax in patients with a hostile thoracic cavity or those who have failed or are not candidates for embolization.

T17. The Role of Minimally Invasive Thoracoscopic Approach for the Operation of Non-Small Cell Lung Cancer Involving Vertebral Column

Kwanyong Hyun, Chang Hyun Kang, Samina Park, Yoohwa Hwang, Hyun Joo Lee, In Kyu Park, *Young Tae Kim

Seoul National University College of Medicine, Seoul, Republic of Korea

Objective: Close cooperation with neurosurgical team is a key factor for the success in surgical treatment of non–small cell lung cancer (NSCLC) invading vertebral column. We report a case of successful resection of vertebra and NSCLC with a support of thoracoscopic lobectomy and vertebral dissection.

Case Video Summary: 52-year-old man with a complaint of back pain was referred to our clinic for a lung mass. Computed tomography scans of the chest revealed a 3.1 cm sized NSCLC, which was invading chest wall and T2 vertebra. Magnetic resonance imaging also demonstrated extrapleural mass abutting 2nd rib head and T2-3 vertebra at the 2nd intercostal space with no spinal cord impingement. With a finding of interval decrease in the size of lung and bone lesions after neoadjuvant concurrent chemoradiation for the tumor, the patient underwent surgery. For safe and faster vertebral resection, partial discectomy and intercostal artery ligation were performed through right thoracoscopic approach. Then, the patient was turned over opposite side and thoracoscopic left upper lobectomy and mediastinal lymphadenectomy were performed. Partial discectomy and intercostal artery ligation were also performed on the left side. In prone position, *en bloc* resection of T2 vertebra, 2nd-3rd left rib head, and wedged LUL was performed by neurosurgeon with T2 interbody reconstruction using a cage, and posterior stabilization (C7-T6). The patient fared well postoperatively and recovered full strength without any weakness or gait disturbance. His pain improved significantly and he was discharged home at the 8th postoperative day. Final pathological findings were consistent with T4 adenocarcinoma of the left upper lobe, but with microscopic tumor infiltration of the resection margin of the 2nd-3rd rib. For which, he was arranged for a 3-week boost radiation therapy over the left posterior chest wall.

Conclusions: Thoracoscopic vertebral dissection may help minimize surgical trauma and maximize mobilization of the vertebra during total vertebrectomy. It also provides safe operation-field for further neurosurgical dissection by putting aside the aorta from the vertebral body. Hence, it offers another tool for surgeons in the treatment of NSCLC involving vertebral column.

T18. Endoscopic Repair of Bronchogastric Fistula After Esophagectomy

Igor Brichkov

Rutgers Cancer Institute of New Jersey, New Brunswick, NJ

Objective: A bronchogastric fistula after esophagectomy is a potentially fatal complication. Conventional treatment strategies involve esophageal diversion, resection of the gastric conduit and airway repair with muscular flaps, carrying a significant morbidity. Endoscopic suture repair of fistulae occurring between the airway and gastric conduit after esophagectomy is a safe and effective treatment modality.

Case Video Summary: A 65-year-old male presented with complaints of cough on swallowing 3 weeks after an uneventful minimally invasive Ivor Lewis esophagogastrectomy. Though his initial postoperative course after esophagectomy was unremarkable with no demonstrable leak on esophagography and toleration of soft diet, the patient now complained of increased cough with any oral intake. Computed tomography demonstrated a fistula between the proximal gastric conduit and the proximal membranous right mainstream bronchus. Bronchoscopy and upper endoscopy revealed a 1 cm fistula at the proximal mainstream bronchus with pulmonary soilage within the right lower lobe and fistula in the anterolateral aspect of the proximal gastric conduit, respectively. After ablation of the mucosal edges of the fistula with argon plasma coagulation, the fistula was sutured endoscopically using 2-0 proline. A total of two figure-of-eight sutures were used. Completion endoscopy and bronchoscopy revealed complete closure of the fistula. The repair was buttressed with a self-expanding metallic stent. The patient underwent computed tomographic esophagography on the following day confirming adequate repair of the fistula. The patient was discharged on a regular diet with complete resolution of his symptoms. The stent was removed 6 weeks later with no fistula recurrence.

Conclusions: Endoscopic repair of gastric conduit to airway fistula after esophagectomy is safe and feasible utilizing one or more modalities. Use of endoscopic suturing is an effective method of repairing this potentially fatal complication.

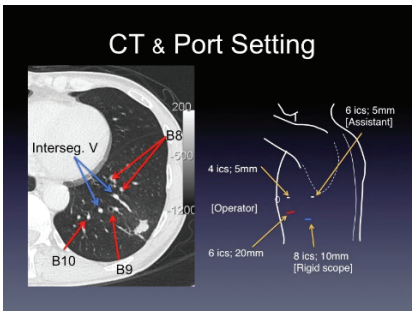
T19. Thoracoscopic Anatomical Lung Segmentectomy Based on Dissection Along the Intersegmental Veins, Left Lateral Basal Segmentectomy

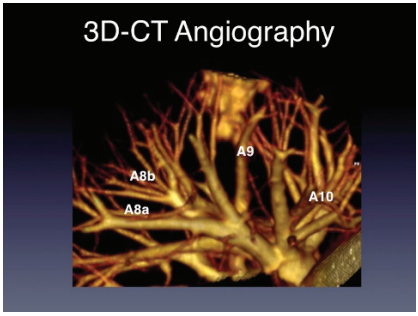
Hiroyuki Oizumi, Hirohisa Kato, Jun Suzuki, Hikaru Watarai, Akira Hamada,
*Kenta Nakahashi, Mitsuaki Sadahiro
Yamagata University, Yamagata, Japan

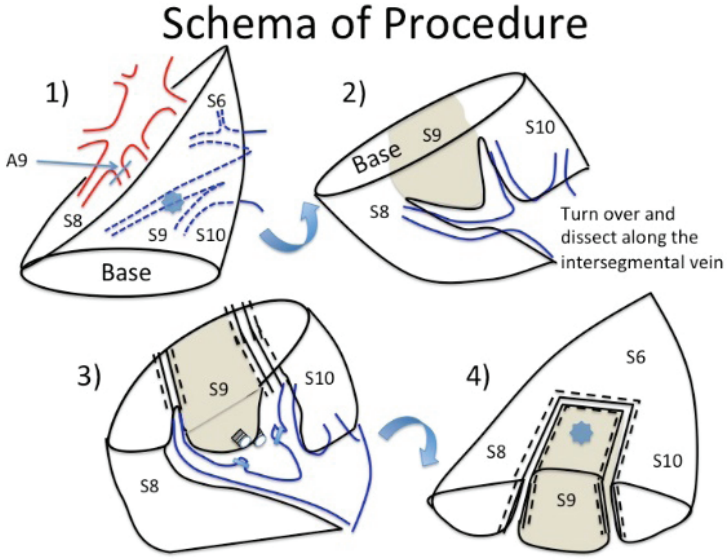
Objective: We conducted 290 thoracoscopic anatomical segmentectomies including combined multiple subsegmentectomies. The lateral basal segmentectomy is one of the most difficult procedures because arteries and bronchi are located in the deep parenchyma from the major fissure. The video demonstrates the main steps of the procedure.

Case Video Summary: A 57-year-old man with suspicion of Non-Tuberculous Mycobacteria Infection was referred to our hospital. Chest computed tomography showed a nodular shadow in his left lateral basal segment (S9). One flexible 20-mm, one 10-mm, and two 5-mm ports were inserted. Needle biopsy specimen of this nodule confirmed the diagnosis of epithelioid granuloma and S9 segmentectomy was performed. We first dissected the inferior pulmonary vein and the branches were identified referring to the 3D computed tomography angiography imaging. In general, inferior pulmonary vein is consisted of superior, superior basal (SBV) and inferior basal vein (IBV). Under turning over the basal segment parenchymal dissection along SBV and IBV leads to the bronchus. We dissected the pulmonary artery in the interlobar fissure. But the intersegmental planes were dissected along the intersegmental veins from the root of the inferior vein. The key to this procedure is to release the vascular sheath and dissect the parenchyma using a sealing device. We encircled the bronchus using monofilament polypropylene thread. A

slip-knot was made outside the thorax and whole-lung ventilation was performed. During lung ventilation, one end of the string was pulled, and the knot slipped to reach the bronchus without a knot-pusher. The outflow of segmental air was blocked and the S9 remained expanded whereas the other segments collapsed. The bronchus was then divided using a stapler. The inflation-deflation lines became gradually distinct. Then, we further dissected the pulmonary parenchyma along the intersegmental vein or the inflation–deflation line. The intersegmental veins were preserved and intrasegmental veins were divided. The peripheral lung was dissected with a stapler. Fibrin glue was sprayed at the cut surface. The operation time was 229 min. The blood loss was 151 ml. Air leakage was not observed and the chest tube was removed at POD 1. The final diagnosis was a Mycobacterium avium complex infection.







Conclusions: In lateral basal segmentectomy dissection of the veins from the root of inferior pulmonary vein facilitates the anatomical exposure of the bronchus. The merit of this procedure should be the avoidance of extra parenchymal (S8, S10) splitting from the superior segment (S6).

T20. Electromagnetic Navigation Bronchoscopy-Guided Dye Marking for Minimally Invasive Resection of More Than 100 Pulmonary Nodules

Kunal Mehta, *Arjun Pennathur, Tadeusz Witek, Michael R. Reidy, Valentino Bianco, William E. Gooding, *Matthew J. Schuchert, *James D. Luketich, Omar Awais
University of Pittsburgh, Pittsburgh, PA

Objective: Electromagnetic-navigational-bronchoscopy (ENB)-guided pleural dye marking followed by resection is a novel method to obtain a definitive diagnosis for small lung nodules. The main objective of this study was to evaluate the safety and efficacy of our preliminary experience with ENB-guided dye localization and minimally invasive resection of lung nodules.

Methods: Patients with peripheral lung nodules underwent ENB-guided dye marking in the operating room followed by minimally invasive resection (video-assisted thoracoscopic surgery or robot-assisted resection) in the same setting. The primary endpoints of this study were the rates of nodule localization and definitive diagnosis of the lung lesion.

Results: We performed ENB-guided localization and minimally invasive resection of 106 lung nodules in 94 patients (50 male; 44 female; median age 64 years). Of these patients, 78% (73/94) had a substantial history of smoking with a median of 20 pack years and 59% (55/94) had a history of previous malignancy. The mean lesion size was 11.2 mm with a mean distance from the lesion to pleural surface of 13.1 mm. The operative mortality was 0% and the median hospital length of stay was 3 days. The nodule was localized and resected with definitive diagnosis obtained in all patients (94/94; 100%). The nodule was neoplastic in 69.1% (65/94) patients. All malignant nodules were completely excised with negative margins.

Conclusions: Our experience with ENB-guided-dye-localization and thoracoscopic resection demonstrated that the technique was safe and successful in the diagnosis of small lung lesions. Further work is required for the optimal selection of patients for using this technique. Thoracic surgeons should further investigate this modality and consider incorporating it into their armamentarium.

T21. Predicting Pulmonary Air Leak Resolution Using Transpleural Airflow Data After Lung Resection

◆Sebastien Gilbert[1], Daniel G. French[2], Natalie Japkowicz[3], Mohsen Ghazel[1]

[1]University of Ottawa, Ottawa, ON, Canada; [2]Dalhousie University, Halifax, NS, Canada; [3]American University, Washington, DC

Objective: To develop an on-demand forecasting model in order to determine the optimal timing to remove chest tubes after pulmonary resection using digitally recorded airflow measurements.

Methods: Digitally recorded airflow data from 32 patients who underwent pulmonary resection was used to estimate a statistical time-series forecasting model of future airflow measurements using historical airflow data. An Autoregressive Integrated Moving Average (ARIMA) statistical forecasting model is fitted to the most recently recorded airflow measurements over a time frame of length $T_{history}$ hours. This model is then used to predict future values of the airflow over the immediate forecasting horizon of length $T_{horizon}$ hours. The inherent non-stationarity in the airflow time series is avoided by limiting the historical data period to $T_{history}$ = 24 hours or less. Also, to account for the uncertainties associated time series predictions, we limit the forecasting horizon to $T_{horizon}$ = 24 hours or less and generate many (1,000) possible forecasting paths of potential predicted values. The likelihood of the safe removal of the chest tube is then estimated by the percentage of these forecasting paths, which satisfy the following criterion: predicted airflow does not exceed 30 ml/min for the next 8 hours. In order to achieve more distant prediction and require the airflow signal to stabilize, we tested a more practical clinical scenario with a forecasting horizon of $T_{horizon}$ = 24 hours and the chest-tube is assumed to be safely removed if the above criterion is met over the last 8 hours (i.e., between 16^{th} and the 24^{th} hour). The predicted times for removal of the chest tubes were then compared to the times when chest tubes were actually removed.

Results: The performance of the proposed system was evaluated on 32 patients (Table). With 95% probability, the system correctly predicted to maintain the chest tube for 7 patients and remove the chest tube for 20 patients, whereas it incorrectly predicted to maintain the chest for the remaining 5 patients (15.83% of 32 patients). For the 20 patients with correctly predicted chest tube removal, the system forecasted removal times that are significantly lower than the actual chest tube removal times, resulting in an average time saving of 3,877 minutes and the 95% confidence interval of the saved time is (932.89, 6,821.11) minutes. The system did not predict any chest tube removal at times when they should not have been removed, hence eliminating the need for reinsertion.

Table 1: Prediction results for the processed data of 32 patients.

		Reality	Prediction			Difference
#	Subject ID	Inserted Chest Tube Duration T_{act} (mins)	Prediction (Remove/ Not remove)	Validation Correct/ Incorrect	Predicted removal time T_{pred} (mins)	Saved Time $T_{act} - T_{pred}$ (mins)
1	61	8440	Do not remove	Correct	NA	NA
2	68	5670	Do not remove	Correct	NA	NA
3	79	5620	Remove	Correct	1450	4170
4	92	9640	Remove	Correct	1450	8190
5	93	3120	Remove	Correct	1450	1670
6	105	5290	Do not remove	Incorrect	NA	NA
7	114	12390	Remove	Correct	7630	4760
8	121	9280	Do not remove	Correct	NA	NA
9	122	5290	Do not remove	Correct	NA	NA
10	124	4380	Do not remove	Correct	NA	NA
11	128	5500	Remove	Correct	1450	4050
12	134	8310	Do not remove	Correct	NA	NA
13	137	4550	Remove	Correct	1450	3100
14	138	9520	Remove	Correct	1450	8070
15	139	3980	Remove	Correct	1450	2530
16	145	5430	Remove	Correct	1450	3980
17	146	3960	Do not remove	Incorrect	NA	NA
18	150	8620	Remove	Correct	5890	2730
19	152	18190	Do not remove	Correct	NA	NA
20	158	6710	Remove	Correct	2710	4000
21	164	4020	Remove	Correct	2290	1730
22	167	5600	Remove	Correct	1450	4150
23	176	8680	Remove	Correct	1450	7230
24	181	6420	Remove	Correct	1450	4970
25	182	4060	Remove	Correct	2290	1770
26	196	4780	Remove	Correct	2770	2010
27	202	3780	Do not remove	Incorrect	NA	NA
28	210	5160	Do not remove	Incorrect	NA	NA
29	214	8020	Do not remove	Incorrect	NA	NA
30	222	4030	Remove	Correct	1450	2580
31	230	3810	Remove	Correct	1570	2240
32	231	5060	Remove	Correct	1450	3610

Conclusions: It is possible to predict the future airflow from a chest tube over the next 8, 16, and 24 hours using previously measured values. Predicting airflow will facilitate earlier and timelier removal of chest tubes and enhance discharge planning, allocation of hospital resources and patient satisfaction. This prediction model can also prevent adverse events associated with premature removal of chest tubes.

T22. Laparoscopic Trans-Diaphragmatic Chest Surgery: Early Experience

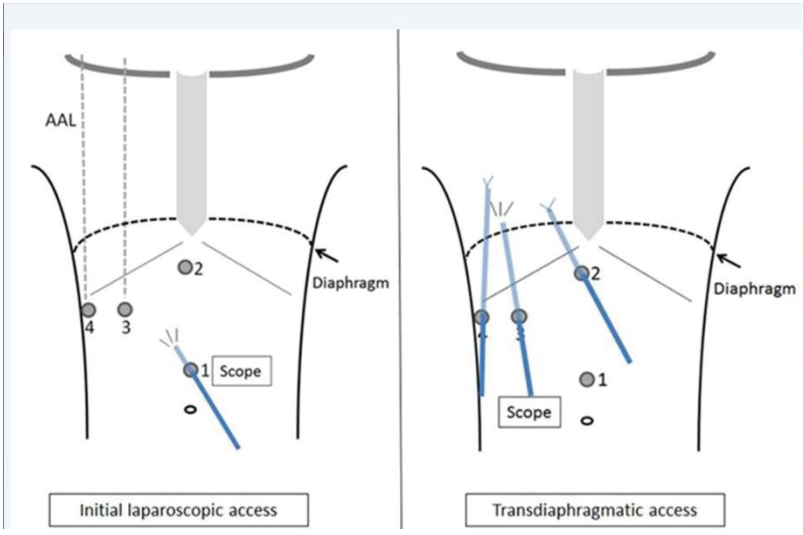
Ilitch Diaz Gutierrez, Eitan Podgaetz, Madhuri Rao, *Rafael Santiago Andrade

University of Minnesota, Minneapolis, MN

Objective: We describe our technique of laparoscopic transdiaphragmatic (LTD) chest surgery without intercostal incisions and focus on technique and safety. The eventual goal of LTD will be to improve postoperative pain management and prevent intercostal neuralgia in select patients.

Methods: We placed the patient in semilateral decubitus and placed a supraumbilical port, a subxiphoid port, and 2 subcostal ports (Figure). We made 2 small openings anteriorly in the hemidiaphragm and advance the subcostal ports through the diaphragm into the chest cavity. We placed the scope through a subcostal port for a thoracoscopic view and advance the subxiphoid port into the chest. The intrathoracic portion of the operation is similar to VATS. At the end, we placed a chest tube through the subxiphoid port, pulled the ports back into the abdomen, and closed the diaphragmatic openings laparoscopically.

Results: We performed 25 LTD chest procedures (wedge = 16, lobectomy = 3, segmentectomy = 3, other = 3) between September 2010 and October 2016. Indications for lung resection were lung nodule = 13, lung cancer = 5, interstitial lung disease = 4, other = 3. Seventeen procedures were on the right and 7 on the left. Median operative time for wedge resections was 137 minutes (106–171 min) and for lobectomy/segmentectomy (n = 6) was 301 min (255–356 min; includes transcervical extended mediastinal lymphadenectomy in 3 patients). Median blood loss for all cases was 20 ml (5–500 ml), and median LoS was 1 day (0–8 days). One patient required conversion to thoracotomy to complete a segmentectomy and one to VATS to complete a lobectomy. Complications occurred in 6 patients (25%) and were urinary retention (n = 3), delirium (n = 1), prolonged air leak (n = 1) and sputum retention requiring bronchoscopy (n = 1). Seventeen patients (70%) have had follow-up CT scans at a median of 8 months (1–28) after surgery without evidence of diaphragmatic hernia.



Conclusion: Our early experience suggests that LTD chest surgery is feasible and safe on short-term follow-up. The specific role of LTD chest surgery will require definition of patient selection criteria, further experience to reduce operating room time, long-term follow-up and eventual comparison with standard VATS.

T23. The Impact of an Energy Sealing Device in Thoracoscopic Anatomic Segmentectomy for Small-Sized Pulmonary Nodules

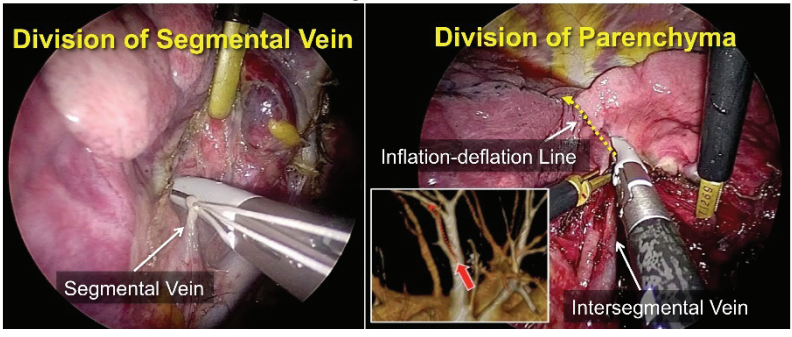
Hirohisa Kato, Hiroyuki Oizumi, Jun Suzuki, Akira Hamada, Hikaru Watarai, Kenta Nakahashi, Mitsuaki Sadahiro

Yamagata University, Yamagata-shi, Japan

Objective: Recently, the number of pulmonary segmentectomies for small-sized pulmonary nodules has increased. Thoracoscopic surgery is also in great demand as minimally invasive surgery. We have made step-by-step improvements in the surgical techniques for thoracoscopic segmentectomy, including the recent use of an energy sealing device to divide the intersegmental parenchyma. Energy sealing devices have been widely used for various endoscopic surgeries, but very few reports have investigated the usefulness of these devices in thoracoscopic segmentectomy.

Methods: Between September 2004 and September 2016 at our institution, 280 consecutive patients underwent thoracoscopic anatomic segmentectomies. Energy sealing devices have been applied for dividing pulmonary vessels since 2008 and parenchyma since 2012. This study included 162 patients who underwent thoracoscopic anatomic segmentectomies using energy sealing devices for division of pulmonary vessels (≤7 mm) after proximal ligation and also for parenchymal division along intersegmental veins and inflation-deflation lines (Figure). They were compared with 118 patients who underwent thoracoscopic anatomic segmentectomies with conventional methods (electrocautery or stapler) with regard to surgical time, blood loss, and duration of chest tube and hospital stay.

Figure



*AATS Member ◆AATS New Member

Results: Patients treated with the energy sealing device underwent segmentectomies (n = 101), sub-segmentectomies (n = 33), and segmentectomy combined with adjacent sub-segmentectomies (n = 28). Difficult segmentectomies with multiple dissection surfaces were performed in 142 patients (87.7%), and the ratio of difficult segmentectomies significantly increased compared with conventional methods (n = 83, 70.3%) ($p < 0.001$). Diagnoses were lung cancer (n = 130), metastatic lung tumors (n = 19), and benign tumors (n = 13). In patients treated with energy sealing devices versus conventional methods, there was no significant difference in median chest tube duration (1 day [range: 1–7 days] vs 1 day [range: 1–8 days], $p = 0.6001$), but there were significant reductions in the following: mean surgical time (178 ± 54.6 min vs 198 ± 64.3 min, $p = 0.0029$); median blood loss (36.5 mL [range: 0–660 mL] vs 60.5 mL [range: 0–882 mL], $p = 0.0055$); and median postoperative hospital stay (6 days [range: 3–16 days] vs 7 days [range: 2–29 days], $p < 0.0001$). There were no deaths or severe complications in patients treated with the energy sealing device although 9 cases (5.6%) with alveolar fistulas needed chemical pleurodesis, and 2 cases (1.2%) were converted to thoracotomy due to pulmonary artery bleeding. During a mean follow-up period of 24.9 months, recurrences occurred in 2 poor-risk patients.

Conclusion: Energy sealing devices are simple and safe to use for dividing pulmonary vessels and parenchyma during thoracoscopic anatomic segmentectomy for small-sized pulmonary nodules.

T24. Using a Biploar Seal-and-Cut Device for Minimally Invasive Lung Resections Seal-and-Cut Device for Minimally Invasive Lung Resections

Thomas Kiefer[1], Sarah Counts[2]

[1]Klinikum, Konstanz, Germany; [2]Yale University, New Haven, CT

Objective: Minimally invasive anatomic lung resections have frequently become the procedures of choice for treatment of lung pathology. A significant aspect of these procedures is the dissection and transection of blood vessels and lung parenchyma with thorascopic staplers. In some instances, the staplers are large and cumbersome in comparison with the size of the blood vessel or tissue that needs to be divided. This has led surgeons to seek out other easier-to-use alternatives, which could also be more cost effective. A potential solution is the use of so called “energy devices” that can be used to seal and cut vessels with one instrument (i.e., ultrasound-driven devices of bipolar instruments) This study describes the prospectively captured experience with these devices in 30 consecutive procedures from a single center.

Methods: From April 2010 to August 2016, 30 minimally invasive lung resections were performed with the use of a bipolar 5 mm seal-and-cut device. This instrument had the ability for 360° of rotation and 80° of articulation. Of the 30 cases, 28 were lobectomies, 1 bilobectomy, and 1 segmentectomy. The indication for surgery was non–small cell lung cancer (NSCLC) in 28 cases, metastases from Colon cancer in 1 case, and 1 was a centrally located, PET-positive benign tumour. Data was prospectively obtained which included operative time, the number of seal-and-cut procedures, the number of potentially saved stapler cartridges, and the overall.

Results: During the 30 procedures, 14 were performed with the assistance of a 3D-imaging-system. In total, 22 veins and 65 arteries were safely dissected and transected with this bipolar technique. There were two conversions to an open procedure, none of which were related to the seal-and-cut device. There were no cases of haemorrhage from the vasculature after using the seal-and-cut device, and the postoperative courses were uneventful. All of the blood vessels that were felt to be safely grasped with the device were completely dissected and transected with it. Operative time was compared to a historical group, which was noted to be significantly shorter (i.e., 132 vs 160 minutes, respectively). This decreased operative time could also be attributed to the learning curve in the historical group. The estimated number of "saved" stapler cartridges averaged to be 4 with a potential to "save" 8 in a left upper lobectomy.

Conclusions: Bipolar dissection of pulmonary vessels with a seal-and-cut device is a safe way to deal with blood vessels during a minimally invasive procedure. In particular, when dealing with small vessels such as the small lobar branches, it is as good if not better than a stapler. There is also a potential significant cost savings if the seal-and-cut device is used instead of a stapling device.

8:25 am **Adjourn**

TUESDAY MORNING, MAY 2, 2017

8:35 am – 9:55 am **Plenary Scientific Session** Ballroom ABC, Hynes
6 minute presentation, 10 minute discussion

Moderators: *Thoralf M. Sundt, III and *Marc R. Moon

39. Intraoperative Extracorporeal Membrane Oxygenation Improves Survival in Lung Transplantation

Konrad Hoetzenecker, Stefan Schwarz, Alberto Benazzo, Peter Jaksch, Gabriella Muraközy, Helmut Hager, Georg Roth, György Lang, Shahrokh Taghavi, *Walter Klepetko
Medical University of Vienna, Vienna, Austria

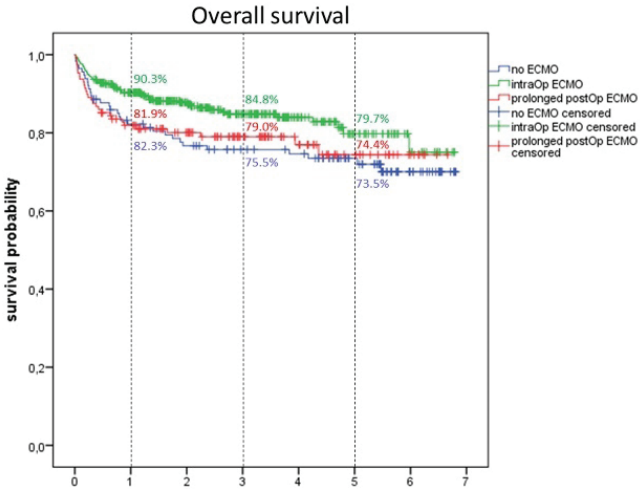
Invited Discussant: *Shaf Keshavjee

Objective: Optimal intraoperative management of patients during lung transplantation remains controversial. Whereas several groups prefer transplantation without extracorporeal support, others favor the routine use of CPB. In our department v/a ECMO has become the standard intraoperative support since more than 10 years, and we gradually have broadened its indication from complex and intraoperative unstable patients, to a preemptive application in almost all patients. In addition, we have introduced the concept of a prolongation of intraoperative ECMO into the early postoperative period, whenever graft function does not meet clearly defined quality criteria at the end of implantation (mPAP/mSAP < 2/3 or PO2/FiO2 > 100), or in patients with other clear risk factors such as PPH. In this report, we review the results of this strategy.

Methods: All standard lung transplantations performed from 01/2010 to 06/2016 were included in this single-center retrospective analysis. Single-lung, retransplantations, heart-lung transplantations, and patients bridged to transplantation were

excluded, leaving 594 patients for analysis. Patients were divided into three groups according to the mode of support (Group I: no ECMO [n = 116], Group II: intraop ECMO [n = 350], Group III: intraop+prolonged postop ECMO [n = 128]).

Results: There were profound differences in patient characteristics between the three groups, with an increasing scale of complexity from Group I to III. The most complex patients were in the prolonged ECMO group (34% PPH, 8.4% high urgent, 25% lobar transplant recipients). The non-ECMO group mainly consisted of COPD patients (56%), with only few high-urgent listings (1.7%) and lobar transplantations (10%). Group III was on ECMO for a median of 2 days postoperatively (range: 1–11). Analysis of the highest PGD grade reached within 72 hours postTx, revealed an overall low number of PGD 3 with a nonsignificant trend toward less PGD 3 (4% vs 6%) in Group II compared with group I. Calculation of PGD was not possible for Group III patients by definition. 1-, 3-, and 5-year survival was significantly better in patients with an intraOp ECMO support compared to non-ECMO patients (90.3% vs 82.3%, 84.8% vs 75.5%, 79.7% vs 73.5%; p = 0.045; Figure). Despite the high number of complex patients in Group III, outcome was encouraging with 1-, 3-, and 5-year survival rates of 81.9%, 79.0%, and 74.4%, which was at all time points equal or better than in the non-ECMO group. This was independent from the development of BOS, with time to BOS being similar in all groups. Multivariate analysis revealed that the use of intraOp ECMO remained an independent predictor of survival with a HR 0.59 (95% CI [0.36–0.96], p = 0.035).



Patients at risk

no ECMO	116	90	82	72	68	48	20	0
intraOp ECMO	350	277	199	139	79	42	15	0
prolonged postOp ECMO	128	98	80	56	38	21	7	0

Conclusions: IntraOp ECMO support leads to superior survival compared to transplantation without ECMO. The concept of prolonged prophylactic postOp ECMO results in excellent outcomes in the most critical patients.

40. Long-Term Outcome Following Concomitant Mitral Valve Surgery and Cox Maze Procedure for Atrial Fibrillation: High Return to Sinus Rhythm and Remarkably Low Incidence of Stroke

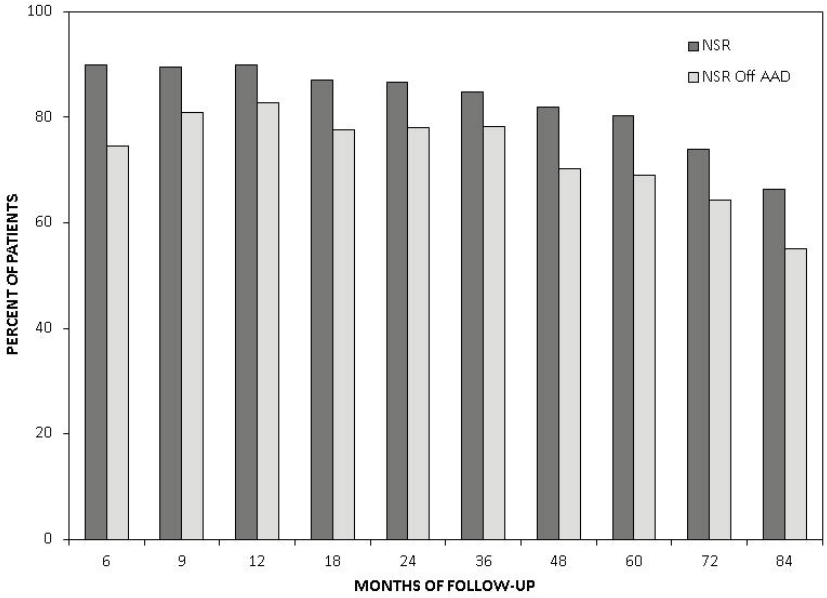
*Niv Ad[1], Sari D. Holmes[2], Paul S. Massimiano[3], Anthony J. Rongione[3], Lisa M. Fornaresio[2]
[1]West Virginia University Heart and Vascular Institute, Morgantown, WV; [2]Adventist HealthCare, Takoma Park, MD

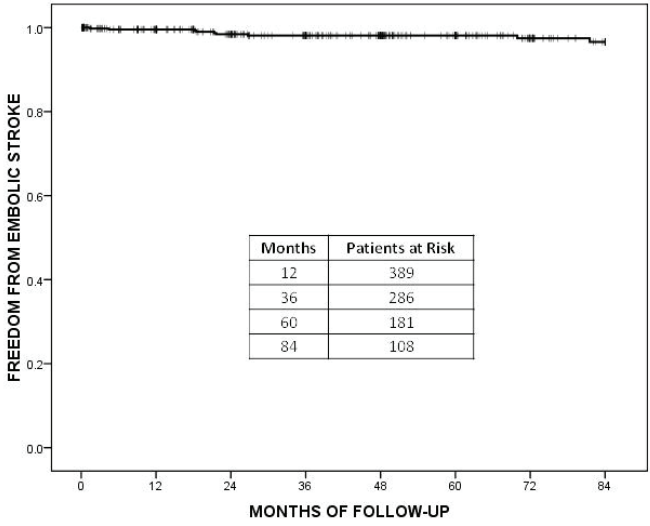
Invited Discussant: *A. Marc Gillinov

Objective: Atrial fibrillation (AF), if untreated, is associated with increased long-term mortality and morbidity in patients undergoing valve surgery. However, data are limited regarding the long-term effect of surgical ablation for AF on outcome. The purpose of this study was to examine the long-term impact of the concomitant full Cox maze (CM) procedure and mitral valve surgery on freedom from atrial arrhythmia and stroke.

Methods: Patients who underwent concomitant CM at a single center since September 2005 were part of a prospective follow-up program (N = 714) of which 473 patients had a mitral valve procedure. Data on rhythm, medication status, follow-up interventions, and clinical events were captured according to the HRS guidelines at 6, 9, 12, 18, 24 months, and yearly thereafter, up to 7 years. Kaplan-Meier survival analysis was conducted to examine freedom from events and mortality during follow-up.

Results: Mean age was 65 years and mean EuroSCORE II was 5%. Mitral valve was the only concomitant procedure in 46% of patients, 44% had 3 total procedures, and 10% had 4+ procedures. Mean left atrium size was 5.3 cm with 36% >5.5 cm, and only 15% with paroxysmal AF. Perioperative stroke occurred in 2 patients (0.4%) and operative mortality was 2.7% (n = 13). Return to sinus rhythm regardless of class I/III anti arrhythmic drugs (AAD) at 1, 5, and 7 years was 90% (333/370), 80% (127/158), and 66% (53/80). Sinus rhythm off AAD at 1, 5, and 7 years was 83% (301/364), 69% (109/158), and 55% (44/80; Figure). At 7 years, monitoring revealed that only 22% of patients with recurrent atrial arrhythmia demonstrated a continuous pattern. Freedom from embolic stroke at 7 years was 96.6% (0.4 strokes per 1,000 patient-years of follow-up) with the majority of patients off anticoagulation (Figure) and cumulative survival was 77%. In the group who underwent only mitral valve and CM procedures (n = 217), sinus rhythm regardless of AAD at 1, 5, and 7 years was 92% (153/167), 86% (68/79), and 80% (36/45) and sinus rhythm off AAD at 1, 5, and 7 years was 85% (140/165), 79% (62/79), and 64% (29/45).





Months	Patients at Risk
12	389
36	286
60	181
84	108

Conclusions: Our study suggests that addition of the Cox maze procedure to mitral valve procedures, even with a very high degree of complexity, was not associated with increased operative risk. In long-term follow-up, the CM procedure also demonstrated acceptable rhythm success, reduced AF burden, and a remarkably low stroke rate. Such findings should be communicated with patients and referring cardiologists.

41. Surgery for Congenital Heart Disease Beyond 50 Years of Age: Mid-Term Outcomes and Risk Factors of an Emerging Population

Mauro Lo Rito, Tommaso Generali, Alessandro Varrica, Mario Carminati, Angelo Micheletti, *Alessandro Frigiola, Marco Ranucci, Massimo Chessa, *Alessandro Giamberti

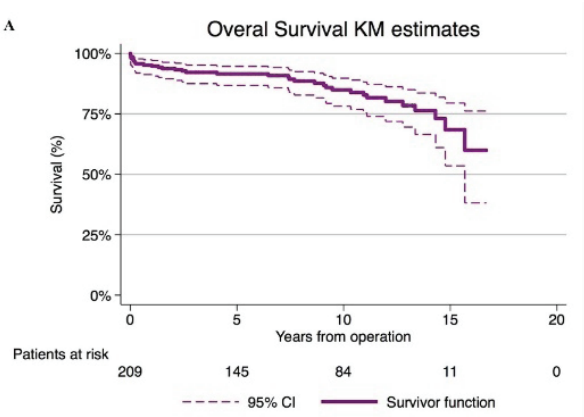
IRCCS Policlinico San Donato, San Donato Milanese, Italy

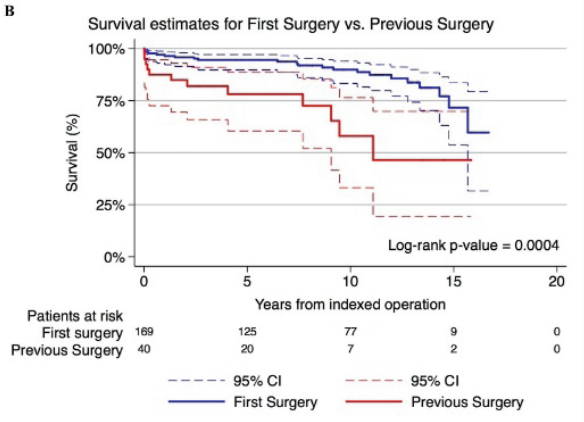
Invited Discussant: *Vaughn A. Starnes

Objective: Adult congenital heart disease (ACHD) population is expanding and ageing with more patients reaching older age. Risk factors and outcomes remain unclear. We sought to investigate patient's characteristics and surgical procedures to assess midterm survival and identify prognostic risk factors for mortality.

Methods: Single-center retrospective study on ACHD patients with ≥50 years of age that underwent cardiac surgery (2000–2014). Patients demographic, procedures and postoperative characteristics where collected from hospital record. The primary outcome was mortality of any cause. Survival was estimated with Kaplan-Meier curves. Univariate Cox proportional hazard and multivariable Cox regression analyses were to identify preoperative risk factors.

Results: ACHD patients included in the study were 221 (M/F: 112/109 pts), mean age 58.5 ± 6.3 years. Primary diagnoses were atrial septal defect (n = 88), partial anomalous pulmonary venous return (n = 36) partial atrioventricular septal defect (n = 23), ventricular septal defect (15) and heterogeneous complex anomalies (n = 59). Patients who had the first primary repair were 180; 84% of them (n = 151) had simple congenital heart anomalies. Patients with previously repaired defect were 41; the large majority underwent surgery for complex anomalies (n = 30/41) mainly involving the right ventricular outflow tract (n = 18/41). Only 2.3% (5/221) of the patients needed coronary artery bypasses for acquired coronary artery disease. In-hospital mortality was 2.3% (5/221). Follow-up completeness was 94.6% (209/221) with a median duration of 8.6 years (IQR: 4.1–12.4). Overall mortality was 16.3% (34/209) with a survival of 91% (95% CI [87–95%]) and 85% (95% CI [78–90%]) at 5 and 10 years (Figure 1A). Patients with previous surgery had a significantly higher overall mortality (30% vs 13%, p = 0.009) compared to the patients without. First-time surgery survival was significantly higher (log-rank p-value: 0.0004) compared to previous surgery survival at 5 (94% vs 78%) and 10 years (90% vs 58%) (Figure 1B). On multivariate Cox regression, age in years (HR: 1.08, 95% CI [1.02–1.14], p = 0.006), previous cardiac surgery (HR: 3.11, 95% CI [1.31–7.39], p = 0.010), and previous transient ischemic brain attack (HR: 4.03, 95% CI [1.36–11.93], p = 0.012) were the most significant prognostic factors for mortality.





Conclusions: Most of the patients with ACHD beyond the age of 50 usually present with simple congenital heart disease in natural history and their operation can be performed safely with low hospital mortality. Determinants for survival seem to relate to previous surgery and older age highlighting the importance of obtaining a repair as much as possible "definitive" in infancy and avoid residual lesion that may require reoperation in later adulthood.

9:30 am **In the Beginning . . . A Video History of the AATS**

9:55 am – 10:30 am **Coffee Break in the Exhibit Hall**

10:00 am – 10:25 am
Integrity and Professionalism: Our Guides to Educating the Next Generation
AATS CT Theater I
Booth #106, Exhibit Hall
Not for Credit

See page 52 for details.

10:30 am **Award Presentations**

10:40 am – 11:45 am **Plenary Scientific Session** Ballroom ABC, Hynes
7 minute presentation, 11 minute discussion
Moderators: *Duke E. Cameron and *Marc R. Moon

10:40 am **20th Annual C. Walton Lillehei Resident Forum Winner Presentation**
Introduced by: *Thoralf M. Sundt, *III, AATS President*

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42. Clinical Outcomes and Rates of Aortic Reoperation Following 1-Stage Repair of Extensive Chronic Thoracic Aortic Dissection

*Nicholas T. Kouchoukos[1], *Alexander Kulik[2], Catherine F. Castner[1]
[1]Missouri Baptist Medical Center, St. Louis, MO; [2]Boca Raton Regional Hospital, Boca Raton, FL

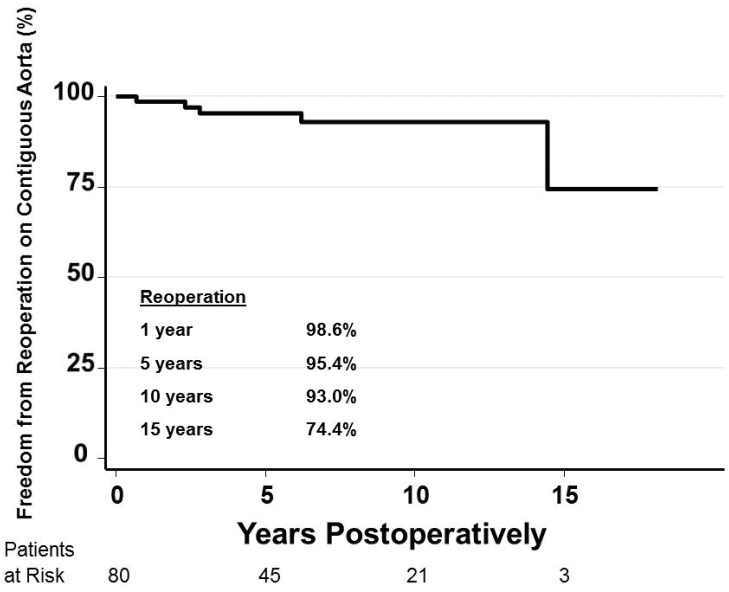
Invited Discussant: *Joseph S. Coselli

Objective: To analyze clinical outcomes, distal segmental aortic growth and aortic reoperation rates after 1-stage open repair of extensive chronic thoracic aortic dissection via bilateral anterior thoracotomy that included resection and graft replacement of part or all of the descending thoracic aorta.

Methods: Eighty patients underwent extensive 1-stage repair of chronic aortic dissection that included the ascending aorta, the entire aortic arch and varying lengths of the descending thoracic aorta (DTA). One-half or more of the DTA was replaced in 62 (78%) of the 80 patients. Hospital mortality was 2.5% (2 patients). Stroke occurred in one patient (1.2%), spinal cord ischemic injury (paraplegia) in one patient (1.2%), and renal failure requiring long-term dialysis in 2 patients (2.5%). Sixty-five of the 78 hospital survivors (83%), had serial imaging studies suitable for calculation of growth rates of the remaining dissected thoracic and abdominal aorta. The median duration of angiographic follow-up was 5.8 years and extended to 18.2 years. Forty-seven patients were followed for more than 5 years, and 21 patients for more than 10 years. The mean diameter of the aorta at the site of the distal anastomosis was 3.87 ± 1.17 cm.

Results: The overall growth rate for the distal contiguous aorta was 0.08 mm/yr. Forty aortas increased in diameter, 16 remained unchanged, and 9 decreased in diameter. Growth rate was highest for aortas ≥4.5 cm in diameter (2.45 mm/yr) (n = 12), and lowest for aortas <3 cm in diameter (0.4 mm/yr) (n = 5). Five patients

required reoperation on the contiguous thoracic or abdominal aorta 8, 27, 34, 51, and 174 months postoperatively for progressive enlargement. Actuarial freedom from reoperation on the contiguous aorta at 5 and 10 years was 95.4% and 93%, respectively (Figure). Actuarial freedom from any aortic reoperation at 5 and 10 years was 89.2% and 84.4%, respectively. Actuarial survival for the entire cohort at 5 and 10 years was 76.4% and 52.6%, respectively. No patient whose cause of death was known died of aortic rupture.



Conclusions: Our extended experience with the 1-stage open procedure confirms its safety and durability for treatment of chronic aortic dissection with enlargement confined to the thoracic aorta. Durability may be related to firm fixation of the aortic prosthetic graft to the outer aortic wall and by a suture line that is buttressed with felt as well as presence of antegrade flow distally in both the true and false lumens. The procedure is associated with low operative risk, and a low incidence of reoperation on the contiguous aorta. It represents a suitable alternative to the 2-stage and hybrid procedures that are also used to treat this condition.

43. Definitive Chemoradiation Compared to Induction Chemoradiotherapy Followed by Surgery in the Treatment of Esophageal Squamous Cell Carcinoma

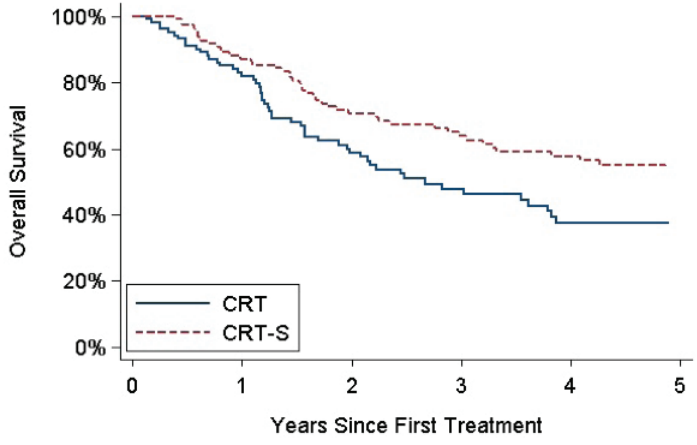
Arianna Barbetta, Dessislava Stefanova, Koby Herman, *Prasad Adusumilli, *Manjit S. Bains, Matthew Bott, *James Huang, David H. Ilson, James M. Isbell, Yelena Y. Janjigian, Geoffrey Ku, *Bernard J. Park, *Valerie W. Rusch, Kay See Tan, Abraham Wu, *David R. Jones, Daniela Molena

Memorial Sloan Kettering Cancer Center, New York, NY

Invited Discussant: *David J. Sugarbaker

Objective(s): Definitive chemoradiation for locally advanced squamous cell carcinoma of the esophagus is being used more frequently due to the perception of increased morbidity and mortality and no clear survival advantage with esophagectomy following chemoradiation. The purpose of this study was to compare the overall and disease free survival of patients treated with definitive chemoradiation (CRT) and patients treated with induction chemoradiation followed by surgery (CRT-S).

Methods: This was a retrospective cohort study of stage II and III squamous cell carcinoma of the middle or distal esophagus. Demographics, histologic features, stage, treatment and outcomes of patients who underwent CRT-S treatment or definitive CRT were collected from our prospective database. Only patients who completed their treatment were included in our analysis. Categorical variables were analyzed using Fisher's exact test. Overall survival (OS) and disease free survival (DFS) were summarized by Kaplan-Meier method and compared between treatments using log-rank test, stratified by stage, and multivariable Cox proportional hazard models.



Number at risk						
CRT	106	78	49	31	21	13
CRT-S	112	93	69	53	46	41

Results: We included 218 patients with locally advanced esophageal squamous cell cancer treated with curative intent between 2000 and 2016; 106 patients (48.6%) were treated with definitive CRT and 112 (51.4%) with CRT-S therapy. CRT-S was used significantly less frequently over time (65% before 2009 and 35% after 2009, $p < 0.01$). The median survival for patients who underwent CRT was 2.7 years (95% CI [1.96–3.86]) and 5.54 years (95% CI [3.29–8.52]) for patients treated with CRT-S ($p < 0.01$). The 5-year OS was 37% (95% CI [26–48%]) in the definitive CRT group versus 54% (95% CI [43–63%]) in the CRT-S group ($p < 0.01$) (see Figure). Median DFS was 1.49 years (95% CI [0.94–1.98]) in the definitive CRT group and 3.03 years (95% CI [1.73–6.28]) in the CRT-S group. Multivariable Cox proportional analysis showed that patients who underwent definitive CRT had 2.16-fold higher hazard of death (95% CI [1.06–4.42], $p = 0.034$) and 2.36-fold higher hazard of recurrence (95% CI [1.09–5.13], $p = 0.030$) compared to CRT-S patients. Among the patients who underwent surgery 51% had residual disease within the esophagus and/or regional lymph nodes.

Conclusions: Surgery after chemoradiation therapy may add significant survival benefit in patients with locally advanced squamous cell cancer of the middle and distal esophagus. Patients who are good surgical candidates should be referred for esophagectomy.

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44. Surgeon Volume Impact on Mitral Valve Repair Rates, Durability and Survival in New York State

*Joanna Chikwe, Nana Toyoda, *Anelechi Anyanwu, Shinobu Itagaki, Natalia N. Egorova, Percy Boateng, Ahmed El-Eshmawi, *David H. Adams

Mount Sinai Medical Center and Stony Brook University Hospital, New York, NY

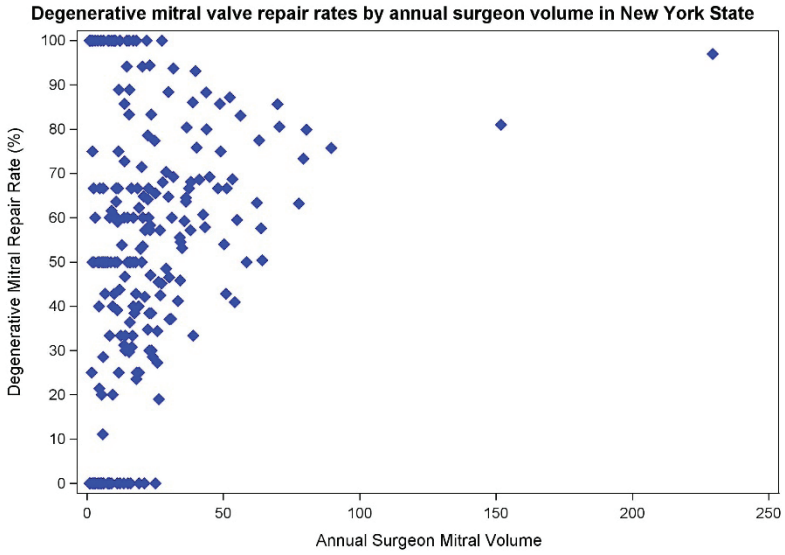
Invited Discussant: *Ralph J. Damiano, Jr.

Objectives: Degenerative mitral valve repair rates remain highly variable despite established benefits of repair over replacement. The contribution of surgeon-specific factors is poorly defined. This study evaluated the influence of surgeon case volume on degenerative mitral repair rates and outcomes.

Methods: From a mandatory New York State database, we identified 38,128 adults who underwent primary mitral valve surgery between 2002 and 2013. After exclusion of other mitral etiologies, a total of 5,475 patients with presumed degenerative disease were identified, in whom mitral repair rates, mitral reoperations within twelve months of repair, and survival were analyzed using multivariable Cox modelling and restricted cubic spline function.

Results: Overall median annual surgeon volume for all mitral cases was 10 cases (range: 1–230) with a mean repair rate of 55% (n = 20,797/38,128). In the degenerative subgroup, the mean repair rate was 67% (n = 3,660/5,475), ranging from 48% (n = 179/370) for surgeons with total annual volume ≤10 mitral cases, to 77% (n = 1,710/2,216) for surgeons with total annual volume ≥51 mitral cases ($p < 0.001$). Higher total annual surgeon volume was associated with increased degenerative mitral repair rates (OR: 1.13 for every additional 10 mitral cases; 95%

CI [1.10–1.17], p < 0.001); a steady decrease in reoperation risk plateauing at 25 total mitral cases annually; and improved one-year survival (adjusted HR: 0.95 for every additional 10 cases; 95% CI [0.92–0.98], p = 0.001). For surgeons with total annual volume ≤25 mitral cases, repair rates were higher (63.4%, n = 180/282) if they operated in the same institution as a surgeon with total annual mitral case volumes ≥50 and repair rates in degenerative mitral patients ≥70% compared to those operating in the other institutions (51.3%, n = 580/1,130) (adjusted OR: 1.79, 95% CI [1.24–2.60], p < 0.001).



Conclusions: This study suggests that individual surgeon case volume is not only a determinant of mitral repair rates, but also freedom from reoperation and survival. Our data support the concept of cardiac surgical subspecialization to improve outcomes in patients with degenerative mitral disease.

11:45 am **Basic Science Lecture** Ballroom ABC, Hynes

Enhancing Surgical Performance: Optimizing Intra-Operative Surgical Leadership and Decision-Making

Rhona Flin, *University of Aberdeen*

12:35 pm **Adjourn for Lunch in the Exhibit Hall**

12:40 pm – 1:50 pm

Enhancing Cardiac Surgery in Underserved Regions a Joint PASCaTS (Pan-African Society for Cardiothoracic Surgery)/AATS Global Forum

AATS CT Theater II
Booth #1828, Exhibit Hall
Not for Credit

Moderators: *R. Morton Bolman, *University of Vermont Medical Center*
*Carlos Mestres, *Cleveland Clinic Abu Dhabi*
Charles A. Yankah, *German German Heart Institute*

Adapting Global Standards for Developing Sustainable and Quality Pediatric Cardiac Programs: Is There a Model That Fits Best in Low and Middle-Income Regions?

Francis Fynn-Thompson, Boston/Kumasi, Ghana

Burn-Out Rheumatic Mitral Valve Disease in Adolescents: Repair Versus Replacement

Manuel Antunes, Coimbra, Portugal

Heart Valve Development and TAVI In Africa: Variability of Demographic Risk Factors and Valve Requirements

Francis Smit, Bloemfontein, South Africa

Integrating Cardiac Surgery into Tertiary Healthcare in Nigeria, A Population of 182 Million: Funding and Budgetary Constraints

Jonathan Nwiloh, Atlanta/AdaziNnukwu, Nigeria

12:45 pm Moderated Poster Competitions

Adult Cardiac Moderated Poster Competition Aisle 200, Exhibit Hall
4 minute presentation, 1 minute discussion *Not for Credit*

Moderators: *Richard Lee and *S. Chris Malaisrie

P1. Outcomes of Aortic Valve Replacement with Bioprostheteic or Mechanical Valves in End-Stage Renal Disease Patients

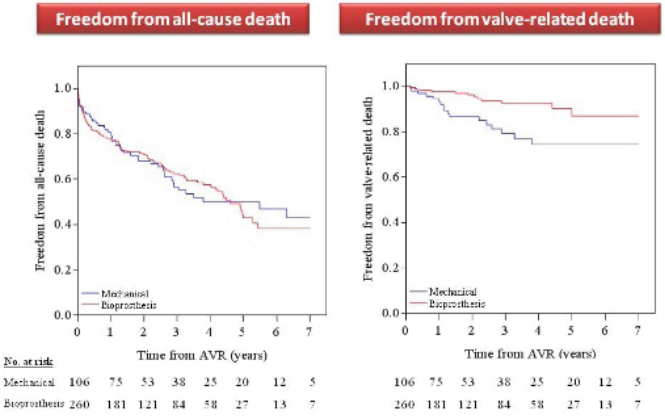
Taro Nakatsu[1], Kenji Minakata[1], Shiro Tanaka[1], Kazuhisa Sakamoto[1], Shingo Hirao[1], Shinichi Tsumaru[1], Hiroomi Nishio[1], Junichiro Nishizawa[2], Keiichi Fujiwara[3], Jiro Esaki[4], Koji Ueyama[5], Tadaaki Koyama[6], Michiya Hanyu[7], Nobushige Tamura[8], Tatsuhiko Komiya[9], Yuhei Saitoh[10], Naoki Kanemitsu[11], Yoshiharu Soga[12], Kotaro Shiraga[13], Shogo Nakayama[14], Michihito Nonaka[15], Genichi Sakaguchi[16], Kazunobu Nishimura[17], Kazuo Yamanaka[18], Tomohiro Nakata[1], Kazuhiro Yamazaki[1], Ryuzo Sakata8, Tadashi Ikeda[1], *Kenji Minatoya[1]

[1]Kyoto University, Kyoto, Japan; [2]Hamamatsu Rosai Hospital, Hamamatsu, Japan; [3]Hyogo Prefectural Amagasaki General Medical Center, Amagasaki, Osaka, Japan; [4]Japanese Red Cross Otsu Hospital, Otsu, Shiga, Japan; [5]Kitano hospital, Osaka, Japan; [6]Kobe City Medical Center General Hospital, Kobe, Japan; [7]Kokura Kinen Hospital, Kitakyusyu, Japan; [8]Kumamoto Chuo Hospital, Kumamoto, Japan; [9]Kurashiki Central Hospital, Kurashiki, Okayama, Japan; [10]Matsue Red Cross Hospital, Matsue, Shimane, Japan; [11]Mitsubishi Kyoto Hospital, Kyoto, Japan; [12]Nagahama City Hospital, Nagahama, Shiga, Japan; [13]National Hospital Organization Kyoto Medical Center, Kyoto, Japan; [14]Osaka Red Cross Hospital, Osaka, Japan; [15]Shiga Medical Center for Adults, Moriyama, Shiga, Japan; [16]Shizuoka General Hospital, Shizuoka, Japan; [17]Takamatsu Red Cross Hospital, Takamatsu, Kagawa, Japan; [18]Tenri Hospital, Tenri, Nara, Japan

Objective: Bioprosthetic valves are often selected for patients with end-stage renal disease (ESRD) undergoing aortic valve replacement (AVR) because such patients are thought to have limited life expectancies. However, bioprosthethic valves are believed to be less durable than mechanical valves due to progressive early structural valve deterioration (SVD), and this may necessitate reoperation. Therefore, a mechanical valve remains a suitable choice, especially in younger patients. The aim of this study was to analyze the long-term outcomes of ESRD patients undergoing AVR with either bioprosthetic valves or mechanical valves.

Methods: We conducted a multi-center (18 centers) retrospective observational study. The subjects consisted of a total of 366 ESRD patients on chronic dialysis undergoing AVR between 2008 and 2015. Subjects were divided into two groups: group B (bioprosthetic valves, n = 260) and group M (mechanical valves, n = 106). Patients undergoing concomitant procedures (coronary artery bypass grafting, mitral and/or tricuspid valve procedures, and aortic aneurysm repairs) were included. All the patients who survived surgery underwent follow-up surveys. Definitions of valve-related events were based on the AATS guidelines.

Results: The patients in group B were older (73.7 ± 6.9 years vs. 64.0 ± 10.0 years, $p < 0.01$), and had a shorter duration of hemodialysis preoperatively (9.6 ± 7.7 years vs. 12.0 ± 8.0 years, $p < 0.01$) than those in group M. The prevalence of diabetes mellitus was higher in group B than in group M (40.0% vs. 28.3%, $p = 0.04$). There was no significant difference in in-hospital mortality (12.3% in group B vs. 9.4% in group M, $p = 0.48$). The mean follow-up period was 2.3 ± 2.0 years in group B and 2.6 ± 2.2 years in group M. The 3- and 5-year overall survival rates were 62.5% and 43.0% in group B, and 56.6% and 50.0% in group M (log-rank $p = 0.92$). The 3- and 5-year freedom from valve-related deaths were 92.6% and 87.2% in group B, and 79.3% and 74.3% in group M (log-rank $p < 0.01$). The 3- and 5-year freedom from major bleeding were 81.6% and 73.9% in group B, and 79.8% and 74.1% in group M ($p = 0.80$). The 5-year freedom from thromboembolic events was 91.5% in group B, and 96.4% in group M ($p = 0.82$). Structural valve deterioration (SVD) was observed in only four patients in group B (1.5%). Also, there were no significant differences in terms of occurrence of prosthetic valve endocarditis and reoperation between the two groups.



Conclusion: There were no differences in early and late survival in ESRD patients undergoing AVR with bioprosthetic valves or mechanical valves. Bioprosthetic valves can be used regardless of a patient's age and provide better freedom from valve-related deaths than mechanical valves.

P2. Long-Term Effects of Prosthesis Selection in Adults Under 40 Years Old Undergoing Mitral Valve Replacement at 117 Hospitals in the State of California

Andrew B. Goldstone, William L. Patrick, Peter Chiu, Michael J. Paulsen, Bharathi Lingala, Michael Baiocchi, *Y. Joseph Woo

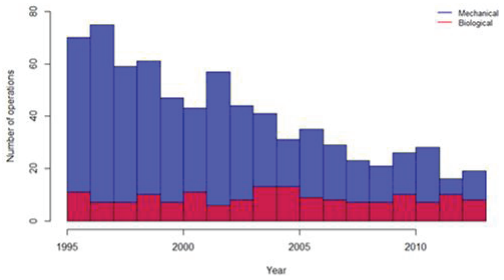
Stanford University, Stanford, CA

Objective: Information regarding outcomes of mitral valve replacement in patients under 40 years of age are limited to single center experiences. Furthermore, the choice between a mechanical or biological prosthesis is not informed by large-scale studies.

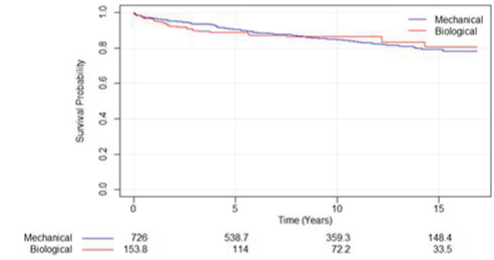
Methods: We compared long-term survival and rates of reoperation, stroke, bleeding, and endocarditis between inverse probability weighted cohorts, ≤40 years of age, who underwent primary mitral valve replacement (MVR) with a mechanical (N = 725, 82.0%) or biological prosthesis (N = 159, 18.0%) in 117 hospitals within California between 1996 and 2013. Weighted Cox proportional hazards regression with a robust variance estimator was used to compare survival; competing risk analyses employing the method of Fine and Gray were used compare rates of longitudinal secondary endpoints. Standard errors were calculated from 500 bootstrap replicates.

Results: The proportion of bioprostheses implanted for MVR increased from 14% in 1996 to 30% in 2013 ($P < 0.001$); this increase was secondary to a decrease in total valve replacement procedures, and not due to an increase in the actual number of bioprostheses implanted (Figure A). Overall 30-day mortality was 1.1% (N = 10), and this risk did not differ between mechanical or bioprosthetic valve recipients ($P = 0.92$). Survival at 17 years after initial receipt of a bioprosthetic valve did not differ from that of mechanical valve recipients (hazard ratio (HR) 1.1, 95% CI 0.7–1.6) (Figure B). However, the risk of reoperation was substantially higher in bioprosthetic valve recipients (HR 5.0, 95% CI 2.9–7.8), and began to rise as early as 5 years after the index MVR (Figure C). Perioperative mortality after redo-MVR was 1.3% (N = 1 of 78); 69% of bioprosthetic valve recipients opted for a mechanical valve at the time of re-replacement. Mechanical valves increased the cumulative incidence of bleeding (HR 1.8, 95% CI 1.1–2.3), while that of stroke and endocarditis did not differ by prosthesis type.

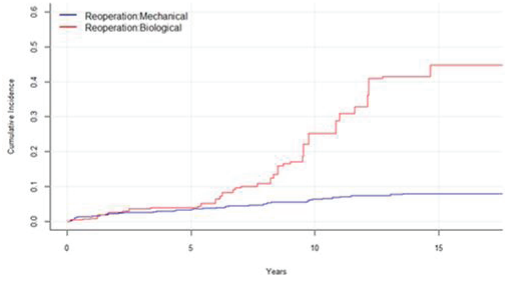
A Number of biological and mechanical mitral prostheses implanted per year, 1996-2013



B Survival after MVR with a biological vs. mechanical prosthesis



C Cumulative incidence of reoperation after MVR with a biological vs. mechanical prosthesis



Conclusions: In patients ≤40 years old undergoing MVR in either academic or community practice, long-term survival is not affected by choosing a mechanical or biological prosthesis. Instead, one must weigh the risks of reoperation and therapeutic anticoagulation. This may be of particular importance for women of childbearing age.

P3. Early Reperfusion Strategy Improves the Outcome of Surgery for Type A Acute Aortic Dissection with Malperfusion

Keiji Uchida, Norihisa Karube, Keiichiro Kasama, Ryo Izubuchi, Kenichi Fushimi, Motohiko Goda, Shinichi Suzuki, Kiyotaka Imoto, Munetaka Masuda

Yokohama City University Medical Center, Yokohama, Japan

Objective: How to control the malperfusion is the key to improve the outcome of surgery for type A acute aortic dissection. Immediate central aortic repair and primary entry tear resection is mandatory, and most of dynamic type branch vessel obstruction resolves then. But acute occlusion of coronary, carotid, and visceral arteries sometimes lead to irreversible organ damage after aortic surgery. We revised our treatment strategy to reperfuse each ischemic organs directly before central repair.

Methods: Our current early reperfusion strategy consists of percutaneous coronary artery intervention and stenting for coronary artery malperfusion, direct surgical fenestration for carotid artery occlusion, cannulation and active perfusion of superior mesenteric artery for visceral malperfusion, and external shunting from brachial artery to the femoral artery for lower limb ischemia. Central repair is subsequently performed after reperfusion therapy without any delay, but if irreversible organ damage is recognized, aggressive further treatment is discontinued.

We retrospectively analyzed the data of 424 patients who underwent initial treatment for type A acute aortic dissection in our institute during the last ten years. Among them, 103 patients (24%) were diagnosed to have one or more organ malperfusion. Coronary malperfusion was diagnosed in 24 patients (5.7%), carotid in 32 (7.5%), spinal cord in 6 (1.4%), visceral in 16 (3.8%), and lower extremity in 47 (11%).

Results: We applied early reperfusion strategy to 32 patients, 12 patients for coronary, 3 for carotid, 9 for visceral, and 8 for lower extremity. Among them, central repair was abandoned in 5 patients, 4 with persistent coma after initial treatment, and one with cardiogenic shock even after coronary stenting for left main trunk occlusion. Central repair was performed in 27 patients, one patient (3.7%) with lower limb ischemia and severe emphysema died from pneumonia and sepsis. The other 26 patients overcame the ischemic organ damage and survived.

In the same period, overall mortality of central repair surgery for type A acute aortic dissection was 22/346 (6.4%). The mortality of patients without malperfusion was 9/255 (3.5%), and with malperfusion was 13/91 (14%). Malperfuion was significant ($P < 0.01$) risk factor of hospital death. But among the 91 patients with malperfusion, the mortality of 27 patients with early reperfusion strategy was only 3.7%, whereas the mortality of patients who underwent conventional central repair without early reperfusion was 12/64 (19%). Early reperfusion strategy significantly ($P < 0.01$) improved the outcome, and this was almost similar to the patients without malperfusion.

Conclusion: Our strategy may improve the outcome of surgery for type A acute aortic dissection with malperfusion. And this strategy enables us to avoid unproductive central repair operation for hopelessly ill patients.

P4. Combined Transaortic and Transapical Approach to Septal Myectomy in Patients with Hypertrophic Cardiomyopathy and Complex Subaortic and Midventricular Obstruction

Dustin Hang, *Hartzell V. Schaff, Steve R. Ommen, *Joseph A. Dearani, Rick A. Nishimura
Mayo Clinic, Rochester, MN

Objectives: Residual midventricular obstruction following transaortic myectomy may lead to recurrent symptoms and need for reoperation in pt with hypertrophic cardiomyopathy (HCM) and long-segment septal hypertrophy. In these pt, a combined transaortic and transapical approach to septal myectomy during initial operation allows for complete relief of subaortic and intracavitary gradients and may reduce risk of poor late functional results. We reviewed patients with HCM and complex subaortic and midventricular obstruction (MVO) who underwent this combined approach for septal myectomy.

Methods: Between July 1999 and March 2016, 2,353 pt underwent septal myectomy. We analyzed preoperative data and early outcomes of pt age 18 and older who underwent combined transaortic and transapical septal myectomy for subaortic LVOT obstruction due to SAM and midventricular obstruction and/or cavitary obliteration.

Results: The combined procedure was performed in 77 pt. Midventricular obstruction was present in 54 pt (70.1%), and 23 pt (29.9%) had systolic midcavitary obliteration. In 56 pt the complex septal obstruction was identified preoperatively, and combined transaortic and transapical myectomy was performed during a single period of aortic occlusion; in 21 pt the need for additional transapical resection was recognized after initial transaortic septal myectomy, and pt required a second period of cardiopulmonary bypass to relieve residual distal septal obstruction. For all pt, the median (25^{th}, 75^{th} percentile) pre- and post-bypass directly measured intracavitary gradients were 92 (52,127) and 5 (0,16) mmHg, respectively; median pre-discharge transthoracic LVOT and midventricular gradients were 0 (0,0) and 0 (0,8) mmHg, respectively. Median crossclamp times and perfusion times were 35 (27,43) and 48 (40,64) minutes, respectively. IABP was employed in 2 (2.6%) patients, ECMO in 1 (1.3%), and there were no reoperations for bleeding. Stroke occurred in 2 (2.6%) patients, transient neurological deficits in 2 (2.6%), septicemia in 1 (1.3%), prolonged ventilation in 6 (7.8%), pneumonia in 1 (1.3%), renal failure in 2 (2.6%), complete heart block requiring device implantation in 2 (2.6%), and atrial fibrillation in 19 (24.7%). The 30 day and 1 year survivals were both 95%, with 2 early deaths, and 1 late death.

Conclusions: A combined transaortic and transapical septal myectomy is an effective and reasonably safe approach for HCM pt with subaortic obstruction and midventricular obstruction and/or cavitary obliteration. This approach may prevent residual obstruction in the midventricle and, in pt with diastolic heart failure and small LV chamber size, permits myectomy to augment diastolic filling and improve LV stroke volume.

P5. Computed Tomography Versus Coronary Angiography for Coronary Screening in Heart Valve Surgery

Joon Bum Kim, Jihoon Kim, Ho Jin Kim, Sung-Ho Jung, Suk Jung Choo, Cheol Hyun Chung, *Jae Won Lee

Asan Medical Center, Seoul, Republic of Korea

Objective: In the setting of elective heart valve surgeries, screening for coronary diseases (CAD) is recommended for patients aged over 40 years or those with risk factors. While conventional coronary angiography (CAG) is regarded as the gold standard method, CT angiography has emerged as an alternative modality to evaluate CAD; however, there have been only few studies that evaluated the feasibility of coronary CT angiography in the real clinical settings.

Methods: Out of 6,104 consecutive adult patients undergoing elective heart valve operations between 2001 and 2015, we identified 3,949 patients aged >40 years or who had coronary risk factors (diabetes, hypertension, dyslipidemia and obesity [BMI > 30 kg/m^2]) after the exclusion of patients with pre-existing CAD. Of these, 3,205 patients (aged 69.6 ± 10.8 yrs, 49.9% female) who underwent preoperative coronary CT angiography (n = 1420; CT group) or conventional CAG (n = 1785; CAG group) for coronary screening were enrolled. Perioperative outcomes were compared between these two groups with the use of propensity score matching based on 32 baseline covariates to adjust selection bias.

Table: Outcomes Summary in Propensity Score Matched Patients (N = 1176)

	CT group (n = 588)	CAG group (n = 588)	Odds Ratio	95% CI	P Value
Detection of coronary stenosis (>50%)	42 (7.1%)	67 (11.4%)	0.59	0.39–0.89	0.012
Performance of CABG	24 (4.1%)	40 (6.8%)	0.53	0.31–0.89	0.018
Low cardiac output syndrome (requiring mechanical support)	15 (2.6%)	5 (0.9%)	3.05	1.17–9.43	0.032
Acute kidney injury	46 (7.9%)	48 (8.2%)	0.95	0.63–1.46	0.830
New dialysis	36 (6.2%)	38 (6.5%)	0.94	0.59–1.51	0.810
Early mortality (30-day or inhospital)	9 (1.5%)	9 (1.5%)	1.00	0.38–2.58	> 0.999

Results: In the CT group, 202 patients (14.0%) underwent additional CAG based on the abnormal CT results (segments with any plaque or stenosis >50%), which confirmed significant CAD (stenosis >50%) in 73 patients (5.1%) with resultant combination of CABG in 43 patients (3.0%). In the CAG group, significantly greater proportion of patients (10.3%, n = 183, P < 0.001) were confirmed to have CAD >50% with higher prevalence of CABG (4.7%, n = 84, P = 0.015) than the CT group. Postoperatively, significantly more patients in the CT group experienced low cardiac output syndrome than the CAG group (2.3% vs. 1.1%, P = 0.007), while the rates of early mortality (1.8% vs. 1.5%, P = 0.495) and acute kidney injury (6.3% vs. 6.9%, P = 0.443) were not significantly different between the two groups. Propensity score matching yielded 588 pairs of patients well balanced for all measureable baseline covariates. After matching, perioperative results remained essentially similar with unadjusted results: In the CT group, CAD detection and concomitant

CABG rates were lower, the risk of low cardiac output syndrome was higher, and the risks of early mortality and acute kidney injury were similar compared with the CAG group (Table). In a subgroup analysis on patients who underwent both CT and CAG (n = 202), the negative predictive value of "CAD > 50% estimated by CT" for the confirmation by CAG (CAD > 50%) was 84.2% only.

Conclusions: Coronary CT angiography tended to underestimate significant CAD in high risk patients scheduled for elective heart valve operations compared with CAG. These results were also associated with a lower rate of combining CABG and higher incidence of postoperative heart failure if CT was used for coronary screening instead of CAG.

P6. Surgical Treatment of Atrial Fibrillation with Different Lesion Set and Energy Sources: Mid-Term Results in Nine Hundred Patients

Alexander Bogachev-Prokophiev, Alexander V. Afanasyev, Sergey Zheleznev, Alexei Pivkin, Ravil Sharifullin, Alexander Karas'kov

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Objective: To evaluate mid-term results of concomitant atrial fibrillation ablation during open cardiac surgery.

Methods: From 2006 to 2016 953 patients with acquired cardiac disease and atrial fibrillation underwent concomitant atrial fibrillation ablation using different device and lesion set. Mean age was 56.5 ± 6.9 years. Atrial fibrillation was paroxysmal in 108 (11.4%), persistent in 515 (54%) and long standing persistent in 330 (34.6%) of patients. Mean atrial fibrillation duration was 22.6 ± 15.1 months. Follow up in progress.

Results: At 60 months follow up overall freedom from atrial fibrillation was 67.2%. Predictors for atrial fibrillation recurrence were duration of atrial fibrillation more than 1 year before surgery (HR 2.8; 95% CI, 1.1–4.2, p = 0.007), size of left atrium more than 5.5 cm (HR 1.9, 95% CI, 1.2–2.8, p = 0.022), and own surgeon experience with HR 1.01 (95% CI, 1.01–1.25, p = 0.024). There is no difference between bilateral and left-sided MAZE procedures in term of freedom from atrial fibrillation / flutter (69.5% vs 73.9%) at 4 years after surgery, log-rank test, p = 0.181. There is no difference in atrial fibrillation / flutter recurrences between cryo- and bipolar radiofrequency ablation energy sources (71.2% and 68.3%, respectively, log-rank test, p = 0.455) at mean follow-up. In mitral valve surgery patients with paroxysmal atrial fibrillation Maze procedure demonstrate benefit over pulmonary vein isolation at 18 months follow up (88% vs 57%, log-rank test, p = 0.012, respectively). In patients with coronary artery disease and paroxysmal atrial fibrillation we didn't find difference between bilateral and left-sided ablation at 12 months follow up (92% vs 89%, log-rank test, p = 0.456); however in persistent patients bilateral procedure showed superior results at 12 months (87% vs 70%, log-rank test, p = 0.035). In propensity score matched patients using dry and wet radiofrequency ablation we didn't find difference in freedom from atrial fibrillation at 18 months (85.7 vs 84.0%, log-rank test, p = 0.658, respectively).

Conclusion: Concomitant atrial fibrillation ablation is reproducible and effective procedure. Left-sided lesion set is preferable for patients with paroxysmal atrial fibrillation without risk factors for late atrial fibrillation recurrences. There is no difference in freedom from atrial fibrillation between cryo- and bipolar radiofrequency ablation. There is no evidence for using wet ablation instead of dry bipolar radiofrequency energy.

P7. The Impact of Specific Preoperative Organ Dysfunction in Patients Undergoing Mitral Valve Surgery

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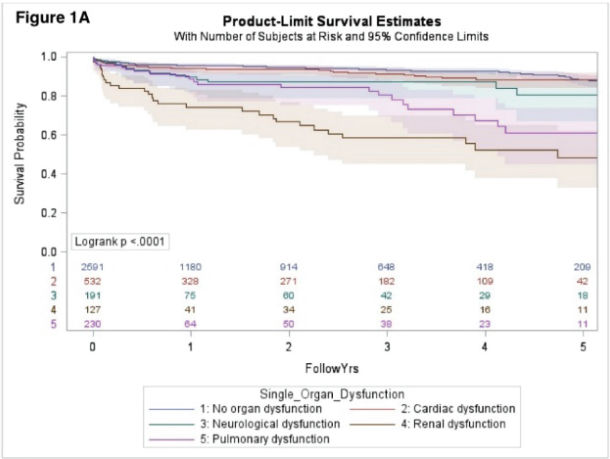
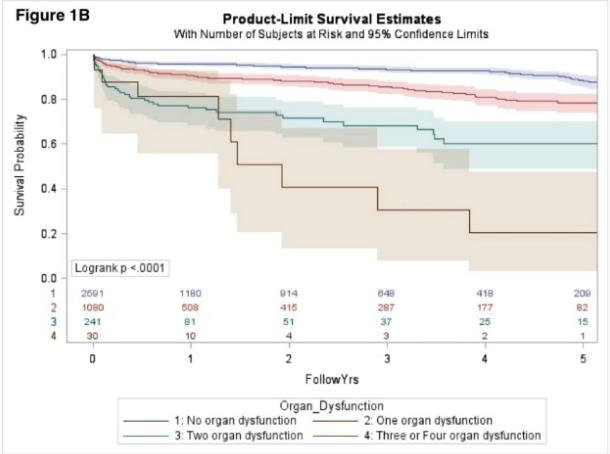
Objective: Optimizing treatment strategies to risk profile patients undergoing mitral valve (MV) surgery remains a priority. The role that specific individual, and combinations of preoperative organ dysfunction (OD) plays in informing these decisions remains uncertain. This study sought to determine the relative effect that OD in particular systems has on short- and long-term outcomes in those undergoing MV surgery.

Methods: A retrospective analysis of 3,942 patients who underwent MV surgery with or without concomitant CABG or MAZE procedures between 1/2005 and 1/2016 were studied. Patients were classified by the presence or absence of preoperative OD: (1) cardiac: ejection fraction <35%, (2) pulmonary: severe COPD defined by a FEV1% predicted <50%, (3) neurologic: prior permanent stroke, (4) renal: documented chronic renal failure, a history of a creatinine greater than 2.0 mg/dL, or end-stage renal disease. Kaplan-Meier survival estimates and multiple regression models were used to assess the impact on morbidity and mortality of individual and combined OD. An adjusted analysis was conducted controlling for standard preoperative variables.

Results: A total of 1,351 (34.3%) patients had at least one OD, including 271 patients (6.9%) with more than one OD. The presence of existing renal dysfunction was associated with the worst early and long-term prognosis. Thirty day mortality was 7.1% (9/127) for those with renal dysfunction, 4.3% (10/230) for severe COPD, 2.6% (14/532) for heart failure, and 2.1% (4/191) for neurologic dysfunction compared to 1.9% (49/2591) in the no OD group. Five-year survival estimates for OD patients are as follows: chronic renal failure 48.2%, severe COPD 60.9%, heart failure 88.3%, and prior stroke 80.5% (Figure 1A). At 5 years there was a significantly higher mortality for each additional OD present, compared to patients with 0 ODs (Figure 1B). Mortality hazard ratios for 1, 2, and > 3 additional ODs were 1.57, 2.99, and 4.78, respectively.





Conclusions: The presence of preoperative chronic renal failure most profoundly decreases early and late survival following MV surgery. The sequential addition of OD, specifically severe lung dysfunction, is a powerful predictor of poorer long-term survival.

P8. Comparison of Hemodynamic Performance and Exercise Capacity of 3 Contemporary Bioprosthetic Aortic Valves: Results from a Prospective Randomized Study

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Objective: We sought to determine whether there are differences in hemodynamic performance and exercise capacity among three new-generation biological aortic valve.

Methods: 279 adults undergoing aortic valve replacement were randomized to receive the Edwards Magna (n = 93), Sorin Mitroflow (n = 93), or St. Jude Trifecta bioprostheses (n = 93). Hemodynamic performance was evaluated by transthoracic echocardiography and ergospirometry was used to determine exercise capacity.

Results: Mean age was 74 ± 8 years and there were 144 men (51.6%). There were no significant differences in baseline characteristics among implant groups. At 4 years follow up, survival (Trifecta = 73.6 ± 8.7%, Mitroflow = 72.8 ± 9.6% and Perimount = 77.5 ± 10.4%), freedom from stroke (Trifecta = 94.7 ± 5.1%, Mitroflow = 96 ± 3.9% and Perimount = 95.2 ± 4.6%) and patients in NYHA class I/II (Trifecta = 74.2 ± 0.3%, Mitroflow = 75.3 ± 0.2% and Perimount = 85.8 ± 0.1%) were similar. Mean transvalvular gradient did not differ among the groups (Trifecta = 10.6 ± 4.4 mmHg, Mitroflow = 12.1 ± 5.11 mmHg and Perimount = 10.9 ± 4.3 mmHg), while the Trifecta had a significant lower peak gradient compared to the Mitroflow (18 ± 6.1 mmHg vs 22.8 ± 8.5 mmHg). VO2max was also similar (Trifecta = 20.8 ± 3.5 mL/min/kg, Mitroflow = 19.6 ± 4.2 mL/min/kg and Perimount = 19 ± 2.9 mL/min/kg)

Conclusions: This prospective, randomized comparison reveals that the 3 valves studied performed nearly equally in term of hemodynamic performance and exercise capacity. Longitudinal follow-up of these randomized cohorts is essential to determine late clinical implications of these findings.

P9. Intercostal Artery Management in Thoracoabdominal Aortic Surgery: to Reattach or Not to Reattach?

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Objective: The need for intercostal artery (ICA) reattachment remains controversial in thoracoabdominal aortic aneurysm surgery. We reviewed our experience over 14 year period to assess the effects of intercostal artery management on neurologic outcome after descending thoracic or thoracoabdominal aortic (D/TAAA) repair.

Methods: Intraoperative data were reviewed to ascertain the status of thoracic ICAs 3–12 and lumbar arteries 1–4. Arteries were classified as reattached, ligated or occluded or not exposed. Temporality of reimplantation or ligation in response to an intraoperative ischemic event (loss of motor evoked potential (MEP)) was

noted. Adjustment for other predictors of immediate or delayed paraplegia (paraplegia/paraparesis, DP) was performed by multiple logistic regression. Effect of specific artery level and type of reimplantation technique was assessed by stratified contingency table methods.

Results: Between 2001 and 2014, 1097 D/TAAAs were performed. Mean age was 64 ± 15 years and 37% were females. Spinalcord-deficits (paraplegia) were identified in 10%, of which 35 (3%) were immediate and 77 (7%) were DP. Overall DP resolution was 47% at discharge. Both immediate and DP were significantly associated with ICA-reattachment when performed in response to intraoperative ischemic events (OR 2.8, $p < 0.004$ and OR 3.5, $p < 0.0001$, respectively). Most D/TAAAs requiring ICA-management involved T8-12-ICAs. Multivariable analysis demonstrated that T8-12-ICA ligation significantly increased risk of DP (OR 1.5/artery ligated, $p < 0.001$), after adjusting for other risk-factors (age > 65, GFR, Extent 2/3 aneurysm, increased operative time, and intraoperative MEP-loss). T8-12-ICA ligation also increased risk of reoperation for bleeding (OR 1.4/artery, $p < 0.001$) after adjusting for Extent 2 or 3 aneurysm. Although T8-12-ICA reimplantation significantly increased operative time (5-min/ICA-level, $p < 0.001$), it did not independently increase DP risk ($p = 0.598$). ICA reimplantation did not increase the risk for bleeding, early mortality, or permanent DP.

Conclusions: Ligation of T8-12-ICAs increases DP risk, especially with intact MEP. These findings support reimplantation of T8-12-ICA, whenever feasible, to improve spinal-cord perfusion and paraplegia risk following D/TAAA repair.

P10. Statewide Impact of Proposed Coronary Artery Bypass Grafting Bundled Payment

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Objective: The Center for Medicare and Medicaid Services (CMS) has proposed a 5-year trial of bundled payments for coronary artery bypass grafting (CABG) through 90 days after discharge in 98 metropolitan statistical areas (MSAs). Hospitals will be paid under the standard fee-for-service arrangement. At the end of each year, CMS will reconcile all payments compared to a target price based on cost data from the prior three years, and will include a preplanned 3% reduction. In addition, the target price transitions over 3 phases; phase 1 is based on 2/3 hospital cost and 1/3 regional cost; phase 2 is 1/3 hospital and 2/3 regional cost; phase 3 is 100% regional costs. The reconciliation payment will be the difference between actual cost and the target price, with an increasing cap (20% cap during phase 3). To investigate the impact of the inpatient component of the proposal, we reviewed actual costs for patients undergoing CABG relative to the expected payment.

Methods: A total of 13,276 Medicare patients with estimated cost data underwent isolated CABG from 2008–2015 in 8 CMS defined MSAs within the state. Costs were adjusted to 2015 equivalent dollars and historical estimated inpatient costs were calculated using the previous three years (2012–2014) and stratified by MS-DRG (231–236). Actual 2015 inpatient costs were compared to target prices estimated for each year of the pilot program. No adjustment was made for quality metrics, transfer status, or post-acute care costs (not captured).

Results: From 2008–2015, the mean yearly increase in hospital cost was 3.6%, while the mean 2015 cost per patient ($50,394) was 4.9% higher than the historical comparison ($48,031). After modeling each phase, hospitals would have to pay increasing amounts back to CMS (Year 1: $17,682, Year 2: $166,418, Years 3&4: $276,055, Year 5: $367,985). Moreover, there is potential for significant variation by hospital (Figure 1). If 2015 had been the final phase of the pilot, 13 of the 18 hospitals (72%) would have owed CMS for cost overruns averaging $614,270 (Range $67,404–$2,102,292). Costs were below the target price at only 5 of 18 hospitals, and CMS would have paid average reconciliation of $272,355 (Range $88,628–$567,429). Without the cap, the highest reconciliation payment owed to CMS would have remained at $2,102,292, while the highest payment from CMS would have increased to $1,544,141.

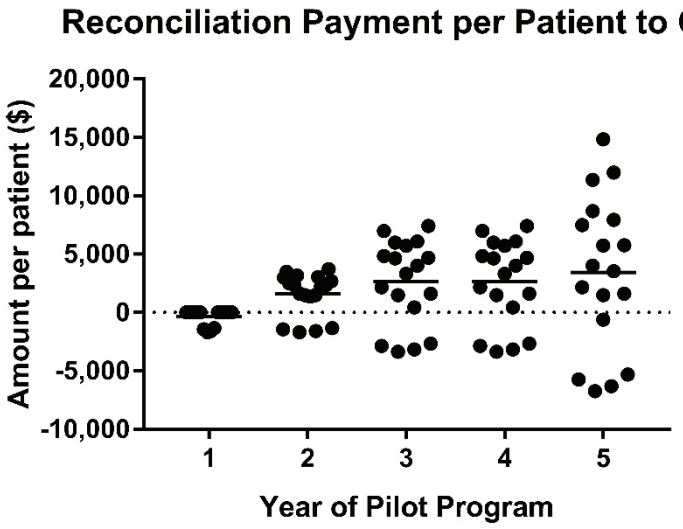

Figure 1: Mean reconciliation payment by hospital (negative indicates CMS owes money to the hospital).

Conclusions: Yearly inpatient costs increase on average by 3.6%, which added to the 3% reduction places hospitals in the red from the start. As regional pricing is phased into the program, hospitals can expect to owe CMS increasing amounts in reconciliation ($122,661 average increase with each phase). The net effect is shifting of financial risks to hospitals, which will likely influence access to care for higher risk patients.

*AATS Member ◆AATS New Member

P11. Use of an Administrative Database Improves Accuracy of Hospital Reported Readmission Rates

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Objectives: Rate of readmission after cardiac surgery continues to be clinically important. As hospital systems prepare for the coming reality of a global payment system, an accurate knowledge of readmission rate is increasingly, economically important. Readmission rates are reported to government bodies and recorded in the Society of Thoracic Surgeons Adult Cardiac Database. Government reporting is from hospital administrative databases, while STS reported data is from certified and audited clinical databases. In our area 90 hospitals share administrative claims data. 28 of these hospitals, doing cardiac surgery, also share STS clinical data. The STS reporting hospitals represent 5 different hospital systems. We used these two sources to compare the readmissions data for accuracy.

Methods: An abbreviated set of 6 fields from the 40,047 STS records were matched back into the billing data records. The matching index visit was identified and then the billing records were queried for any subsequent in-patient visits for that patient within 30 days after surgery or 30 days after discharge (for dates of surgery after 7/1/2014). The billing records included date of readmission and hospital of readmission where appropriate. In cases where no readmissions were identified from the billings, it was noted. The presence or absence of readmission was compared to the data in the STS record.

Results: In the STS data set, 34421 (86.0%) were marked no readmission and there was no billing record indicating a readmission. A further 1155 (2.9%) patients had STS records that were marked 'No' or were missing in the STS data, but there were billing records that showed a readmission. The reported STS readmission rate of 2962 (7.4%) under reported the readmission rate by 2.9 actual percentage points. The true rate should have been 10.3%. That is, the clinical database missed 28% of readmissions. Approximately 36% of readmissions were to a hospital that was a part of a different hospital system.

Procedure	Reported in STS Database Records (%)	Actual Corrected Readmission Rate (%)	STS National Rate (%)
All Cases	7.4	10.3	--
AVR	6.55	9.97	10.0
CAB	7.33	10.14	10.0
MVR	8.71	13.06	15.7
MVRpr	5.02	7.97	8.8
CAB-AVR	8.50	12.35	11.6
CAB-MVR	6.33	11.76	16.1
CAB-MVRpr	9.76	12.58	13.3

Conclusions: Accurate measurement of readmission rates is increasingly important as payor look to financially penalize hospitals with readmission rates above a designated level. Matching patient records to our administrative database showed that the clinical database may fail to capture readmissions, especially to other area hospitals. Currently in our region, we are capturing only about 72% of the actual readmissions. Combining data with an administrative database can enhance accuracy of reporting.

P12. Cardiothoracic Surgery T32 Training Grants Are Vital to the Development of Academic Surgeons

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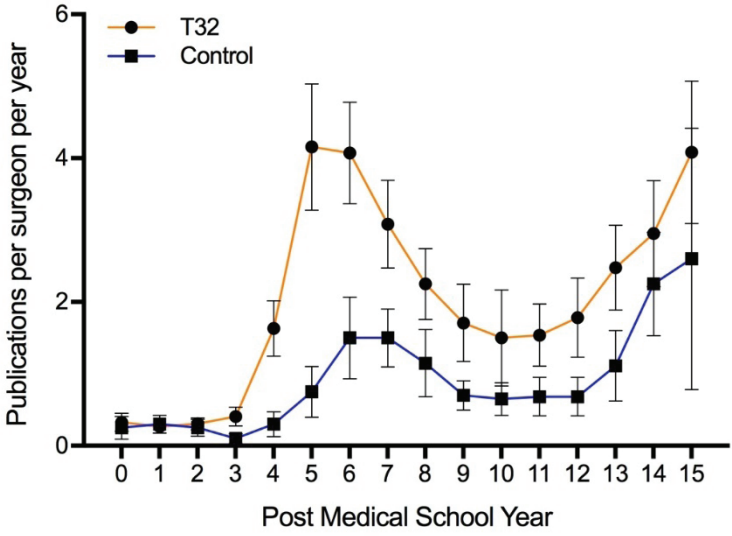
Objective: The Ruth L. Kirschstein Institutional National Research Service Award (T32) provides institutions with the financial means necessary to prepare predoctoral and postdoctoral trainees for careers in academic medicine. After the Cardiac Surgery Program of the National Heart, Lung and Blood Institute (NHLBI) was phased out in 1990, T32 training grants became crucial sources of extramural funding to support cardiothoracic (CT) surgical research, providing residents the opportunity to pursue and cultivate research interests. We hypothesized that institutions with a CT surgery T32 training grant have produced more academically-prolific surgeons compared to institutions without such funding.

Methods: Information on all trainees supported by CT T32 training grants at two academic surgery programs (T32) were obtained, along with information on trainees from two similarly sized training programs without CT T32 grant funding (Control). Data collected included medical school graduation year, residency start and end years, current academic rank and institution, fellowship details, additional degrees, and all research publications. Non-surgery residents and residents who did not pursue CT surgery after residency were excluded from the analysis. Residents at programs with T32 grants were compared with residents at programs without T32 grants.

Results: Data on 101 current trainees or practicing CT surgeons (T32: 81 vs. Control: 20) from 4 institutions were obtained, with a total publication count of 2,411 manuscripts. Sixty-nine individuals (T32: 49 vs. Control: 20) were analyzed after applying the exclusion criteria. The T32 group consisted of 18 current trainees and 31 practicing CT surgeons and the Control group consisted of 20 practicing CT surgeons. The T32 group had significantly more publications per surgeon per year compared with the Control group over 15 years post medical school graduation (Figure, $p < 0.0001$). The T32 and Control groups both have a bimodal distribution of publications, with peaks at or near the completion of residency (years 5–8) and again after approximately 10 years in practice (years 14 and 15). Additionally, T32 programs have produced significantly more academic surgeons as compared with Control programs (77% [24/31] vs. 45% [9/20], $p = 0.034$).



Conclusions: T32 training grants supporting CT surgery research are vital to the development of prolific academic CT surgeons. These results warrant continued funding by NHLBI to support the development and training of residents interested in CT surgery and attending surgeons should continue to apply for these grants.

Late-Breaking Clincial Trial

LB3. Is Hybrid Thoracoscopic Approach Effective for Treatment of Long Standing Persistent Lone Atrial Fibrillation? Clinical Update of the Historic-AF Trial

Claudio Muneretto[1], Ralf Krakor[2], Gianluigi Bisleri[3], Fabrizio Rosati[1], Lorenzo Di Bacco[1], Laura Giroletti[1], Antonio Curnis[1], Elisa Merati[4], Massimo Moltrasio[4], Claudio Tondo[4], Gianluca Polvani[4]

[1]University of Brescia, Brescia, Italy; [2]THG Staedtisches Klinikum, Dortmund, Germany; [3]Queen's University, Kingston, ON, Canada; [4]University of Milan, Milan, Italy

Moderators: ◆James Gangemi and ◆Joe Turek

P13. Surgical Strategy of Anatomical Repair for Congenitally Corrected Transposition of the Great Arteries

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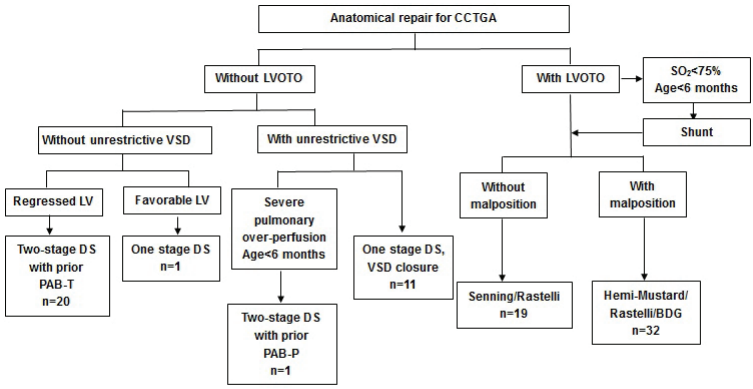
Objective: Anatomical repair for congenitally corrected transposition of the great arteries (CCTGA) remains controversial. This study was to review our surgical strategy in pediatric patients with CCTGA.

Methods: From Jan 2005 to Feb 2016, consecutive CCTGA patients who underwent anatomical repair at our institution were enrolled in this retrospective study. As showed in the Figure, various types of biventricular repair were customized individually.

Results: A total of 85 patients were included. The median age of the patients underwent anatomical repair was 4.8 years (range, 8 months to 12 years). Left ventricular outflow tract obstruction (LVOTO) was presented in 51 (60.0%) patients (44 pulmonary stenosis and 7 pulmonary atresia). Positional anomaly (25 dextrocardia and 10 mesocardia) and situs inversus were documented in 35 (41.2%) and 10 (11.8%) patients, respectively. Sixty-four patients had an unrestrictive VSD and 10 of them presented with pulmonary vascular obstructive disease. Moderate-to-severe tricuspid regurgitation was presented in 39 (45.9%) patients. Prior pulmonary artery banding was required in 21 patients (1 to reduce pulmonary blood and 20 to retrain the LV). As showed in the Figure, 33, 19 and 32 patients accepted Senning/arterial switch operation (ASO), Senning/Rastelli and Hemi-Mustard/BDG/Rastelli, respectively. There were no differences considering both cardiopulmonary bypass time (ANOVA: P = 0.332) and cross-clamp time (ANOVA: P = 0.472) between these approaches. Early after repair, there were 5 in-hospital deaths and 9 reoperations. In multivariate analysis, the only risk factor for early deaths was the year of surgery before 2012. During a 4.6-years (0.5 to 10.3 years) follow-up, 7 late deaths were documented without risk factors found. Estimated overall survival rate after anatomical repair was 91.7%, 82.9% and 82.9% at 1 year, 5 years and 10 years, respectively. Instead of Senning/ASO, most (3/4, 75.0%) early LV dysfunction were noted in patients underwent Senning/Rastelli procedure. However, all the late LV dysfunction were found in patients underwent Senning/ASO and previous retraining. At the latest follow-up, 94.5% (69/73) of the survivors were in NYHA functional class I-II. Compared with patients underwent Senning/Rastelli, a lower early mortality was documented in patients who had Hemi-Mustard/Rastelli/BDG, although more positional cardiac anomalies presented.



CCTGA=congenitally corrected transposition of the great arteries; LVOTO=left ventricular outflow tract obstruction; SO_2=Oxygen Saturation; VSD=ventricular septal defect; LV=left ventricle; DS=double switch; PAB-T=pulmonary arterial banding for LV retraining; PAB-P=pulmonary arterial banding reducing pulmonary blood; BDG=bidirectional Glenn shunt

Conclusions: Favorable outcomes of anatomical repair for CCTGA can be achieved with appropriate surgical strategies. Postoperative LV dysfunction is significant to the outcomes after both Senning/ASO and Senning/Rastelli. Hemi-Mustard/Rastelli/BDG may be an option for patients with cardiac malposition, providing lower early mortality.

P14. MELD Score and Ventilation Indices Are Strong Determinants of Death, Intensive Care Morbidity and Massive Transfusion After Adult Congenital Heart Disease Surgery

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Objective: Predicting peri-operative death and morbidity after ACHD surgery is difficult, due to patients' complex histories and paucity of published outcomes data. Existing perioperative risk score calculators fail to capture comorbidities unique to the Adult Congenital Heart Disease population. We sought to identify robust determinants of ACHD intensive care morbidity.

Methods: Following REB approval, data was acquired from 4 prospectively maintained databases on 772 consecutive adults undergoing surgery (excluding transplants) by our congenital team between 2004 and 2015. Thorough chart review was undertaken by congenital cardiac intensivists and anesthesiologists, focusing on pre-operative biomarkers and physiologic parameters. Endpoints included: stroke, renal failure requiring dialysis (AKI), blood product usage and death. Analysis was via parametric univariate (UV) and multivariable (MV) risk-adjusted regressions, guided by bootstrapping for reliability.

Results: Underlying baseline diagnosis included: tetralogy of Fallot (36%), septal defects (29%), bicuspid aortic valve disease (7%) and Fontan, Ebstein's, endocarditis, ccTGA, coarctation (all 3%). Median age was 37 (17–77) and the majority had undergone multiple previous sternotomies (none = 39%, 1 = 30%, 2 = 19%, 3–7 = 11%). Overall in-hospital mortality was 4.4% (2004–2007 =, 4.6%, 2008–2011 = 5.1%, 2012–2015 = 3.7%).

AKI, duration on ventilator, blood product usage and death all have strong and reliable risk factors in common (Table). FEV1, FVC, creatinine, albumin, MELD scores, multiple previous sternotomies and single ventricle physiology were highly significant and reliable predictors of all these endpoints. Of these, FEV1, albumin and MELD IX were most commonly incorporated in multivariable risk-adjusted models. For MELD categories 0–9, 10–19 and 20+ mortality was 2.7%, 11% and 33% respectively ($P < .0001$).

Blood product usage was massive: 10% were exposed to 33 or more units (max 423). Only 37% avoided any exposure (predictors included: ASD repair, later operative year, fewer sternotomies). Of those who received products, median exposure was: PRBC 3 (max 138), platelets 5 (max 175), FFP 4 (max 130).

No biomarkers or physiologic parameters were strong predictors of stroke. Instead, multivariable models of stroke included older age, bicuspid aortic valve disease and previous Mustard surgery (Table).

N=772	Stroke	AKI	Longer Vent times (hrs)	Blood product exposure (units)	Death
	N=15, 1.9%,	N=26, 3.4%	Median 6.4 Range 0.4-2848 IQR 4-16	Median 4 Range 0-423 IQR 0-15	N=34, 4.4%
# sternotomies	-	P=.0012, OR 1.6	P=.002, PE .01	P<.0001, PE 0.8	P<.0001, OR 1.6
Older age	P=.019 OR 1.04	-	-	-	-
Cyanosis	-	-	P<.0001, PE 167	P=.0004, PE 2.7	P=.004, OR 7.0
Lower FEV1	-	P<.0001, OR .95	P<.0001, PE -2.9	P<.0001, PE -.41	P<.0001, OR .93
Lower FVC	-	P=.0008, OR .95	P<.0001, PE -2.9	P<.0001, PE -.04	P<.0001, OR .94
Higher billirubin	-	P=.003, OR 1.05	P=.002, PE 2.3	P<.0001, PE .08	P=.030, OR 1.03
Lower albumin	-	P=.017, OR .91	P<.0001, PE -7.7	P<.0001, PE -.13	P=.0002, OR .88
Higher creatinine	-	P=.0002, OR 1.03	P=.003, PE .77	P<.0001, PE .02	P<.0001, OR 1.03
Higher INR	-	-	-	P<.000, PE 1.7	P=.007, OR 2.17
Warfarin	-	P=.0006, 4.13	-	P<.0001, PE 1.8	P<.0001, OR 4.0
Higher MELD	-	P<.0001, OR 1.2	P=.0006, PE 7.2	P<.0001, PE 0.3	P<.0001, OR 1.2
Higher MELD IX	-	P<.0001, OR 1.4	P<.0001, PE 16	P<.0001, PE .49	P<.0001, OR 1.5
Dev delay	-	-	-	-	-
Worse ventricular Fx	-	P<.0001, OR 2.5	P=.0006, PE 33	P<.0001, PE .83	-
Fontan	-	P=.001, OR 6.96	-	P<.0001, PE 4.5	P=.0003, OR 6.9
Ebsteins'	-	P=.021, OR 4.5	-	P=.027, PE 1.3	P=.0068, OR 4.8
Previous Mustard	P=.035, OR 10.7	-	P<.0001, PE 466	-	P=.0058, OR 11
Bicuspid aortic valve disease	P=.0065, OR 5.1	-	-	P=.006, PE 1.1	-
Endocarditis	-	-	P=.003, PE 109	P<.0001, PE 2.7	P=.004, OR 5.3
Systemic RV	-	P=.047, OR 3.6	P=.0001, PE 121	-	P=.019, OR 3.8

Univariate predictors. Variables in orange squares are included in multivariable models, with dark squares being particularly reliable risk factors

Conclusions: MELD score, ventilation parameters and biomarkers such as albumin are very strong and reliable determinants of severe morbidity, massive transfusion and death after ACHD surgery. Stroke is not easily predicted and is determined more by operation type. These peri-operative prediction models will help better counsel ACHD patients. Predicting massive transfusion will also help strategize for future transplant eligibility.

P15. The CHSS Complete Atrioventricular Septal Defect Inception Cohort: Pre-Intervention Echocardiographic Characteristics

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Objective: Previous studies have demonstrated that the modified Atrioventricular Valve Index (mAVVI), Right Ventricular-Left Ventricular (RV/LV) inflow angle, and Left Ventricular Inflow Index effectively differentiate balanced vs. unbalanced Complete Atrioventricular Septal Defect (CAVSD) and may be useful in informing surgical management. This core lab analysis of baseline, pre-intervention echocardiograms of infants diagnosed with CAVSD provides a description of the echocardiographic spectrum of disease and assesses the relationship of known measures of inflow physiology with known measures of ventricular geometry.

Methods: Patients diagnosed with CAVSD before one year of age with atrioventricular and ventriculoarterial concordance were prospectively enrolled into an inception cohort. Pre-intervention echocardiograms were submitted by participating institutions. A single sonographer analyzed the images according to a standardized protocol of 111 morphologic and functional characteristics. Data are summarized using descriptive statistics and Pearson correlation coefficients.

Results: Baseline echocardiograms were available for 59% (194/328) of patients. The median age at which echocardiograms were performed was 15 days old (IQR 1–83), at a median weight of 3.3 kg (IQR 2.8–4.2). Right-dominant AVSD (mAVVI ≤ 0.4) was present in 22% (42/194), left-dominant (mAVVI ≥ 0.6) in 5% (9/194), and balanced (0.4 &lt mAVVI &gt 0.6) in 73% (143/194). Septal malalignment was present in 15% (25/186), with left malalignment accounting for 92% (23/25). The median mAVVI was 0.5 (IQR 0.4–0.5, absolute range = 0.2–0.7). The median RV/LV inflow angle was 89.0 (IQR 80.0–101.3) degrees. The median LVII was 0.5 (IQR 0.5–0.6). The median right atrioventricular valve (AVV) area was 1.6 (IQR 1.2–2.1) cm^2. The median left AVV area was 1.2 (IQR 0.9–1.7) cm^2. The median total AVV area was 3.0 (IQR 2.2–3.8) cm^2. mAVVI was weakly correlated with left ventricular size and inversely correlated with right ventricular size. The RV/LV inflow angle was not correlated with RV or LV size and only moderately correlated with RAVV and LAVV annular sizes. LVII was weakly correlated with LV size (Table).

Table: Correlation of Measures of Inflow Physiology with Ventricular Geometry

	Pearson Correlation Coefficient	P-value
mAVVI		
RV/LV inflow angle	0.12	0.13
Color inflow diameter at RAVV annulus	-0.29	0.001
Color inflow diameter at LAVV annulus	0.41	< 0.0001
RV end diastolic area	-0.31	0.0001
LV end diastolic area	0.43	< 0.0001
RV/LV inflow angle		
Color inflow diameter at RAVV annulus	-0.40	< 0.0001
Color inflow diameter at LAVV annulus	-0.36	< 0.0001
RV end diastolic area	0.08	0.26
LV end diastolic area	0.12	0.11
LVII		
mAVVI	0.28	0.001
RV/LV inflow angle	0.28	0.0002
Color inflow diameter at RAVV annulus	-0.26	0.002
RV end diastolic area	-0.10	0.22
LV end diastolic area	0.16	0.04

Abbreviations: mAVVI=modified atrioventricular valve index, RV/LV=right ventricular/left ventricular, RAVV=right atrioventricular valve, LAVV=left atrioventricular valve

Conclusions: In this large data set of baseline echocardiographic characteristics of patients with CAVSD, measures of inflow physiology are, at best, only moderately correlated with ventricular geometry. The role and impact of these observations on surgical strategy and clinical outcomes will require the continued study of this cohort.

P16. Effect of Atrioventricular Valve Repair on Multi-Stage Palliation Outcomes of Single Ventricle Anomalies

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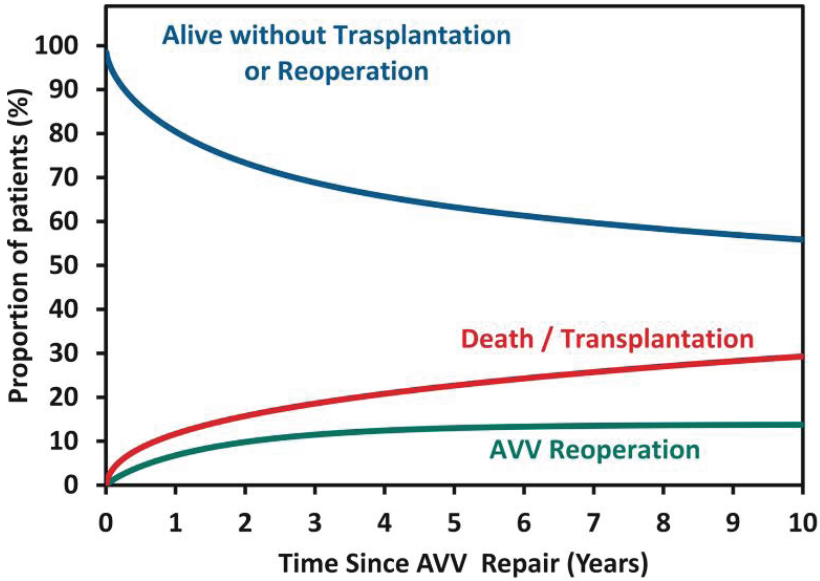
Objectives: Accomplishment of multi-stage palliation of single ventricle (SV) anomalies depends on set anatomic and hemodynamic criteria. The presence of significant atrioventricular valve (AVV) regurgitation results in unfavorable conditions that affect the success of this palliation strategy. We report our institution's experience with AVV repair and examine factors affecting outcomes.

Methods: We followed 604 infants who underwent their initial palliative surgery between 2002–12. Our cohort comprised those who underwent AVV repair at various palliation points. We examined patients' characteristics and anatomic details associated with outcomes. Additionally, comparative analysis using propensity-matched control was performed.

Results: Fifty-seven patients received AVV repair during the first-stage (n = 8), Glenn (n = 30) and Fontan (n = 19) stages. Median age at time of initial palliation was 5 days (IQR 3–16) while median age at time of AVV repair was 6.6 months (IQR 4.2–24.1). Underlying SV anomaly was hypoplastic left heart syndrome (n = 29),

atrial isomerism (n = 14), other (n = 14). The AVV was tricuspid (n = 30), mitral (n = 8), common (n = 19) while dominant ventricle morphology was right (n = 41), left (n = 13), both (n = 3). On preoperative echocardiogram, 55 (97%) had AVV regurgitation ≥ moderate and 8 (14%) had depressed ventricular function ≥ moderate. Post-repair, AVV regurgitation was none or trivial (n = 21, 37%), mild (n = 19, 33%), moderate (n = 17, 30%).



Competing risks analysis showed that at 10 years following AVV repair, 15 % had died, 15% had received heart transplantation, 14% had undergone AVV reoperation and 56% were alive without transplantation or AVV reoperation. Overall survival and transplant-free survival at 10 years following AVV repair was 78% and 68%, respectively. Factors associated with transplant-free survival were AVV repair at first-stage surgery (HR 1.8 (0.6–5.6), p = 0.005) and post-repair depressed ventricular function ≥ moderate (HR 5.4 (1.5–19.8), p = 0.036).

When comparing with a matched control group, transplant-free survival was lower in our patient cohort (68% vs. 87%, p = 0.013).

Conclusions: The presence of significant AVV regurgitation affects SV palliation survival. This is especially evident in patients who require AVV repair at first-stage surgery and those with diminished ventricular function. Different approaches are warranted in these high-risk patients and those might implicate the mode of initial palliation, timing of AVV repair and listing for transplantation.

P17. Long-Term Results of Tissue-Engineered Vascular Grafts in Pediatric Patients with Congenital Heart Disease

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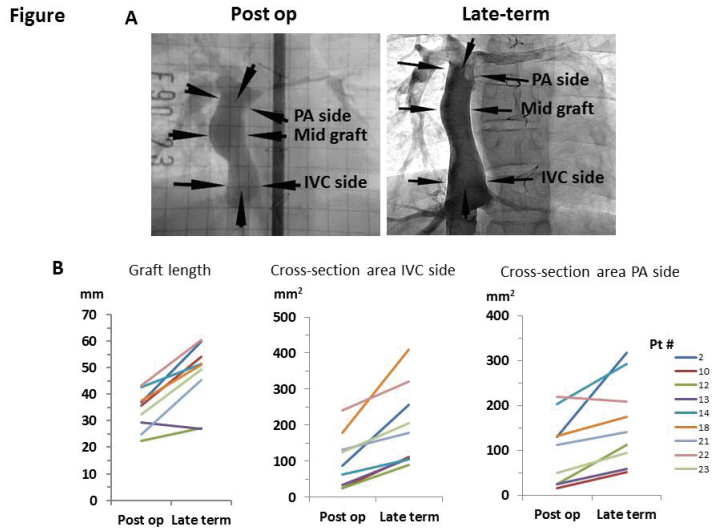
Objective: Tissue engineering holds great promise for the advancement of cardiovascular surgery as well as other medical fields. Tissue-engineered vascular grafts have the ability to grow and remodel and could therefore make substantial advances in pediatric cardiovascular surgery. In 2001, we began a human clinical trial evaluating these grafts in patients with univentricular physiology. Herein, we report the long-term results of patients who underwent implantation of tissue-engineered vascular grafts as extracardiac total cavopulmonary conduits.

Methods: Tissue-engineered vascular grafts seeded with autologous bone marrow mononuclear cells were implanted in 25 patients with univentricular physiology as extracardiac total cavopulmonary conduits. The graft is composed of a woven fabric of poly-l-lactide acid or polyglycolic acid and a 50:50 poly (l-lactic-co-ε-caprolactone) copolymer. Patients were followed up postoperatively in a multidisciplinary clinic. The length and cross-sectional area of the graft were measured using both postoperative and late-term angiography or CT angiography at three locations: the side near the inferior vena cava, the mid graft, and the side near the pulmonary artery.

Results: Median patient age at operation was 5.5 years and the mean follow-up period was 10.3 years. Eight patients died during the follow-up period. There was no graft-related mortality. There was no evidence of aneurysmal formation, graft rupture, graft infection, or calcification. Ten patients (40%) had asymptomatic graft stenosis. Six of 10 patients underwent successful balloon angioplasty. One patient had thrombus formation in the graft one year after surgery, which was successfully resolved by anticoagulation therapy. For patients who were less than 5 years old at implantation, angiographical assessment shows the growth of graft (graft length; 33.9 ± 7.3 mm vs. 47.4 ± 12.4 mm, p = 0.001, cross-sectional area at the side near inferior vena cava; 101.1 ± 77.3 mm^2 vs. 160.7 ± 96.5 mm^2, p = 0.01, cross-sectional area at the side near pulmonary artery; 100.7 ± 74.8 mm^2 vs. 198.6 ± 111.6 mm^2, p = 0.001, postoperative and late-term, respectively) (Figure A, B).

Conclusions: Our results indicate that tissue-engineered vascular grafts have grown according to the patients growth. Stenosis is the primary mode of failure of the tissue-engineered vascular graft.Tissue-engineered vascular grafts have feasibility in pediatric cardiovascular surgery.

Figure



P18. Outcomes and Prognostic Factors for Acquired Pulmonary Vein Stenosis in the Current Era

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Objective: The optimal management and prognostic factors of acquired pulmonary vein stenosis (APVS) remain controversial. We sought to determine current APVS outcomes and prognostic factors in a multicentric study in the current era.

Methods: Seventy-five patients with APVS who underwent 103 procedures in 14 European/North-American centers between 2000 and 2012 were included retrospectively. A specific PVS severity score was developed, based on the echographic pressure gradient and the focal/diffuse aspect of the stenosis for each PV. A risk analysis was performed. Mean follow-up was 43 ± 39 months. Seventy-six % (57/75) of APVS occurred after repair of a total anomalous pulmonary venous return. Mean preoperative score was 8.1 ± 3.8. The mean number of affected PV per patient was 2.9 ± 1.1. Sutureless repair was used in 42/103 procedures (41%),

patch veinoplasty in 28/103 (27%), endarterectomy in 16/103 (16%). Median age and weight at surgery were 5 months (range: 5d.–184 m.) and 5.5kg (range:2.8–42) respectively.

Results: Overall PV restenosis, reoperation and mortality occurred in 56% (n = 58/103), 49% (n = 50/103) and 27% (n = 20/75) respectively. Kaplan-Meier cumulative patient survival and reoperation-free survival at 10 years were 69 ± 11% and 48 ± 10% respectively. Preoperative PVS scores > 8.5 and > 9 had the best predictive accuracy for postoperative PV restenosis and reoperation respectively. Restenosis and reoperation rates were significantly lower after sutureless repair compared to non-sutureless repair : 40% (n = 17/42) vs. 67% (n = 41/61) (p = 0.007) for restenosis and 31% (n = 13/42) vs. 61% (n = 37/61) (p = 0.003) for reoperation. Mortality rate after sutureless repair (20%; 7/35) was not significantly different from non-sutureless repair (33%; 13/40) (p = 0.22). Kaplan-Meier cumulative reoperation-free survival at 8 years was significantly lower in patients with preoperative PVS score > 9 (35 ± 14% vs. 59 ± 11% for PVS score < = 9 ; logrank p = 0.002), non-sutureless repair (34 ± 13% vs. 68 ± 12% for sutureless repair ; logrank p = 0.003), and postoperative residual pulmonary hypertension (36 ± 17% vs. 69 ± 12% without postoperative pulmonary hypertension; logrank p = 0.02). Results of the univariate analysis are showed in the Table. Multivariate analyis showed that a high postoperative PVS score was an independent risk factor for PV restenosis (OR = 7.76 (95%CI:1.16–51.77); p = 0.034), PV reoperation (OR = 2.18 (1.25–3.8); p = 0.006) and PVS-related mortality (OR = 1.57 (1.11–2.2); p = 0.009).

	PV restenosis	PV reoperation	PV-related mortality
Weight	OR=0.95 (0.89 - 1.01); p=0.08	OR=0.96 (0.90 - 1.02); p=0.14	OR=0.73 (0.53 - 1.00); p=0.048
Female gender	OR=4.03 (1.75 - 9.28); p=0.001 *	OR=2.68 (1.21 - 5.96); p=0.015 *	OR=3.25 (1.11 - 9.48); p=0.03 *
Preoperative pulmonary hypertension	OR=2.78 (0.93 - 8.29); p=0.067	OR=3.27 (1.09 - 9.80); p=0.034 *	OR=2.14 (0.53 - 8.72); p=0.28
Preoperative severity score>8.5	OR=3.39 (1.47 - 7.78); p=0.004 *	OR=2.59 (1.16 - 5.78); p=0.019 *	OR=2.61 (0.90 - 7.57); p=0.078
Diffuse aspect of PV stenosis	OR=2.97 (1.32 - 6.66); p=0.008 *	OR=2.49 (1.13 - 5.50); p=0.024 *	OR=1.70 (0.61 - 4.77); p=0.31
Single ventricle	OR=1.66 (0.66 - 4.18); p=0.28	OR=2.02 (0.82 - 5.02); p=0.12	OR=1.19 (0.36 - 3.96); p=0.77
Bilateral disease	OR=2.54 (1.13 - 5.70); p=0.023 *	OR=2.05 (0.92 - 4.56); p=0.08	OR=1.25 (0.44 - 3.54); p=0.67
Sutureless procedure	OR=0.33 (0.15 - 0.75); p=0.008 **	OR=0.29 (0.13 - 0.67); p=0.003 **	OR=0.52 (0.18 - 1.50); p=0.23
Postoperative severity score	OR=2.45 (1.70 - 3.54); p<0.001 *	OR=1.57 (1.34 - 1.84); p<0.001 *	OR=1.39 (1.20 - 1.62); p<0.001 *
Postoperative pulmonary hypertension	No convergence	OR= 83.95 (8.54 - 825.1); p=0.0001 *	OR=62.99 (4.90 - 810.12); p=0.001 *

Results of the univariate analysis

Results are presented as (Odds ratio [OR (95% CI)], p-value).
*: significant (p<0.05), 95% Confidence intervals not including 1.
** : protective factor
PV: Pulmonary Vein. Pulmonary hypertension: defined as pulmonary artery pressure >3/4 systemic pressure.

Conclusion: Acquired PVS still has a guarded prognosis in the current era. The sutureless technique used for acquired PVS seems to be associated with a lower risk of PV restenosis and reoperation but does not seem to reduce significantly the risk of mortality. The severity of the residual disease evaluated by a new severity score is an independent risk factor for poor outcomes regardless of surgical technique.

P19. Autosomal Dominant Mannose-Binding Lecithin Binding Deficiency Is Associated with Worse Neurodevelopmental Outcomes After Cardiac Surgery in Infants

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Objective: Mannose-binding lectin (MBL) is an acute-phase reactant. Low MBL levels have been associated with adverse outcomes, including neurodevelopment, in preterm infants. The *MBL2* gene is the major genetic determinant of MBL plasma protein levels. The *MBL2* missense variant rs1800450 (p.Gly54Asp, minor allele frequency of 10.26%) causes autosomal dominant MBL deficiency. We tested the hypothesis that this variant, which causes low MBL levels, is associated with worse neurodevelopmental outcomes after cardiac surgery in neonates.

Methods: This is an analysis of a previously described cohort of non-syndromic congenital heart disease (CHD) patients who underwent cardiac surgery with cardiopulmonary bypass before 6 months of age (n = 295). Four-year neurodevelopment was assessed in three domains: Full-Scale Intellectual Quotient (FSIQ), the Visual Motor Integration (VMI) development test, and the Child Behavior Checklist (CBCL) to assess behavioral problems. The CBCL measured total behavioral problems, pervasive developmental problems (PDPs), and internalizing/externalizing problems. To assess the effect of autosomal dominant MBL deficiency, patients with at least one minor allele at *MBL2* missense variant rs1800450 were grouped together. Multivariable linear regression models, adjusting for confounders (see **Figure 1A** for full list of covariates), were fit. A Bonferroni-adjusted threshold for significance was set at $\alpha = 0.0083$ to adjust for the 6 total neurodevelopmental outcomes tested (0.05/6).

Results: Autosomal dominant MBL deficiency was associated with a significantly increased covariate-adjusted PDP score ($\beta = 3.98$, $P = 0.0025$, see **Figure 1A**). Examination of the interaction between age at first surgery and MBL genotype revealed significant effect modification for the patients with autosomal dominant MBL deficiency ($P_{interaction} = 0.039$, **Figure 1B**), with the poorest neurodevelopment scores occurring in children who had surgery earlier in life. There was a trend toward

significance for MBL deficiency and CBCL total problems (β = 3.23, *P* = 0.097) and internalizing problems (β = 3.33, *P* = 0.093). While there was no significant association between autosomal dominant MBL deficiency and FSIQ, VMI, or CBCL externalizing problems score, the beta coefficients for each outcome (see **Figure 1A**) correspond to a deleterious effect of low MBL levels on neurodevelopment.

a

Association of autosomal dominant MBL deficiency genotype with 4-year neurodevelopmental outcomes.

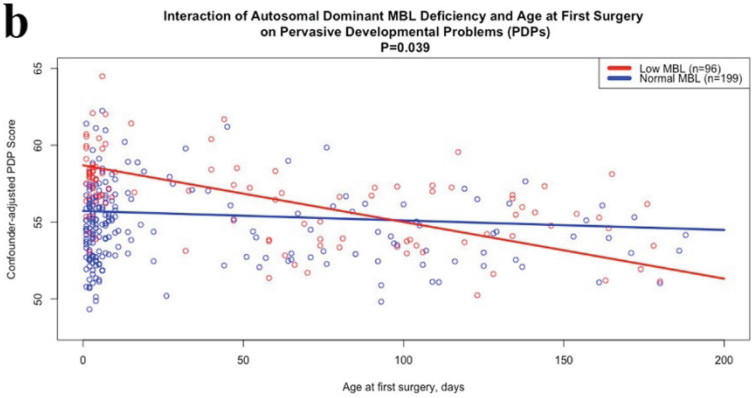
Outcome*	Beta Coefficient (±SE)	P-Value
Full IQ Score	-2.78 (±2.75)	0.31
VMI Score	-2.89 (±2.98)	0.33
CBCL Total Problems Score †	3.23 (±1.94)	*0.097*
CBCL Persistent Developmental Problems Score †	3.98 (±1.30)	**0.0025**
CBCL Internalizing Problems Score †	3.33 (±1.97)	*0.093*
CBCL Externalizing Problems Score †	1.40 (±1.88)	0.46

Abbreviations: CBCL – Child Behavior Checklist 1.5 to 5 years; IQ – Intellectual Quotient; VMI – developmental test of Visual Motor Integration

* Linear regression model for association of autosomal dominant MBL deficiency and 4-year neurodevelopmental outcomes adjusts for: first 3 principal component eigenvectors (to adjust for genetic ancestry stratification), gestational age, birth weight, birth head circumference, *APOE* ε2 genotype, diagnostic class (class 1 as the reference group), preoperative intubation, preoperative length of stay, total minutes of cardiopulmonary bypass, total minutes of deep hypothermic circulatory arrest, delayed sternal closure, use of extracorporeal membrane oxygenation; hematocrit at first surgery, mother's education at 4-year follow-up, and mother's socioeconomic status at 4-year follow-up.

† For CBCL outcomes, higher scores and beta coefficients correspond to increased prevalence of problems in neurodevelopment.

b



Conclusions: After cardiac surgery, children with autosomal dominant MBL deficiency have increased PDP scores at 4-year neurodevelopmental follow-up, independent of other covariates. There is a significant interaction between MBL levels and age at first surgery suggesting that the poorest neurodevelopmental outcome of low MBL levels occurs at early age. These data provide additional evidence that genetic variants are important modifiers of morbidity and disability after surgery for CHD.

P20. Bovine Arch Anatomy Influences Re-Coarctation Rates in the Era of the Extended End-to-End Anastomosis

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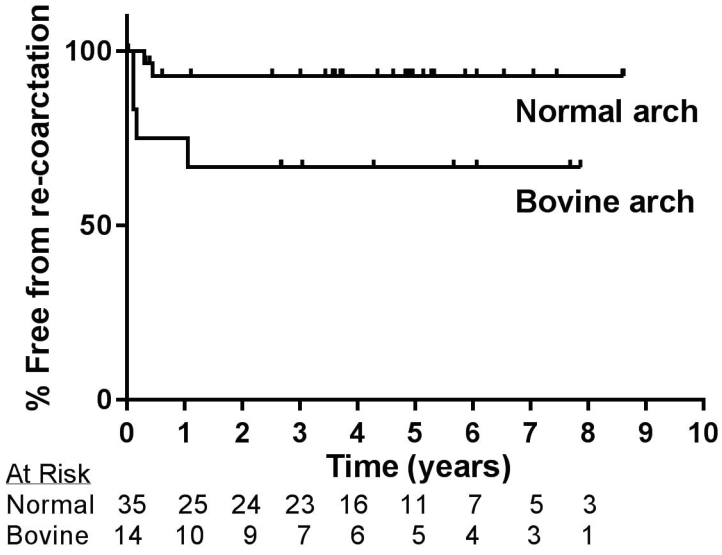
Objective: Bovine arch anatomy has never been shown to influence re-coarctation after extended end-to-end anastomosis via a left thoracotomy, yet in all these studies the bovine arch is grossly underreported (prevalence in these studies no more than 5%, while imaging and autopsy studies show 15–37% prevalence of the bovine arch). This study aims to: 1) assess chart review reliability in bovine arch identification, 2) determine re-coarctation risk with a bovine arch, and 3) explore an anatomic explanation for recurrent arch obstruction based on arch anatomy.

Methods: 49 patients underwent surgical repair for aortic coarctation via an extended end-to-end anastomosis at a single institution over a 6 year period (2007–2012). Echocardiographic images from these patients were specifically reviewed for arch anatomy and compared to a chart review of the echocardiographic reports looking for the same. Recurrent arch obstruction was defined as an echocardiographic gradient across the repair ≥20 mmHg and compared across arch anatomies. For cases with angiographic images (18/49; 6 bovine arches; 12 normal arches), a scaled clamping distance (indexed to the diameter of the sinotubular junction) between the left subclavian artery and the maximal proximal clamp location on orthogonal projections was then calculated for normal anatomy versus bovine arch anatomy.



Results: Only 3/49 (6.1%) patients were indicated on chart review to have a bovine arch, compared to 14/49 (28.6%) on targeted retrospective review. For patients with a bovine arch, 4/14 (28.6%) had a follow-up gradient ≥20 mm Hg. Conversely, for patients with normal aortic arch anatomy, 2/35 (5.7%) had a follow-up gradient ≥20 mm Hg. Figure 1 shows the Kaplan-Meier curve for freedom from re-coarctation between the two arch anatomies ($p < 0.03$). The mean clamping index for patients with normal arch anatomy was 1.31 ± 0.55, while the mean for patients with bovine arch anatomy was only 0.80 ± 0.39 ($p < 0.05$). Age and weight at time of operation were not significantly different between study groups.

Conclusions: Bovine arch anatomy often goes undocumented on preoperative imaging assessment, yet children undergoing extended end-to-end repair with bovine arch anatomy are at a significantly increased risk of recurrent arch obstruction. This may be due to a reduced clampable distance to facilitate repair. These results should trigger a profound paradigm shift in preoperative assessment, parental counseling and surgical approach for children with discrete aortic coarctation.

P21. Atrioventricular Valve Regurgitation in Patients Undergoing Total Cavopulmonary Connection: Impact of Valve Morphology on Survival and Reintervention

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Objective: To evaluate the morphology of atrioventricular valve (AVV), the mechanisms of AVV regurgitation and outcomes of AVV surgery in single ventricle patients, and to determine their influence on clinical outcomes after total cavopulmonary connection (TCPC).

Methods: A total of 460 patients underwent a TCPC between 1994 and 2015, including 101 (22%) patients who had at least one AVV surgery before or at time of TCPC. AVV morphology was classified into single mitral valve (MV), single tricuspid valve (TV), two separated valves (2AVVs), and common AVV (CAVV). Morphological feature of AVV regurgitation in patients who needed AVV surgery were analyzed. Outcomes following TCPC were compared to the remaining 359 patients who did not require AVV surgery. Factors influencing mortality, AVV reoperation and systemic ventricular function, were analyzed.

Results: In 101 patients who had AVV surgery, AVV morphology showed 2AVVs in 33 patients, MV in 11, TV in 41, and a CAVV in 16. Patients with a TV and a CAVV underwent AVV surgery more frequently, 27 and 36 %, respectively, than patients with a MV, 10% ($p < 0.001$). AVV regurgitation was due to one or more of the following mechanism: dysplastic leaflet (n = 62), prolapse (53), annular dilation (27), cleft (22), and chordal anomaly (14). Morphological anomalies were observed in 89 patients (88%). The primary procedure was 81 AVV repairs, 16 AVV closures, and 4 AVV replacements. Among 81 initial repairs, repeat repair was required in 20 patients, AVV replacement in 7, and AVV closure in 3. Overall survival following TCPC was lower in patients who had AVV surgery than those who did not. (88 % vs. 95 % at 15 years, $p = 0.01$). In patients who had AVV surgery, freedom

from reoperation on AVV was 75 % at 15 years and significant AVV regurgitation (moderate or more) was observed in 12 patients at medial follow-up of 6.5 years. Patients undergoing AVV replacement showed lower survival compared to those who had repair or closure of AVV ($p = 0.02$). Risk factor analysis revealed papillary muscle anomaly as a risk for mortality following TCPC ($p = 0.001$), leaflet prolapse for AVV reoperation ($p = 0.009$), and chordal anomaly for AVV replacement ($p < 0.001$). Systemic ventricular function did not differ in patients with and without AVV surgery at last follow-up. However, annular dilation ($p = 0.006$ at TCPC and $p = 0.061$ at last follow-up) and the number of AVV surgeries ($p = 0.024$ at last follow-up) were identified as risk factors for reduced ventricular function.

Conclusions: AVV regurgitation in functional single ventricle is more frequently associated with TV or CAVV morphology. Morphological anomalies are the primary cause of AVV regurgitation. AVV regurgitation requiring surgical intervention influences survival following TCPC. Surgical management based on mechanisms of regurgitation is mandatory and early intervention is suggested to improve ventricular function and clinical outcomes.

P22. Cardiac Progenitor Cell Infusion to Treat the Patients with Single Ventricle Univentricular Heart Disease Strategy Using Cardiac Progenitor Cell Infusion in Children with Single Ventricle Regenerative Therapy Using Cardiac Progenitor Cell for Congenital Heart Disease

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Objective: Cardiac regenerative strategy using cardiac progenitor cell infusion in children with single ventricle physiology including hypoplastic left heart syndrome has conducted since 2011.The aim of this study is to investigate the prognostic factors that may affect the cardiac function improvements after cell therapy.

Methods: Between January, 2011, and March, 2015, 41 children (2.8 ± 1.4 yr) with single ventricle physiology were assigned to receive intracoronary infusion of cardiac progenitor cells after staged palliation. Cardiac tissues were harvested during surgery and progenitor cells were isolated and cultured. A total of 3.0×10^5 cells per kilogram of the body weight was selectively infused into each coronary artery about 1–2 months after surgical procedure. The primary endpoint was to assess the feasibility and safety; the secondary endpoint was to evaluate cardiac function and heart failure status up to 12 months after cell infusion. Multiple linear regression analysis was performed to investigate the prognostic factors impact of progenitor cell infusion on cardiac function.

Results: Intracoronary injection of cardiac progenitor cells was successfully carried out in all 41 children. There were no major adverse events up to 1 year. Based on cMRI and catheter examination, children received progenitor cell infusion showed a significant improvement of ventricular ejection fraction, ventricular mechanical efficiency (Ea/Ees; systemic ventricle and ventriculoarterial coupling) and ventricular stiffness. In addition, plasma BNP levels, heart failure status (Ross scale, NYUPHF index), stressful aspects of parent-child interaction (Parenting Stress Index), and

quality of life assessed by ITQOL-SF47 were all markedly improved during follow-up observation. Multiple linear regression analysis showed that ejection fraction and WAZ (weight for age z score) at cell infusion seemed to be a pivotal predictor for cardiac function improvement (P = 0.001).

Conclusions: We report here the 12-month of follow-up results of intracoronary infusion of cardiac progenitor cells in 41 children with single ventricle physiology. The trial revealed improvement in ventricular ejection fraction, reduction of heart failure status and parenting stress index, and greatly improvement quality of life after cell therapy. Baseline cardiac function and WAZ may be a predictor to determine the therapeutic efficacy of progenitor cell infusion

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P23. Selective Versus Standard Cerebro-Myocardiall Perfusion in Neonates Undergoing Aortic Arch Repair: A Multi-Center European Study – Versus Standard Cerebro-Myocardial Perfusion in Neonates Undergoing Aortic Arch Repair: A Multi-Center European Study

◆Giovanni Battista Luciani[1], Stiljan Hoxha[1], Emanuela Angeli[2], Francesco Petridis[2], Lucio Careddu[2], Alessio Rungatscher[1], *Massimo Caputo[3], Gaetano Gargiulo[2]

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Objective: Myocardial protection during neonatal aortic arch surgery using selective ante-grade cerebral perfusion may be provided by concomitant myocardial perfusion. A novel technique for cerebro-myocardial protection was developed, where regional low-flow perfusion is combined with controlled and independent coronary perfusion, using separate pump rotors. This study aimed to compare results of selective and independent cerebro-myocardial perfusion (CMP) with standard CMP, using an arterial line Y-connector, in neonatal aortic arch surgery.

Methods: Between May 2008 and May 2016, 69 consecutive neonates underwent aortic arch repair using cerebro-myocardial perfusion for indications other than HLHS at three European Centers. Selective and independent CMP (Group 1) was used in 34 patients and standard (Group 2) in 35. Baseline demography was comparable in Group 1 vs. Group 2 relative to age (19 ± 18 vs. 10 ± 6, p = 0.7), gender (22/34 vs. 21/35 male, p = 0.9), weight (3.1 ± 1.1 vs. 2.8 ± 0.9 kg, p = 0.2), BSA (0.20 ± 0.05 vs. 0.19 ± 0.03, p = 0.1). Prevalence of single stage biventricular repair (20/34 vs. 23/35, p = 0.9), staged repair (8/34 vs. 10/35, p = 0.7) and single ventricle palliation (6/34 vs. 2/35, p = 0.1) were also similar. Duration of splanchnic arrest at 25°C was similar (27 ± 8 vs. 28 ± 7 min., p = 0.9), although CMP flows were higher in Group 1 (179 ± 86 vs. 109 ± 53 mL/min, p = 0.007). Cardioplegic arrest to complete intra-cardiac repair was more common in Group 2 (13/34 vs. 23/35, p = 0.02), although duration of myocardial ischemia was comparable (44 ± 22 vs. 28 ± 26 min, p = 0.6). Arch repair was achieved by end-to-side anastomosis (25/34 vs. 35/35, p = 0.04) or by patch augmentation (9/34 vs. none).

Results: There were 2 (2.9%) hospital deaths, one in each group, due to sepsis and multiple organ failure, respectively. There was no permanent neurological injury in either group. Perioperative cardiac dysfunction (high inotropes; ECMO; ischemia at EKG or laboratory; EF < 30%) (1/34 vs. 7/35, p = 0.02) and renal dysfunction

(9/34 vs. 24/35, p = 0.007) were more common in Group 2, although need for peritoneal dialysis was similar (4/34 vs. 1/35, p = 0.06). During a mean follow-up of 3.2 ± 2.4 years (0.3–7.3), there were 2 (cardiac, multiple organ failure) late deaths in Group 1 and 3 (cardiac, sepsis, multiple organ failure) in Group 2, with comparable 5-year survival (75 ± 17% vs. 88 ± 6%, p = 0.7). Further catheter or surgical procedure on the arch was necessary in 4/33 vs. 5/34 hospital survivors, with comparable 5-year freedom from reintervention (86 ± 6% vs. 84 ± 7%, p = 0.6).

Conclusions: Overall CMP is a safe and effective perfusion strategy in patients requiring neonatal arch repair. Selective and independent CMP is associated with reduced cardiac morbidity and may thus be better suited in neonates needing complex (TGA, DORV, truncus) arch repair.

P24. The Most Prevalent Tetralogy of Fallot Surgical Repair Strategy Is Associated with Unfavourable Right Bundle Branch Block

Sara Hussain[1], Ahmad Makhdoum[2], Charis Tan[3], Prisca Pondorfer[4], Quazi Ibrahim[1], *Yves D'Udekem[3], Richard Whitlock[1], *Glen Van Arsdell[4]

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Objectives: There are multiple strategies that can be employed for effective repair of Tetralogy of Fallot (TOF). Published STS and EACTS data shows that more than 50% of repairs involve transventricular VSD closure and transannular patch (TAP). We sought to determine if the type of TOF repair impacts the prevalence of late RBBB given that emerging literature demonstrates an association between right bundle branch block (RBBB), ventricular asynchrony, and decreasing LV function.

Methods: Cases performed between 1996–2004 at 2 large pediatric centers were reviewed for operative details and ECG findings. The primary outcome of interest was RBBB on ECG or Holter monitoring reports. Logistic regression analyses were performed to study the association between RBBB and TOF surgical repair strategies, adjusted for confounding effects.

Results: A total of 402 TOF repair cases were performed with a mean age of 1.03 years (1.2). The main repair strategies performed were annulus preservation (AP = 141, 35%), annulus preservation and infundibular incision (AP+Infund = 44, 11%), minimal TAP (miniTAP = 202, 50%) and transannular patching (TAP = 15, 4%). The VSD was closed through a transatrial approach in 378 (94%) of cases. RBBB was evident in 212 patients (53%) with a mean follow-up of 17.0 years. Univariate analysis demonstrated that RVOT repair strategy and approach to VSD closure were significant predictors of RBBB. Significant association between RVOT repair strategy and approach to VSD closure were observed (p < 0.001). The odds of developing RBBB was 3.4 higher when a trans-ventricular incision is used to close the VSD compared to a transatrial approach (95% CI of OR: 1.1, 10.3, p = 0.03). Use of a large transannular patch increases the odds for developing RBBB by 4.6 times in comparison to an annulus preservation strategy (95% CI of OR: 0.99, 21.3, p = 0.05).

Table: Odds of Developing Right Bundle Branch Block

		Odds	p-Value	95% CI
Model 1 (VSD closure)	**Transventricular VSD Closure**	**3.4**	**0.032**	**1.1, 10.3**
	Constant	1.2	0.115	
Model 2 (RVOT repair strategy)	miniTAP	0.75	0.197	0.481, 1.162
	AP+Infund	2.0	0.095	0.887, 4.440
	largeTAP	4.6	0.052	0.986, 21.262
	Constant	1.3	0.121	

Conclusions: A trans-ventricular approach to VSD closure and/or large TAP repair were found to significantly increase the odds of developing RBBB in repaired TOF patients. This data suggests that the approach to VSD closure and relief of outflow obstruction have an impact on RBBB – a finding which could prove to be important to ventricular function.

General Thoracic Moderated Poster Competition Aisle 200, Exhibit Hall
4 minute presentation, 1 minute discussion *Not for Credit*

Moderators: *Yolonda L. Colson and *David T. Cooke

P25. Comparison of a Digital with a Traditional Thoracic Drainage System for Postoperative Chest Tube Management After Pulmonary Resection: A Prospective Randomized Trial

Kazuya Takamochi, Shuko Nojiri, Shiaki Oh, Takeshi Matsunaga, Kenji Suzuki
Juntendo University, Tokyo, Japan

Objective: A digitally monitored thoracic drainage system enables the objective evaluation of the air flow and intrapleural pressure. The objective of this study was to confirm the superiority of a test treatment group using a digital monitoring thoracic drainage system (group D) in comparison to a traditional thoracic drainage system (group T) in chest tube management after pulmonary resection.

Methods: The patients were prospectively randomized before surgery to groups D or T (1:1). The patients were stratified by the potential risk factors of air leak (age, gender, smoking status and the presence of emphysema or chronic obstructive pulmonary disease) before randomization. The eligible patients consisted of those who were scheduled to undergo segmentectomy or lobectomy, had a predicted value of postoperative FEV 1.0 ≥ 800 and performance status 0–1, were more than 20 years of age and gave their informed consent. The primary endpoint was the duration of chest tube placement (days). The secondary endpoints were the duration of postoperative air leak (days), duration of hospitalization (days), frequency of postoperative pleurodesis and frequency of postoperative adverse events.

Results: Of the 320 eligible patients, 20 were excluded due to protocol deviation after allocation (final patient number: 135 to group D and 165 to group T). No statistically significant differences were found between groups D and T in terms of the duration of chest tube placement (3.1 vs. 3.6 days, respectively; p = 0.235),

duration of postoperative air leak (1.0 vs. 1.7 days, respectively; p = 0.067), duration of hospitalization (7.8 vs. 8.0 days, respectively; p = 0.699), frequency of postoperative pleurodesis (8.1% vs. 3.0%, respectively; p = 0.069) and frequency of postoperative adverse events (25.1% vs. 21.2%, respectively; p = 0.490). In subgroup analyses of the 64 patients who had a postoperative air leak (20 in group D and 44 in group T), the duration of chest tube placement (5.5 vs. 4.5 days, respectively; p = 0.174), duration of postoperative air leak (4.1 vs. 2.9 days, respectively; p = 0.138) and duration of hospitalization (10.2 vs. 9.1 days, respectively; p = 0.344) were also not significantly different between the two groups.

Conclusions: The use of a digitally monitored thoracic drainage system did not shorten the duration of chest tube placement in comparison to a traditional thoracic drainage system. Further large scale randomized trial in patients with postoperative air leak is warranted to evaluate whether a digitally monitored thoracic drainage system is effective for dispersing air leak in comparison to a traditional thoracic drainage system.

P26. Are Minimum Volume Standards Appropriate for Lung and Esophageal Cancer Surgery?

Sebron Harrison, Virginia Tangel, Xian Wu, Licia Gaber-Baylis, Gregory P. Giambrone, *Jeffrey L. Port, *Nasser K. Altorki, Peter M. Fleischut, *Brendon M. Stiles

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

Objective: Several hospital systems have adopted minimum volume standards for surgical procedures, including lung and esophageal cancer resection. These announcements were highly publicized in the popular press and led to a controversial "Take the Volume Pledge" campaign. We sought to determine whether these proposed hospital administrative cutoffs are associated with differences in outcomes in thoracic surgical procedures.

Methods: Analyzing the State Inpatient Databases, Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality database, we evaluated all patients (≥18 yo) who underwent lobectomy/pneumonectomy or esophagectomy for cancer in California, Florida, and New York (2009–2011). Low volume hospitals were defined by the announced proposed minimum volume standards per year: <40 lung resections, <20 esophagectomies. We compared demographic data and determined the incidence of complications and mortality between patients operated on at low- versus high-volume hospitals. Propensity matching (demographics, income, payer, comorbidities) was performed to balance the cohorts for analysis.

Results: During the time period, 20,138 patients underwent lobectomy/pneumonectomy of which 12,432 operations (61.7%) were performed at low volume hospitals (n = 456) and 7,706 operations at high volume hospitals (n = 48). Of 1,324 patients undergoing esophagectomy, 1,087 operations (82.1%) were performed at low volume hospitals (n = 184), while only 237 operations were performed at high volume hospitals (n = 6). Although some differences in mortality and complications were apparent in unmatched volume-based groups, after propensity matching (lung 1:1, esophagus 2:1), no major differences were apparent for in-hospital

mortality or major complications for either lung or esophageal cancer resection (Table: *data with n < 11 masked per HCUP requirement). Length of stay was longer in low volume hospitals after lung resection (6 vs. 5 days, p < 0.001), but not after esophageal resection.

Table: Outcomes Post-Propensity Match by Yearly Volume Category (*Masked Due to Small N)

	Lung Resection (Lobectomy/ Pneumonectomy)			Esophageal Resection		
	Low Volume (1–39) n = 6349	High Volume (40+) n = 6349	p Value	Low Volume (1–19) n = 376	High Volume (20+) n = 188	p Value
In-hospital mortality	134 (2.1%)	113 (1.8%)	0.17	14 (3.7%)	<11 (*)	>0.05
Cardiovascular complications	1075 (16.9%)	1087 (17.1%)	0.78	118 (31.4%)	50 (26.6%)	0.23
Pulmonary complications	2224 (35%)	2129 (33.5%)	0.07	198 (52.7%)	92 (48.9%)	0.41
Infectious complications	310 (4.9%)	266 (4.2%)	0.06	63 (16.8%)	32 (17.0%)	0.94
Intraoperative complications	180 (2.8%)	181 (2.9%)	0.96	24 (6.4%)	<11 (*)	>0.05
Anastomotic leak	N/A	N/A		47 (12.5%)	20 (10.6%)	0.53
Median length of stay (Q1-Q3)	6 (4–9)	5 (4–8)	< 0.001	11.5 (8–18)	12 (9–19)	0.13

Conclusions: Although several groups have publicly called for minimum volume requirements for surgical procedures, the majority of patients undergo lung and esophageal cancer resection at hospitals below the proposed cutoffs. The proposed volume standards for lung and esophageal cancer resection are not associated with a difference in perioperative outcomes in this large administrative database. The AATS should determine whether such standards are appropriate and if so should play a leading role in determining meaningful minimum volume requirements.

P27. Pneumonectomy After Induction Therapy for Non-Small Cell Lung Cancer: Development of a Nomogram Using Machine Learning Techniques to Assist Patient Selection

Chi-Fu Jeffrey Yang[1], Hanghang Wang[1], Derek Chan[1], Babatunde Yerokun[1], *Thomas A. D'Amico[1], Matthew Hartwig[1], *Mark Berry[2]

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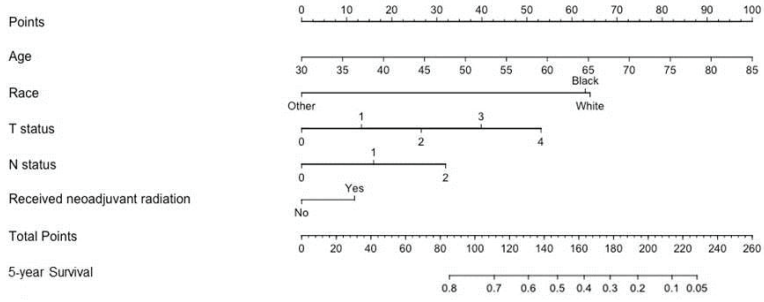
Objective: Deciding whether the long-term survival benefit of pneumonectomy after induction chemotherapy for locally advanced non-small cell lung cancer (NSCLC) outweighs operative risks is a difficult clinical problem. The goal of this study was to use machine learning methods to develop a prediction model that allows estimation of survival of NSCLC patients who undergo pneumonectomy after induction therapy.

Methods: Overall survival of patients with stage I-IIIA NSCLC treated with pneumonectomy after induction chemotherapy from 2003 to 2012 in the National Cancer Data Base was evaluated with Kaplan-meier analyses and compared to the survival of a propensity score-matched group of patients treated with chemoradiation alone. A Cox proportional hazards model was used to determine survival predictors for pneumonectomy patients and develop an associated risk score to predict long-term survival. Variables were initially evaluated using machine learning techniques (lasso regression with the tuning parameter chosen by K-fold cross-validation) with final variables in the survival analysis determined by stepwise forward selection using the Akaike Information Criteria.

Results: The 5-year survival of 629 NSCLC patients treated with pneumonectomy after induction therapy was significantly better than matched patients treated with chemoradiation alone (44.3% [95% CI: 39.3%–49.1%] vs 20.1% [95% CI: 15.9%–24.5%], $p < 0.01$). Age, race, T-status, N-status, and use of induction radiation were identified as independent prognostic factors of overall survival in the pneumonectomy patients and used to create a nomogram (Concordance index = 0.73) predicting overall survival (Figure). Patients with a risk score of ≤157 were predicted to have a 5-year survival greater than the 44.3% 5-year survival observed in the entire pneumonectomy cohort, while patients with a risk score ≥ 195 had a 5-year survival less than the 20.1% survival observed for the matched chemoradiation cohort.

Figure. Prognostic nomogram for patients with NSCLC who undergo induction therapy followed by pneumonectomy.



Conclusions: In this study, we have utilized machine learning techniques to develop a nomogram that predicts survival after induction chemotherapy followed by pneumonectomy using individual NSCLC patient characteristics. This nomogram can be used in the treatment selection process in this difficult clinical situation by precisely estimating whether this potentially morbid treatment strategy is likely to provide survival benefits beyond nonsurgical treatment with chemoradiation.

P28. Impact of the Number of Lymph Nodes Examined During a Sublobar Resection on the Survival of Patients with Stage I Non-Small Cell Lung Cancer

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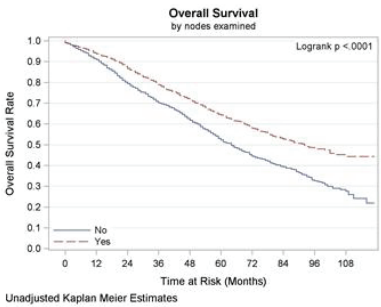
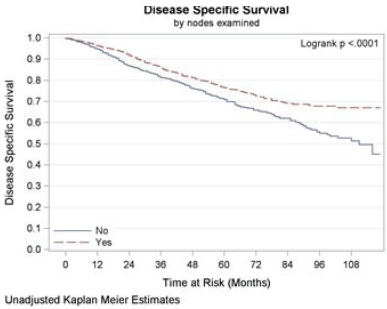
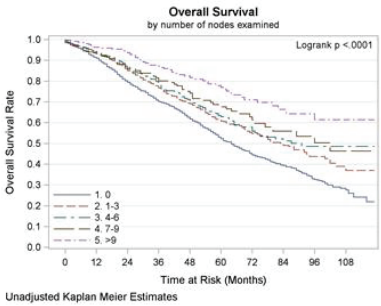
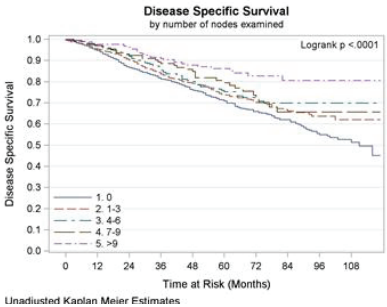
Objective: Early stage lung cancer is being detected at a higher frequency with the implementation of screening programs. At the same time, medically complex patients with multiple comorbidities are presenting for surgery, with a concomitant rise in sublobar resection. We sought to examine the impact of sampling lymph nodes on the outcomes of patients undergoing sublobar resection for small (<2 cm) stage I NSCLC (non-small cell lung cancer).

Methods: All patients in the Surveillance, Epidemiology and End Results (SEER) from 2004–2013 with small (<2 cm) stage I NSCLC undergoing sublobar resection (wedge/segmentectomy) and no other cancer history were included. The association of the number of lymph nodes (LN) examined (categories None, 1–3, 4–6, 7–9, >9) with both the overall survival (OS) and disease specific survival (DSS) were examined using univariate as well as multivariate analyses while controlling for covariates such as age, size (<1 cm, >1 cm), grade, histology (adenocarcinoma vs. others) and extent of resection (wedge/segmentectomy) were performed.









Results: Data from 3916 eligible patients were analyzed. 715 (18.3%) of patients had segmentectomy. No lymph nodes were examined in 49% and 23% of wedge resection and segmentectomy patients, respectively. Among all the eligible patients, 1132 (29%), 474 (12%), 228 (6%) and 328 (8%) patients had 1–3, 4–6, 7–9 and >9 LN examined respectively. Univariate analyses demonstrated significant

associations between overall and disease specific survivals with age, grade, histology, gender, extent of surgery and LNE (Figure 1). The association between the number of lymph nodes examined (LNE) and survival remained significant even after adjusting for significant covariates including extent of sublobar resection (HR for groups with LN 1–3, 4–6, 7–9 and >9 compared to 0 LN examined are 0.79, 0.77, 0.68 and 0.45 for OS ($P < 0.001$) and 0.85, 0.77, 0.71 and 0.44 for DSS (<0.05) respectively. In multivariate modeling, LNE was retained as a significant variable and extent of resection was not. In patients in whom at least one lymph node was examined, extent of resection was not predictive of outcome. Similarly, in patients undergoing segmentectomy, LNE was not predictive of outcome.

Conclusions: A significant proportion of patients having sublobar resection for early stage NSCLC in the United States do not have a single lymph node removed for pathologic examination. The number of lymph nodes examined has a significant survival impact, presumably due to avoidance of mis-staging. This impact seems greater than the impact of extent of resection (segmentectomy vs. wedge resection). Appropriate lymph node examination remains an important part of resection for lung cancer even if the resection is sublobar.

P29. Improvements in TNM Staging of Pulmonary Neuroendocrine Tumors Requires Histology and Regrouping of Tumor Sizes

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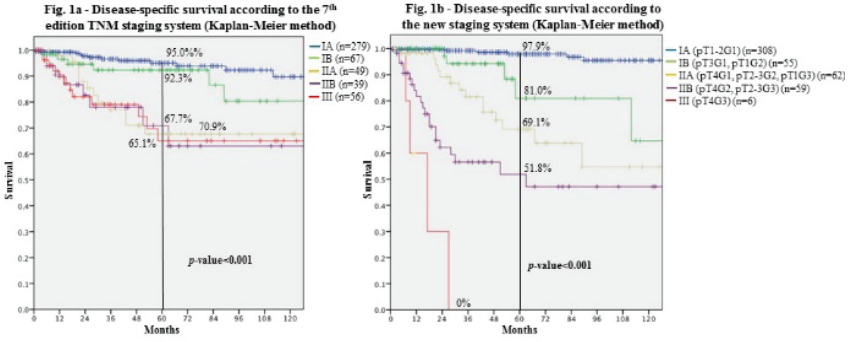
Objective: Neuroendocrine tumors (NET) of the lung occur as a spectrum of disease ranging from indolent low-grade to aggressive high-grade tumors. Currently, they are staged with the AJCC 7th edition TNM non-small cell lung cancer staging system. This decision is based on analysis of SEER data without data on histology or disease specific survival, and so its applicability for NET is limited. This study aims to identify predictors of disease-specific survival and to propose a staging system specific for lung NET.

Methods: Multicenter retrospective cohort study of 510 consecutive patients [F/M: 313/197; median age: 61 years (IQR:51–70)] undergoing lung resection for primary NET between 2000–2015. Cox proportional hazards models were done to identify predictors of disease-specific survival. Predictors included age, gender, smoking history, ECOG performance status, prior malignancies, presence of symptoms, extent of lung resection, lymphadenectomy, histology, tumor size (pT) and location, pleural invasion and nodal status (pN). Kaplan-Meier survival analyses were done by stage using the 7th edition TNM system and a proposed NET specific TNM system.

Results: Patients underwent lobectomy in 67% (340/510), wedge resection/segmentectomy in 21% (110/510), bilobectomy in 6% (32/510), pneumonectomy in 4% (19/510) and sleeve resection in 2% (9/510). The tumor was low-grade (typical – G1) in 67% (341/510); intermediate-grade (atypical – G2) in 13% (68/510) and high-grade (large cell – G3) in 20% (101/510). The median tumor size was 2.0 cm (IQR 1.4–3.2) and in 65% (329/504) it was peripherally located. During median follow-up of 51 months (IQR 18–99), 51/490 patients died of NET disease. At multivariable analysis histology ($p < 0.001$), pT ($p = 0.01$) but not pN ($p = 0.11$) were independent predictors of disease-specific survival. Five-year survival rate was 97%, 79%, and 52% respectively for G1, G2 and G3 ($p < 0.001$). Survival for pTN0 was T1 = 95%, T2 = 88%, T3 = 62% and T4 = 42% (p = 0.01) but when also stratified by histology was T1 = 97%, T2 = 100%, T3 = 91% and T4 = 67% in G1; T1 = 63%, T2 = 55%, T3/4 = 100% in G2 and T1 = 63%, T2 = 55%, T3 = 42%, T4 = 0% in G3 (p = NS) Using the current TNM, 5-year disease-specific survival rates at pStage are reported in Figure 1a. After regrouping pT and adding G (Figure 1b), we proposed a new staging system as follows: stage IA (pT1–2G1) stage IB (pT3G1, pT1G2), stage IIA (pT4G1, pT2–3G2, pT1G3), stage IIB (pT4G2, pT2–3G3) and stage III (pT4G3).



Conclusions: Pulmonary NET are biologically different from non-small cell lung cancers. Incorporation of histology and regrouping of tumor size creates a unique NET TNM staging system that appears to predict survival better compared to the current TNM.

P30. Tumor Site Microenvironment Factors May Influence Number of Circulating Tumor Cells (CTCs) in NSCLC Patients

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Objective: Tumor microenvironment determines not only tumor growth, but also its spread and progression. The rate of tumor cell release from primary site is the factor, which is still hard to measure and determine, nevertheless presence of CTCs in the circulation is well established. However factors, which determine their release rate from tumor site remain still unknown. The number of circulating cells

seems to be a function of their release from tumor site and elimination from blood and lymph circulation bed. Currently CTCs are mostly isolated in vitro. We tried using a specialized catheter for intravenous use isolate CTCs directly from peripheral blood of NSCLC patients trying in the same time look for potential factor in tumor microenvironment which may predict tumor cells release.

Methods: CTCs were isolated in in vivo settings using special catheter; briefly standard steel based cannula coated by antibodies directed against the epithelial cell adhesion (EpCAM) which was inserted in a cubital vein for thirty minutes. There were 30 patients studied in stage I-IIIB NSCLC patients and 12 non-cancer patients as a control group for CTCs. Separately tumor microenvironment of primary tumor site was evaluated. Parameter which were evaluated included both tumor cells as: grade of differentiation, expression intensity of surface markers associated with squamous cell carcinoma and adenocarcinoma, as well as expression of E-Cadherin, EpCAM, proliferation activity evaluated by Ki67 expression and death ligands CD95-FAS and PDL1 ligand. Besides in the tumor stroma number of small capillaries (CD34), intensity of lymphocyte CD3 T cell and macrophages CD68 infiltrates were evaluated.

Results: The device was well tolerated in all applications without side effects. We were able to isolate and detect CTCs in 28 (94.0%) patients with a median (range) of 13 (0–300) CTCs. In the non-cancer patients, no CTCs were detected. The rate of tumor release was correlating directly to higher tumor/stroma ratio, higher tumor proliferating rate and the intensity of macrophages infiltrates. It indirectly correlated to E-Cadherin expression.

Conclusions: The capturing of CTCs from the circulation of patients with NSCLC has been demonstrated to be effective and seems to depend on primary tumor site microenvironment. The most important seems to be those, which constitute cohesiveness of tumor and number of tumor site vessels.

P31. Prognostic Significance of Ground Glass Opacity Component in the Clinical T Classification of Non-Small Cell Lung Cancer

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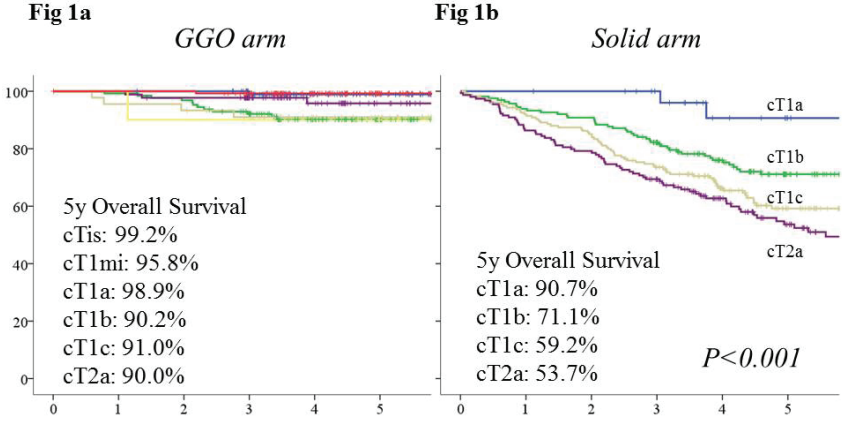
Juntendo University, Tokyo, Japan

Objective: The 8th TNM classification suggests that clinical-T category be determined according to the invasive size excluding the ground glass opacity (GGO) component. However, the presence of a GGO component greatly influence the favorable prognosis of non-small cell lung cancer (NSCLC), and proposed new T classification cannot discriminate radiological part-solid tumor with pure-solid one provided they showed a same solid component size. Therefore, we aimed to investigate whether GGO presence or solid component size are more prognostic in the revised new clinical-T category.

Methods: Between 2008 and 2013, we retrospectively evaluated 1029 surgically resected c-stage I NSCLC based on the 8th TNM classification. According to the new T categories, they were defined based on the solid component size as follow: Tis; 0 cm, T1mi; ≤5 mm, T1a; 6–10 mm, T1b; 11–20 mm, T1c; 21–30 mm, T2a;

31–50 mm. Furthermore, all tumors were classified into 2 groups, i.e., GGO or Solid arms, based on the presence of GGO component. We evaluated the prognostic impact on the GGO presence among the forthcoming T classification using Cox proportional hazard model.

Results: Of the cases, 134 (13%) were categorized in Tis, 88 (9%) in T1mi, 132 (13%) in T1a, 295 (29%) in T1b, 223 (21%) in T1c and 157 (15%) in T2a, respectively. A univariable analysis showed that sex, CEA, maximum tumor size, solid component size and a GGO presence were significant prognostic factor ($p < 0.001$, respectively). Furthermore, a multivariable analysis elucidated that a GGO presence and CEA were independently significant prognostic factor of the overall survival (OS) ($p = 0.001$, <0.001), but maximum tumor size or solid component size were not ($p = 0.939$, 0.429). When the impact of new clinical-T category was assessed based on a GGO presence, the 5y-OS was significantly different between GGO and Solid arm in each T categories (T1a; 98.9% vs. 90.7%, $p = 0.012$, T1b; 90.2% vs. 71.1%, $p < 0.001$, T1c; 91.0% vs. 59.2%, $p = 0.001$, T2a; 90.0% vs. 53.7%, $p = 0.049$) with a median follow-up period of 56 months. Furthermore, the 5y-OS was excellent with 90% or more of the survival outcomes despite the revised T categories, provided the tumor had a GGO appearance (Fig 1a). In contrast, proposed 8th edition of clinical-T categories significantly separated the OS exclusively in Solid arm ($p < 0.001$) (Fig 1b, T1a vs. T1b; $p = 0.033$, T1b vs. T1c; $p = 0.038$).



The 5-year overall survival in the 8th edition of clinical-T classification based on the presence of GGO component.

Conclusions: GGO component was a significant prognostic factor for the survival in the radiological finings. Clinical-T category should be considered based on the presence of GGO on thin-section CT, and tumor size should be applied only to a radiological solid lung cancer. In contrast, revised clinical-T categories did not function for the tumor with GGO component due to their excellent survival outcomes, which was irrelevant with maximum tumor size nor invasive component size.

P32. Natural History of Ground Glass Lesions Among Patients with Previous Lung Cancer: Predictors of Progression

Mara B. Antonoff, Jitesh Shewale, David B. Nelson, *David Rice, Boris Sepesi, *Wayne Hofstetter, *Reza J. Mehran, *Ara A. Vaporciyan, *Garrett Walsh, *Stephen Swisher, *Jack Roth

MD Anderson Cancer Center, Houston, TX

Objective: Ground glass opacities (GGO) on computed tomography (CT) may have varied etiology and unclear significance. Among lung cancer patients, the malignant potential of subsequent GGOs remains unknown, with lack of consensus regarding surveillance and intervention. We sought to describe the natural history of GGOs in patients with previous lung cancer.

Methods: Natural Language Processing was used to identify a cohort of patients with previous history of non-small cell lung cancer and subsequent CT evidence of GGO on cross-sectional imaging from 2007–2013 (after standardization of thin-cut CT technique). Patients met inclusion criteria if they had at least 2 additional CTs following the initial imaging finding of GGO. Charts were then retrospectively reviewed to determine the fate of the GGOs, classifying all lesions as stable, resolved, or progressive (by enlargement or development of solid component) over the course of the study. Multivariable regression modeling was performed in order to determine predictors of GGO progression during follow-up.

Results: 210 patients met inclusion criteria, with a mean follow-up time of 12.4 months. During this period, 55 (26.2%) patients' GGOs were stable, 131 (62.4%) resolved, and 24 (11.4%) progressed (Table). 3/24 (12.5%) GGOs that progressed were subsequently diagnosed as cancer, and all were adenocarcinoma. 107 (51.0%) of patients were women, and while sex did not emerge as a significant predictor of GGO fate, there was a trend among women toward more frequent GGO progression (females 15.0% progress vs males 7.8%, $p = 0.069$). Race was associated with final outcome of GGO ($p = 0.035$), with higher rate of resolution in Caucasians (66.1%) as compared to African Americans (35.0%) or other races (60.0%). Patients with previous squamous cell cancers were more likely than other histologies to experience GGO resolution (85% resolved, $p < 0.001$). Age, smoking history, stage of previous malignancy, and treatment type for cancer did not predict GGO progression. On logistic regression modeling, the following variables were all significant predictors of GGO progression at univariable analysis: advanced age, female sex, as well as the treatment modality, stage, and histology of the initial lung cancer. However, with multivariable regression, only histology of previous malignancy persisted as a significant predictor of subsequent GGO progression (for adenocarcinoma, odds ratio = 7.0, 95% CI 1.59–30.4, $p = 0.010$).

Demographic features and associations with GGO resolution and progression

Variables	GGO status after follow-up			Entire cohort N=210	*P value*
	Stable N=55 (26.2%)	Resolved N=131 (62.4%)	Progressed N=24 (11.4%)		
Age, years					
Mean	70.7	67.6	65.1	68.2	0.077
Median (Range)	72 (32-88)	68 (41-92)	64 (45-81)	69 (32-92)	
Gender					
Female	32 (29.9%)	59 (55.1%)	16 (15.0%)	107	0.069
Male	23 (22.3%)	72 (69.9%)	8 (7.8%)	103	
Race					
White	38 (23.0%)	109 (66.1%)	18 (10.9%)	165	0.035
Black	11 (55.0%)	7 (35.0%)	2 (10.0%)	20	
Others	6 (10.9%)	15 (60.0%)	4 (16.0%)	25	
Smoking history					
No	5 (19.2%)	19 (73.1%)	2 (7.7%)	26	0.483
Yes	50 (27.2%)	112 (60.9%)	22 (11.9%)	184	
Histology of prior lung cancer					
Adenocarcinoma	44 (32.4%)	70 (51.5%)	22 (16.2%)	136	
Squamous cell carcinoma	6 (15.0%)	34 (85.0%)	0 (0.0%)	40	<0.001
Small cell carcinoma	3 (15.8%)	16 (84.2%)	0 (0.0%)	19	
Others	1 (7.1%)	11 (62.7%)	2 (14.3%)	14	
Stage of prior lung cancer					
I	13 (22.8%)	39 (68.4%)	5 (8.8%)	57	
II	8 (28.6%)	18 (64.3%)	2 (7.1%)	28	<0.836
III	8 (23.5%)	21 (61.8%)	5 (14.7%)	34	
IV	23 (27.7%)	48 (57.8%)	12 (14.5%)	83	
Treatment of prior lung cancer					
Surgery	17 (30.9%)	35 (26.7%)	10 (41.7%)	62	
Chemotherapy	40 (29.0%)	82 (59.4%)	16 (11.6%)	138	0.197
Radiation Therapy	24 (43.6%)	64 (48.8%)	7 (7.4%)	95	
Chemo-Radiation Therapy	17 (26.6%)	42 (65.6%)	58 (7.8%)	64	

Conclusions: Among patients with previous lung cancer, the majority of GGOs resolved over time. Previous squamous cell cancer and Caucasian race were associated with less frequent progression, while previous adenocarcinoma emerged as a significant independent predictor of GGO progression. Further investigations are needed to identify additional clinical factors that may be helpful in elucidating the malignant potential of these lesions.

P33. The Dose-Response Relationship Between Perioperative Blood Transfusion and Decreased Survival After Pulmonary Resection for Non-Small Cell Lung Cancer

James Isbell, Kay See Tan, Daniela Molena, *James Huang, Matthew Bott, *Bernard Park, *Prasad Adusumilli, *Valerie Rusch, *Manjit Bains, *Robert Downey, *David R. Jones

Memorial Sloan Kettering Cancer Center, New York, NY

Objective: Perioperative red blood cell (RBC) transfusions have been implicated in decreased overall survival (OS) and disease-free survival (DFS) after surgical resection for non-small lung cancer (NSCLC). Small volume (i.e., 1 unit) RBC transfusions are often discretionary and therefore arguably avoidable. In this study we sought to determine the effects of such small volume RBC transfusions on long-term survival after anatomic pulmonary resection. We also examined the dose-response relationship between increasing exposure to RBC transfusions and survival.

Methods: Using our institution's prospectively collected thoracic surgery database, we identified a total of 5,688 consecutive patients who underwent an anatomic pulmonary resection for NSCLC from January 1, 2000 to June 30, 2016. Propensity scores were calculated by including 25 demographic and clinical covariates in a logistic regression model predicting transfusion. As this study was designed to evaluate longer-term outcomes, patients were excluded if they died within 90 days of their index operation or if there vital status was unknown. The resulting matching-weights were incorporated into Cox models for OS, DFS and cancer recurrence to compare the effects of 0 versus 1 unit RBC transfusion on outcomes. We also performed Cox modeling to determine if there was a dose-response relationship between increasing RBC transfusions and longer-term survival and recurrence.

Results: Only 9.3% of patients in this cohort received one or more perioperative blood transfusions. Median follow-up was 3 years. After confirming balance across covariates with propensity-matched weighting using a threshold of 0.1 of standardized mean differences, we observed no differences in OS, DFS or recurrence between patients receiving 0 or 1 unit RBC (**Table**). However, a dose-response relationship was observed demonstrating a 12% increase in the hazard for death for each additional unit of blood transfused. No effect of transfusion on cancer recurrence was observed (**Table**).

	0 vs. 1 Unit RBC Transfusion		0 vs. ≥1 Unit RBC Transfusion	
Outcome	**HR (95% CI)**	***P* Value**	**HR (95% CI)**	***P* Value**
Overall survival†	0.97 (0.69–1.37)	0.873	1.12 (1.09–1.16)	<0.0001
Disease-free survival†	1.02 (0.74–1.41)	0.920	1.12 (1.09–1.16)	<0.0001
Recurrence‡	1.56 (0.59–4.11)	0.369	1.62 (0.83–3.16)	0.162

†Cox proportional hazards model; ‡Cause-specific Cox model

Conclusions: Although a single unit of RBC transfusion did not appear sufficient to affect survival outcomes in patients undergoing anatomic pulmonary resection for NSCLC, higher volume perioperative RBC transfusions were associated with significantly decreased survival. These results suggest that the avoidance or minimization of blood transfusions could improve long-term survival after lung resection for NSCLC.

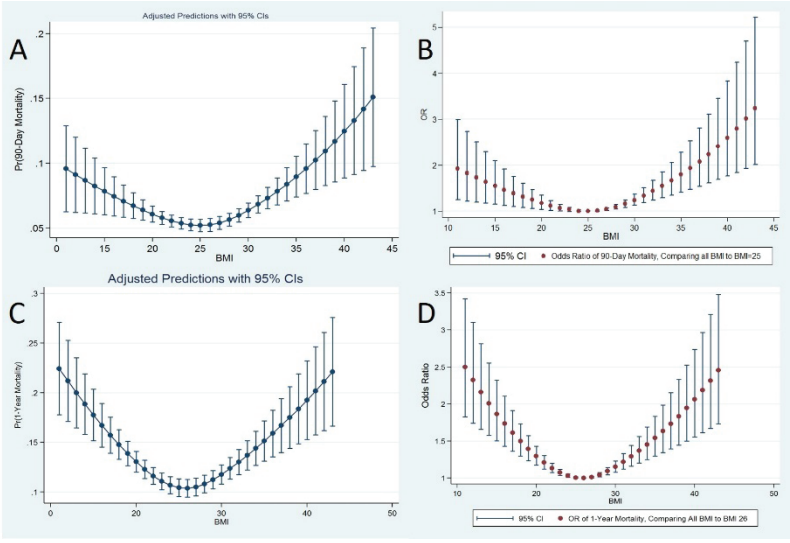
P34. Impact of Body Mass Index on Lung Transplant Survival in the United States Following Implementation of the Lung Allocation Score

Ramiro Fernandez, Niloufar Safaeinili, Stephen Chiu, David D. Odell, *Malcolm M. DeCamp, Ankit Bharat

Northwestern University, Chicago, IL

Objective: The impact of body mass index (BMI) on lung transplant survival remains controversial due to conflicting evidence in the existing literature. Published studies have either included patients prior to the implementation of the lung allocation score (LAS) or used the traditional broad BMI classes. Here, we evaluated the impact of BMI as a continuous variable on short-term as well as one year lung transplant mortality in the largest study to date following the institution of LAS.

Methods: The Scientific Registry of Transplant Recipients database was used to track all adult lung transplant recipients from May 2005 to June 2016. Our outcome of interest was all-cause mortality at 90 days and one year. Logistic regression modelling was used to independently predict mortality adjusting for the following factors: age, gender, ischemic time, LAS, and lung disease. First, the BMI at which the probability of death was lowest at 90 days and one year was determined. We then used the statistical model to determine the increased risk of death for each BMI unit relative to this baseline, independent of the variables mentioned above.



Results: The study included 17,352 lung recipients above the age of 18 years. All-cause mortality was 6.3% (1,098/17,352) and 13.9% (2,404/17,352) at 90 days and one year, respectively. At 90 days, a BMI of 25 held the lowest probability of death (0.05 ± 0.003; Figure 1A). For each BMI unit increase or decrease from 25, there was a steady rise in the probability of death (Figure 1B). The probability of death achieved statistical significance at a BMI of 27 (OR1.04, 95% CI 1.01–1.07), continuously increasing until the maximum unit 43 (OR 3.24, 95% CI 2.01–5.22).

Additionally, the probability of death achieved significance at a BMI of 21 (OR 1.12, 95% CI 1.02–1.23) increasing until the lowest unit of 11 (OR 1.93, 95% CI 1.25–2.99). Similar findings were observed for one-year mortality. The lowest probability of death was with a BMI of 26 (0.1 ± 0.004; Figure 1C). The probability of death steadily rose for each stepwise increase or decrease in BMI unit (Figure 1D). For higher BMIs, this was statistically significant from BMI of 28 (OR 1.05, 95% CI 1.02–1.07) to 43 (OR 2.46, 95% CI 1.73–3.48), and for lower BMIs from 24 (OR 1.03, 95% CI 1.01–1.06) to 11 (OR 2.5, 95% CI 1.83–3.42).

Conclusions: Patients with an elevated BMI, particularly greater than 28, have an independently increased risk of both short- and long-term mortality. Surprisingly, we found that patients with a lower BMI, less than 21, have an increased risk of death following transplantation despite falling within the normal range. A plausible explanation for higher mortality in patients with normal starting BMI is the expected post-transplant weight loss which could place them in the malnourished category.

P35. Anastomotic Complications After Esophagectomy: Impact of Omentoplasty in Propensity-Weighted Cohorts Following Neoadjurant Chemoradiation

Michael Lu, Daniel G. Winger, *James D. Luketich, Ryan M. Levy, *Arjun Pennathur, Inderpal Sarkaria, Rajeev Dhupar, *Katie S. Nason

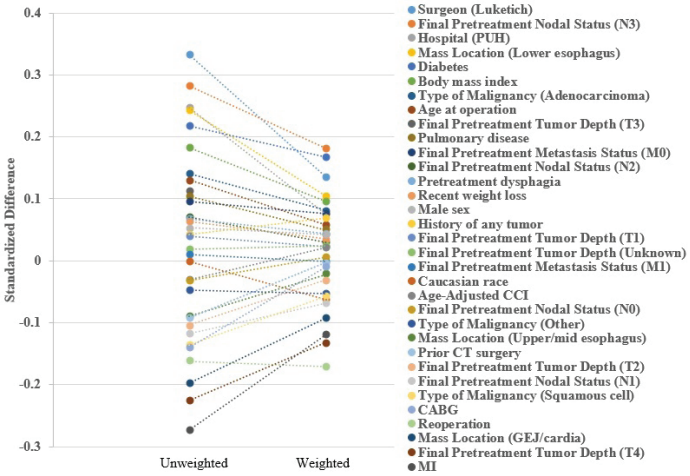
University of Pittsburgh, Pittsburgh, PA

Objective: A Cochrane review of three randomized controlled trials reported reduced rate and severity of post-esophagectomy leaks in patients with anastomotic reinforcement with omentoplasty. Unfortunately, these trials excluded patients treated with neoadjuvant chemoradiation, a factor which may increase the risk of leak due to radiation-associated vascular and tissue damage at the anastomotic site. The aim of this study was to determine whether anastomotic complications and post-operative mortality differ after neoadjuvant chemoradiotherapy followed by esophagectomy with and without anastomotic omentoplasty.

Methods: Data were abstracted for 249 patients who underwent minimally-invasive esophagectomy (MIE) following neoadjuvant chemoradiotherapy (2001–2016). Propensity scores for omentoplasty were estimated using boosted logistic regression modeling using 21 pretreatment variables. The standard percent difference across all pretreatment variables was 13.7%, which improved to 7.5% after balancing. (Figure 1) Propensity scores were converted into inverse probability of treatment weights and assessed for adequate balance (absolute standard percent differences of <20%). The weighted dataset was used to calculate odds of anastomotic leak, reoperation for leaks, major morbidity as defined by the Society of Thoracic Surgeons, any major complications and 30-day/in-hospital mortality after MIE were determined using logistic regression.

Results: Omentoplasty was performed in 142/249 patients (57%). Clinically significant anastomotic leak rate was 14% (n = 34) with major morbidity and any major complications in 34% (n = 84) and 48% (n = 120) respectively. Leak-associated mortality was 11.8% (n = 4). Leaks requiring surgical intervention occurred in 11

patients (4.4%). In the propensity-weighted data, omentoplasty was not associated with differential odds of clinically significant leak (OR 1.74; 95% CI 0.8, 3.9), major morbidity (OR 1.48; 95% CI 0.8, 2.6) or mortality (OR 1.0; 95% CI 0.3, 3.3). Compared to patients with adenocarcinoma, odds of leak after omentoplasty were higher but not significantly different for squamous cancers and for salvage esophagectomy (recurrence after definitive chemoradiotherapy). No other pretreatment variables were significantly associated with anastomotic leak.



Conclusions: Anastomotic omentoplasty during MIE does not appear to improve rates of anastomotic leak or need for operative intervention in patients who have had neoadjuvant chemoradiation for trimodality therapy of esophagogastric carcinoma. Despite propensity weight adjustment, unmeasured bias may be influencing our findings, which should be confirmed with a prospective randomized trial.

P36. Using the National Cancer Database to Create a Scoring System that Identifies Patients with Early-Stage Esophageal Adenocarcinoma at Risk for Nodal Metastases

◆Benny Weksler, Jennifer L. Sullivan
University of Tennessee, Memphis, TN

Objectives: Endoscopic resection is gaining popularity as a treatment for early-stage esophageal adenocarcinoma (EAC), in particular for T1a tumors. Additionally, a growing number of practitioners have reported endoscopic resection of T1b tumors. The goal of this study was to create a scoring system to reflect the risk of nodal metastases in patients with T1a or T1b EAC to better individualize the treatment approach (esophagectomy or endoscopic resection) for early-stage EAC.

Methods: The National Cancer Database (NCDB) was queried for all patients from 2010 to 2013 who underwent esophagectomy with pathologically confirmed T1a or T1b EAC. Unadjusted differences between positive and negative nodal status

were tested with the Student's t-test and Chi-square analysis. Multivariable logistic regression was used to identify relevant variables impacting nodal metastases. We created a point-scoring system using the relevant variables and tested the model discrimination using the c-statistic. Separate models for T1a or T1b were created. Finally, we conducted internal validation by refitting the model in 1000 bootstrap samples. Models with c-statistic >0.7 were considered relevant.

Results: We identified 1283 patients with T1a or T1b tumors; 146 had nodal metastases (11.4%). Their median age was 65 (IQR 59–71), and 1095 were male (85.3%). Tumor stage (T1a vs T1b), tumor grade (well differentiated vs others), tumor size (< 15 mm, 15–25 mm, >25 mm), and the presence of lymphovascular invasion (LVI) were identified as significantly impacting the risk of nodal metastases. We assigned the following points to each variable in order to create a scoring system: Grade 1 = 0 points, Grade 2 = 2 points, grade 3 or 4 = 3 points; size <15 mm = 0 points, size 15–25 mm = 1 point, size >25 mm = 2 points; LVI = 2 points; and then added the points to get the patients' risk scores. In patients with T1a tumors, <3% of the patients with a risk score 3 had nodal metastases, while 16.1% of the patients with a risk score 5 had nodal metastases. In patients with T1b tumors, <5% of the patients with a risk score 2 had nodal metastases, while 41% of the patients with a score 6 had nodal metastases (c-statistic = 0.805, Figure 1). A bootstrap validation cohort did not demonstrate a significant change in the fitness of the model (c-statistic = 0.800) or the strength of the predictor variable.

Figure 1A

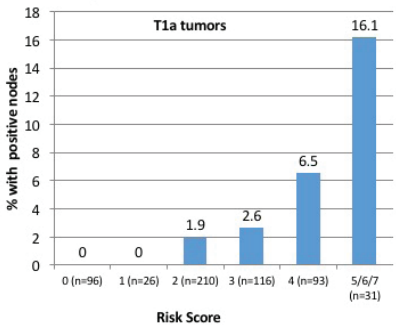
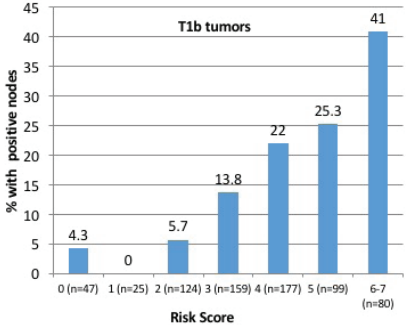


Figure 1B



Conclusion: The proposed scoring system appears useful in discriminating between patients with T1a tumors who would be better served by esophagectomy and those for whom endoscopic resection will likely be sufficient. The risk score also identified a T1b patient population who could be treated with endoscopic resection. In patients with T1b tumors and risk scores >5, the risk of nodal metastases is very high, and consideration should be given to neoadjuvant therapy.

12:45 pm – 2:00 pm **Cardiac Studies in Progress**
5 minute presentation, 8 minute discussion
AATS CT TheaterI
Booth #106, Exhibit Hall
Not for Credit

Moderators: *David H. Adams and *Joseph S. Coselli

LB4. Prospective US IDE Trial of a New Sutureless Aortic Bioprosthesis in Standard Risk Surgical Patients: One Year Hemodynamic, Clinical and Functional Outcomes

*Rakesh M. Suri[1], Hoda Javadikasgari[1], David Heimansohn[2], Neil Weissman[3], *Gorav Ailawadi[4], *Niv Ad[5], *Gabriel Aldea[6], *Vinod Thourani[7], *Wilson Szeto[8], *Robert Michler[9], Hector Michelena[10], Reza Dabir[11], *Bartley Griffith[12], *Eric E. Roselli[1]
[1]Cleveland Clinic, Cleveland, OH; [2]St. Vincent Heart Center of Indiana, Indianapolis, IN; [3]MedStar Health Research Institute, Washington, DC; [4]University of Virginia, Charlottesville, VA; [5]West Virginia University, Morgantown, WV; [6]University of Washington, Seattle, WA; [7]Emory University, Atlanta, GA; [8]University of Pennsylvania, Philadelphia, PA; [9]Montefiore Medical Center, New York City, NY; [10]Mayo Clinic, Rochester, MN; [11]Beaumont Hospital Dearborn, Dearborn, MI; [12]University of, Baltimore, MD

Invited Discussant: *Michael A. Borger

LB5. A Prospective Trial of Anticoagulation and Antiplatelet Strategies After Mechanical Aortic Valve Replacement

*John D. Puskas[1], Marc Gerdisch[2], Dennis Nichols[3], Lilibeth Fermin[4], Birger Rhenman[5], Divya Kapoor[5], *Jack Copeland[6], Reed Quinn[7], *G. Chad Hughes[8], Hormoz Azar[9], Michael McGrath[7], Michael Wait[10], Bobby Kong[11], Tomas Martin[12], Charles Douville[13], Steven Meyer[14], Jian Ye[15], *W.R. Eric Jamieson[15], Lance Landvater[16], Robert Hagberg[17], Timothy Trotter[18], *John Armitage[19], Jeffrey Askew[20], *Kevin Accola[21], Paul Levy[22], David Duncan[23], Bobby Yanagawa[24], John Ely[25], Allen Greave[26]
[1]Mount Sinai Saint Luke's, New York, NY; [2]St. Francis Health, Indianapolis, IN; [3]Tacoma General Hospital, Tacoma, WA; [4]University of Miami, Miami, FL; [5]Southern Arizona VA Medical Center, Tucson, AZ; [6]University of Arizona, Richmond, VA; [7]Maine Medical Center, Portland, ME; [8]Duke University, Durham, NC; [9]Mid-Atlantic Cardiothoracic Surgeons, Norfolk, VA; [10]University of Texas Southwestern, Dallas, TX; [11]Integrated Healthcare Associates, Ypsilanti, MI; [12]University of Florida, Orlando, FL; [13]Providence Portland Medical Center, Portland, OR; [14]University of Alberta, Edmonton, AB, Canada; [15]University of British Columbia, Vancouver, BC, Canada; [16]University of North Carolina, Raleigh, NC; [17]Hartford Hospital, Hartford, CT; [18]Oklahoma City VA Medical Center, Oklahoma City, OK; [19]Medical Clinic, Springfield, OR; [20]Mary Washington Hospital, Fredericksburg, VA; [21]Florida Hospital Center, Orlando, FL; [22]New Mexico Heart Institute, Albuquerque, NM; [23]Novant Health Forsyth Medical Center, Winston-Salem, NC; [24]University of Toronto, Toronto, ON, Canada; [25]On-X Life Technologies, Austin, TX; [26]MultiCare Cardiothoracic Surgical Associates, Tacoma, WA

Invited Discussant: ◆Joseph Lamelas

LB6. Early Patency of Externally Stented Saphenous Vein Grafts in CABG – Interim Report from the Multicenter Randomized VEST III Trial

David Taggart[1], Alexandros Paraforos[2], George Krasopolous[1], John T. Donovan[2], Cha Rajakaruna[3], Hunaid A. Vohra[3], Joseph Zacharias[4], Mohammed Nittal Bittar[4], Amal Bose[4], Ravi De Silva[5], Marius Berman[5], Leonid Ladyshenskij[6], Matthias Thielmann[7], Daniel Wendt[7], Sigrid Sandner[8], Philipp Angleitner[8], Günther Laufer[8], Nikolaos Bonaros[9], Yeong-Hoon Choi[10], Oliver Liakopoulos[10], Sunil Ohri[11], Stephan Jacobs[12], Alexander Lipey[13], Gil Bolotin[14], Ivar Friedrich[2]

[1]John Radcliffe Hospital, Oxford, United Kingdom; [2]Brüderkrankenhaus Trier, Trier, Germany; [3]Bristol Royal Infirmary, Bristol, United Kingdom; [4]Blackpool Victoria Hospital, Blackpool, United Kingdom; [5]Papworth Hospital, Cambridge, United Kingdom; [6]Immanuel Klinikum, Bernau, Germany; [7]Westdeutsches Herzzentrum Essen, Essen, Germany; [8]Medical University of Wien, Wien, Austria; [9]Medical University Innsbruck, Innsbruck, Austria; [10]Herzzentrum Uniklinik-Köln, Köln, Germany; [11]University Hospital Southampton, Southampton, United Kingdom; [12]Deutsches Herzzentrum Berlin, Berlin, Germany; [13]The Chaim Sheba Medical Center, Ramat Gan, Israel; [14]Rambam Health Care Campus, Haifa, Israel

Invited Discussant: *Sertac Cicek

LB7. Surgical and Pharmacological Novel Interventions to Improve Overall Results of Saphenous Vein Graft Patency in Coronary Artery Bypass Grafting surgery: An International Multicenter Randomized Controlled Clinical Trial (SUPERIOR SVG Study)

Saswata Deb[1], Steve K. Singh[2], Michael W.A. Chu[3], Domingos Souza[4], Richard Whitlock[5], Steven R. Meyer[6], Subodh Verma[7], Michael Raabe[8], Anders Jeppsson[9], Laura Jimenez-Juan[1], Anna Zavodni[1], Ayman Al-Saleh[5], Katheryn Brady[5], Purnima Rao-Melacini[5], Emilie P. Belley-Cote[5], *Richard J. Novick[10], *Stephen E. Fremes[1]

[1]University of Toronto, Toronto, ON, Canada; [2]Brigham and Women's Hospital, Boston, MA; [3]University of Western Ontario, London, ON, Canada; [4]Orebro Medical Centre Hospital, Orebro, Sweden; [5]McMaster University, Hamilton, ON, Canada; [6]University of Alberta, Edmonton, AB, Canada; [7]St. Michael's Hospital, Toronto, ON, Canada; [8]St. Boniface General Hospital, Winnepeg, MB, Canada; [9]Salhgrenska University Hospital, Gothenburg, Sweden; [10]University of Calgary, Calgary, AB, Canada

Invited Discussant: *Clifford W. Barlow

2:00 pm – 3:30 pm **Transcatheter Valve Therapies: Implications for Your Practice and How to Stay Engaged** Ballroom ABC, Hynes

Course Directors: *Michael A. Borger, *Columbia University*
*Lars G. Svensson, *Cleveland Clinic*
*Vinod H. Thourani, *Emory University*

Panelists: *John V. Conte, *Johns Hopkins University*
Patrick T. O'Gara, *Brigham & Women's Hospital*

2:00 pm **Introduction**
*Michael A. Borger, *Columbia University*

2:02 pm **TCT1. Transcatheter Aortic Valve Replacement in Patients with Severe Mitral or Tricuspid Regurgitation at Extreme Surgical Risk**
*Michael J. Reardon[1], *G. Michael Deeb[2], Neal S. Kleiman[3], *Thomas G. Gleason[4], Steven J. Yakubov[5], *David H. Adams[6], Jeffrey J. Popma[7]
[1]Houston Methodist Hospital, Houston, TX; [2]University of Michigan, Ann Arbor, MI; [3]The Methodist DeBakey Heart and Vascular Center, Houston, TX; [4]University of Pittsburgh, Pittsburgh, PA; [5]Riverside Methodist Hospital, Columbus, OH; [6]Mount Sinai Health System, New York, NY; [7]Beth Israel Deaconess Medical Center, Boston, MA

Invited Discussant: *Lars G. Svensson

Objectives: Patients with severe symptomatic aortic stenosis who also had either severe mitral regurgitation (SMR) or severe tricuspid valve regurgitation (STR) were excluded from major transcatheter aortic valve replacement (TAVR) trials. We studied these two subgroups in patients deemed at extreme surgical risk in the CoreValve US Expanded Use Study.

Methods: The CoreValve US Expanded Use Study is a prospective, nonrandomized, single-arm study that evaluated the safety and efficacy of self-expanding TAVR in complex subsets of extreme-risk patients including those with SMR or STR at baseline. Patient eligibility was reviewed by a National Screening Committee comprising cardiac surgeons and interventional cardiologists. The primary endpoint was the composite of all-cause mortality or major stroke at 1 year. We also calculated the number of patients who had good medical benefit at 6 months and 1 year, defined as a Kansas City Cardiomyopathy Questionnaire (KCCQ) summary score >45 at 6 months and >60 at 1 year and with less than a 10-point decrease from baseline.

Results: There were 53 patients in each group. Baseline characteristics for the SMR and STR cohorts were; mean age: 84.2 ± 6.4, 84.9 ± 6.5 years; male sex: 29 (54.7%), 22 (41.5%); mean STS score: 9.9 ± 5.0%, 9.2 ± 4.0%; NYHA class IV: 9 (17.0%), 7 (13.2%) and grade III/IV LV diastolic dysfunction: 9/49 (18.4%), 11/46 (23.9%). Improvements in MR occurred over time in both patient groups (Figure). A good medical benefit was present in 31/47 SMR patients (66.0%) and 33/47 STR patients

(70.2%) at 6 months, and in 25/44 SMR patients (56.8%) and 24/45 STR patients (53.3%) at 1 year. The Kaplan-Meier rates of all-cause mortality or major stroke for the SMR and STR cohorts were 11.3% and 3.8% at 30 days, and 21.0% and 19.2% at 1 year. There were no major strokes in either cohort to 1 year.

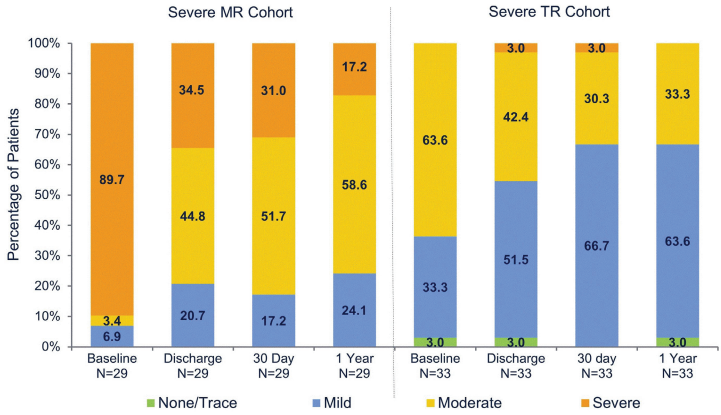


Figure: The severity of mitral regurgitation over time in patients with severe MR or severe TR and with assessments at each time point reported.

Conclusions: TAVR in patients with severe MR or TR is reasonable and safe and leads to improvement in mitral valve regurgitation. Longer-term follow-up is needed.

See page 64 for details.

2:14 pm **TCT2. Outcomes After Transcatheter and Surgical Aortic Valve Replacement in Intermediate Risk Patients with Preoperative Mitral Regurgitation: Analysis of PARTNER IIA Randomized Cohort**

*S. Chris Malaisrie[1], Robert W. Hodson[2], Thomas McAndrew[2], Charles Davidson[1], Jeffrey Swanson[4], Rebecca T. Hahn[5], Philippe Pibarot[6], Wael Jaber[7], Nishath Quader[8], Alan Zajarias[8], *Lars Svensson[7], *Isaac George[5], *Alfredo Trento[9], *Vinod H. Thourani[10], *Wilson Y. Szeto[11], *Todd Dewey[12], *Craig R. Smith[5], Martin B. Leon[5], John G. Webb[13]

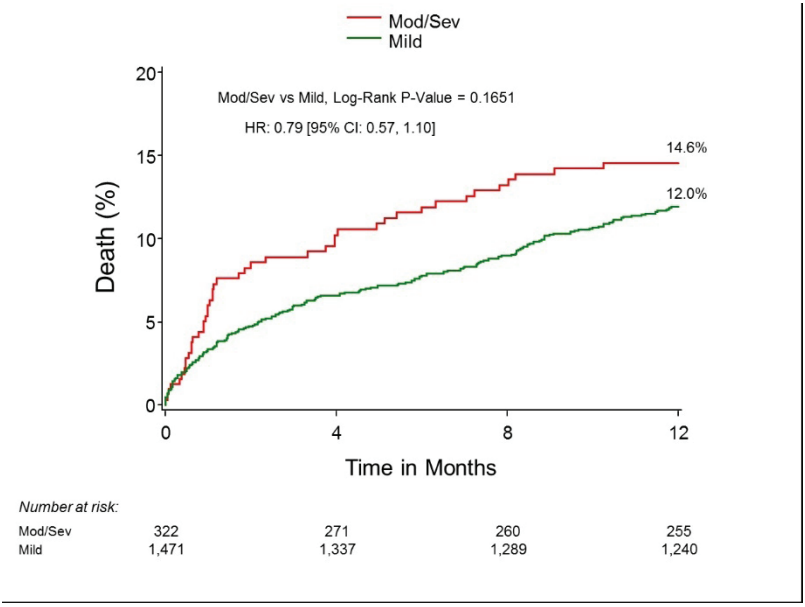
[1]Northwestern University, Chicago, IL; [2]Providence Heart Clinic, Portland, OR; [-]Cardiovascular Research Foundation, New York, NY; [4]Providence Heart Clinic, Portland, OR; [5]Columbia University, New York, NY; [6]Laval University, Quebec City, QC, Canada; [7]Cleveland Clinic, Cleveland, OH; [8]Washington University, St. Louis, MO; [9]Cedars Sinai Medical Center, Los Angeles, CA; [10]Emory University, Atlanta, GA; [11]University of Pennsylvania, Philadelphia, PA; [12]HCA Medical City Dallas, Dallas, TX; [13]St. Paul's Hospital, Vancouver, BC, Canada

Invited Discussant: *John V. Conte

Objective: The association of preoperative mitral regurgitation (MR) on clinical outcomes of patients undergoing transcatheter aortic valve replacement (TAVR) has been studied in high-risk cohorts. The objective of this study is to examine the effect of preoperative moderate or severe MR on outcomes after TAVR or surgical aortic valve replacement (SAVR) in an intermediate-risk cohort.

Methods: Data were drawn from the Placement of Aortic Transcatheter Valve (PARTNER) 2A Trial which randomized 2,032 intermediate-risk patients with severe, symptomatic aortic stenosis to either TAVR or SAVR. An ad-hoc analysis was performed on 1,793 patients with baseline MR echocardiographic data. Both TAVR and SAVR patients were analyzed according to the degree of preoperative MR (moderate/severe versus none/trace/mild).

Results: At baseline, moderate or severe MR was reported in 322 patients (18%). At 30 days, among 249 survivors who had isolated SAVR/TAVR, moderate/severe MR had improved in 120 patients (48.2%) to mild or less; and at 1 year, among 192 survivors, 103 (53.6%) remained mild or less. Thirty-day mortality was higher in patients with moderate or severe MR than in those with mild or less MR (6.0 versus 3.4%; HR: 1.79, 95% CI [1.05–3.04], P = 0.03). At 1-year, the combined outcome of death (14.6 vs 12.0%; HR: 1.26, 95% CI [0.91–1.75], P = 0.17), stroke (11.8 vs 9.7%; HR: 1.23, 95% CI [0.85–1.78], p = 0.26), and rehospitalization (17.2 vs 13.9%; HR: 1.27, CI [0.93–1.73], P = 0.13) was higher in the moderate or severe group (32.1 vs 26.6%; HR: 1.26, 95% CI [1.01–1.58], p = 0.04). The combined 1-year outcome in moderate or severe MR was not statistically different between SAVR and TAVR (33.8 vs 30.1%; HR: 1.18, 95% CI [0.79–1.74], p = 0.42).



Conclusions: Both TAVR and SAVR were associated with a significant improvement in MR in survivors through 1 year. However, moderate or severe MR at baseline was associated with increased 30-day mortality and death/stroke/rehospitalization through 1 year in both TAVR and SAVR. In comparison of TAVR and SAVR treatment groups with baseline moderate or severe MR, 1-year survival and combined endpoints were similar.

TUESDAY AFTERNOON, MAY 2, 2017

2:00 pm – 3:30 pm **ELSO at AATS** Room 306, Hynes

See page 65 for details.

3:30 pm – 4:00 pm
AATS/AmSECT Heater-Cooler-Induced Nontuberculous Mycobacterium Infections: An Emerging Public Health Concern AATS CT Theater II
Booth #1828, Exhibit Hall
Not for Credit

See page 65 for details.

TUESDAY AFTERNOON, MAY 2, 2017

4:05 pm – 5:35 pm **Adult Cardiac Surgery Simultaneous Scientific Session: Valve Surgery and Ablation** Ballroom ABC, Hynes
6 minute presentation, 9 minute discussion

Moderators: *Vinay Badhwar and *Faisal G. Bakaeen

45. Complex Versus Simple Degenerative Mitral Valve Disease: Does Valve Complexity Matter?

Hoda Javadikasgari, *Tomislav Mihaljevic, *Rakesh M. Suri, *Lars G. Svensson, *Jose L. Navia, Robert Z. Wang, Asley Lowry, *Eugene H. Blackstone, Stephanie Mick, A. Marc Gillinov

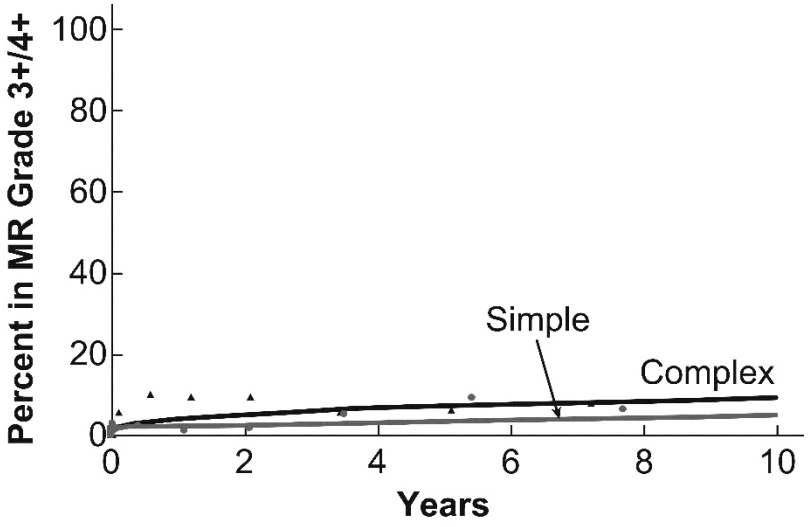
Cleveland Clinic, Cleveland, OH

Invited Discussant:

Objectives: While cardiologists agree that early surgical referral of patients with "simple" degenerative mitral valve disease (posterior prolapse) is supported by evidence, many were historically reluctant to recommend surgical intervention for asymptomatic patients with "complex" disease (anterior or bileaflet prolapse), fearing that surgical outcomes were inferior. At a center where surgeons favor mitral valve repair for all subsets of leaflet prolapse, we sought to compare results of patients undergoing repair to correct simple versus complex degenerative mitral valve disease.

Methods: From 1/1985 to 1/2016, 6,444 patients underwent primary isolated mitral valve surgery for degenerative disease, including 3,183 with simple disease (3,101 repairs [97%]) and 3,261 with complex disease (3,052 repairs [94%]). Simple (posterior prolapse) versus complex (anterior or bileaflet prolapse) degenerative mitral valve disease was defined based on echocardiographic images. Logistic regression analysis was used to generate propensity scores for risk-adjusted comparisons. Durability was assessed by recurrence of mitral regurgitation.

Results: Compared to patients with simple disease, those who underwent repair of complex pathology were more likely to be younger (mean age 56 ± 13 vs 59 ± 11 years, P < .0001) and female (n = 1,160 [38%] vs n = 744 [24%], P < .0001) but with similar symptoms (NYHA class III/IV of n = 376 [12%] vs n = 353 [11%], P = .36). The most common type of mitral valve repair was ring/band anuloplasty (2,964 [98%] in simple group vs 2,929 [98%]) in complex group, P = .4) followed by leaflet resection (2,714 [90%] in simple group vs 2,171 [72%] in complex group, P < .0001). Unadjusted survival at 15 years after repair was 77% for both simple and complex valve disease (P = .2). Using propensity match analysis, hospital outcomes after repair for simple disease was similar to complex pathology (P >.1), whereas recurrence of 3+ to 4+ mitral regurgitation at 10 years following repair was 5.4% for simple versus 9.8% for complex pathology (P = .6, Figure) and survival at 15 years after repair was 78% for simple versus 76% for complex valve disease (P > .9).



Conclusions: Long-term outcomes after degenerative mitral valve repair are excellent, regardless of mitral valve prolapse complexity. These results support the guideline-based recommendation toward early surgical referral of patients with degenerative disease, regardless of mitral valve disease complexity.

46. Respect When You Can, Resect When You Should: A Realistic Approach to Mitral Valve Repair

*Gilles Daniel Dreyfus[1], Filip Dulguerov[1], Cecilia Marcacci[1], Clara Alexandrescu[1], Franck Levy[1], Shelley Rahman[2], Elie Dan Schouver[1]

[1]Cardiothoracic Center of Monaco, Monte Carlo, Monaco; [2]Royal Brompton and Harefield NHS Foundation Trust, London, United Kingdom

Invited Discussant: *Gebrine El Khoury

Objective: Avoiding resection to treat Posterior Leaflet Prolapse (PLP) has become popular to repair degenerative Mitral Regurgitation (MR). However, those who advocate such policy still resect in 35% of their cases. As we do not subscribe to such simplification, we have reviewed all our PLP in degenerative disease. The aim of the study is: 1) to identify which technique is needed for each lesion; 2) to analyze early and long-term outcome for mortality, residual/recurrent MR and reoperation.

Methods: From January 2005 to December 2015, 701 patients with severe MR underwent Mitral Valve Repair (MVR). There were 376 patients with degenerative PLP, including 93 isolated P2 and 283 associated to other segments (P1, P3, posterior commissure, anterior leaflet). Patients mean age was 67 ± 13,1 years; there were 265 males (70.5%) and 239 patients were in NYHA class 1 or 2 (63.6%). No resection was achievable in only 24 patients (6,4%). Excess leaflet tissue was addressed by resecting as follows: a) resection for excessive height in 237 patients (63%) (at the free edge in 159 (67.1 %); at the annular level in 78 (32.9%); b) resection for excessive width in 248 cases (65,9%), treated preferably by triangular resection in 238 cases (96%) and by quadrangular resection in 10 cases (4%). Leaflet prolapse was addressed by secondary native chordal transfer and in 182 patients (48.4%) and/or by using artificial neochordae in 120 patients (31.9%). Annular dilatation was treated in all patients with a semirigid annuloplasty ring (mean size 34, range: 28–40).

Results: There were 3 hospital deaths (0.8%). There was no Systolic Anterior Motion (SAM). Follow-up was complete for 368 patients (97.4%) with a mean duration of 4.4 ± 3.2 years. All patients were followed annually and echocardiogram parameters used were obtained in our core lab. Mean coaptation height was 8 ± 2.07 mm. 320 patients showed 0 or 1+ MR (87%), 36 showed 2+ (9.8%) and 12 showed 3+ or more (3.2%), among which 5 were reoperated (1.4%). There was a significant decrease in left ventricle sizes (end systolic diameter: from 36.60 mm to 33.87 mm, $p < 0.001$; end diastolic diameter: from 57.80 mm to 51.20 mm, $p < 0.001$), in pulmonary artery systolic pressure (from 39.1 mmHg to 28.4 mmHg, $p < 0.001$) and in left atrial volume (from 146.9 ml to 100.6 ml, $p < 0.001$). Freedom from reoperation at 10 years was 98.6%. Survival at 10 years was 87.3%.

Conclusions: Our data do not support the “respect rather than resect” concept, but rather the “resect with respect” one. Our results show a low operative mortality, no SAM, a good surface of coaptation, a very low incidence of residual/recurrent MR and low incidence of reoperation. Moreover, we should not teach MVR without providing younger surgeons the necessary tools to address all lesions.

47. Outcome of Tricuspid Valve Surgery in the Presence of Permanent Pacemaker: Analysis of 616 Patients

Nishant Saran, Sameh Said, *Hartzell Schaff, *Kevin Greason, *Lyle Joyce, David Joyce, *John Stulak, *Simon Maltais, *Alberto Pochettino, *Joseph Dearani, *Richard Daly
Mayo Clinic, Rochester, MN

Invited Discussant: *T. Sloane Guy

Objective: There is limited literature about patients with permanent pacemakers (PPM) requiring tricuspid valve (TV) surgery. Several mechanisms are proposed for tricuspid regurgitation (TR) in the presence of PPM. We sought to evaluate the outcome of TV surgery in the presence of PPM.

Methods: We retrospectively reviewed the records of all 616 adult patients who underwent TV surgery in the presence of PPM between January 1993 and December 2013. Patients were divided into two etiologic groups: pacemaker-associated TR (PATR, n = 363, 59%) and pacemaker-induced TR (PITR, n = 252 [41%]). One patient was not categorized, as PPM involvement was unknown. Statistical analysis included logistic regression, Kaplan-Meier estimated survival, and Cox proportional hazard model, where appropriate.

Results: Patient demographics included a mean age of 69.5 ± 11.9 years and female sex in 320 patients (52%). In the PATR group, the most common etiology was functional secondary to annular dilatation (n = 310 [85%]). The PATR group was found to have higher prior TV surgery (P = 0.049), concomitant mitral valve surgery (P < 0.001), congestive heart failure (P = 0.019) and TV stenosis (P = 0.040). The most common mechanism leading to TR in PITR group was restricted mobility of leaflets (n = 103 [41%]), followed by adherent leaflet to PPM leads (n = 93 [37%]), leaflet perforation (n = 31 [12%]), scarring of leaflets (n = 19 [8%]), and chordal entrapment (n = 18 [7%]) (Figure). The most common leaflet involved was septal (SL, n = 185 [73%]), followed by inferior (IL, n = 131 [52%]) and anterior leaflet (AL, n = 105 [42%]); all 3 leaflets were involved in 86 patients (34%), whereas chordal involvement was present in 18 (7%). The majority of PATR patients received valve repair (n = 219 [60%]), whereas the majority of PITR patients underwent TV replacement (n = 148 [59%]) (P < 0.001). Patients who underwent TV replacement, in either group, had a worse survival (PITR, HR: 1.37, 95% CI [.96–1.94]; PATR, HR: 1.45, 95% CI [1.11–1.89]). In the PITR group, younger age (OR: 1.03, 95% CI [1.00–1.05], P = 0.018) and SL involvement (OR: 4.02, 95% CI [2.06–7.86], P < 0.001) were associated with increased risk of repair; whereas chordal entrapment (P = 0.039) and IL if involved alone (P = 0.002) were associated with higher chances of TV replacement. Multivariate analysis predicted better survival outcomes for the PITR group (HR: 0.791, 95% CI [0.635, 0.980], P = 0.037) after controlling for congestive heart failure, prior TV surgery, TV stenosis, and type of TV surgery performed.

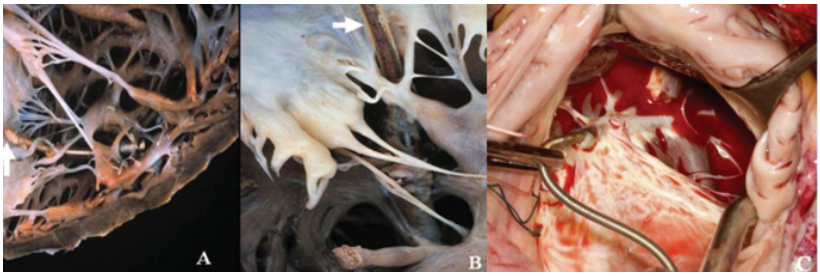


Figure: A. Chordal entrapment B. Leaflet Perforation C. Adherent leaflet.

Conclusion: Several mechanisms lead to PITR with decrease chance of successful repair in the presence of chordal entrapment and inferior leaflet involvement. Valve repair in this setting may offer a survival benefit compared to replacement.

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48. Transcatheter or Surgical Intervention for the Failed Pulmonary Valve Homograft in the Ross Population?

Khadija Alassas[1], Talal Hijji[2], Aysha Husain[1], Abdelmoneim Eldali[1], Ziad Dahdouh[1], Valeria Pergola[3], Giovanni Di Salvo[3], Mansour Aljufan[1], Zohair Yousef Al Halees[1], Bahaa Michel Fadel[1]

[1]King Faisal Specialist Hospital and Research Centre, Riyadh, Saudi Arabia; [2]Al Faisal University, Riyadh, Saudi Arabia; [3]Croydon University Hospital, London, United Kingdom

Invited Discussant: *Gosta B. Petterson

Objective: Ross patients are at an increased risk for the development of pulmonary valve (PV) homograft malfunction. For those who require PV reintervention, percutaneous transcatheter PV implantation (TPVI) provides a less invasive therapeutic option than redo PV replacement (PVR). We aim to examine the outcome following TPVI vs redo PVR in the Ross population.

Methods: We performed a retrospective analysis of all adult Ross patients who underwent TPVI (n = 47; Melody 81% and Edwards SAPIEN valve 19%) or PVR (n = 41) at our institution. The clinical and echocardiographic data prior to, immediately following intervention and at last follow-up were analyzed.

Results: Baseline parameters including age, left and right ventricular (RV) systolic function were similar in both groups. Median follow-up was 63 and 99 months for the TPVI and PVR groups, respectively. Hospital stay was 3.1 ± 2.5 days in the TPVI group and 13.6 ± 12.4 days in the PVR group ($p < 0.0001$). No procedure-related in-hospital mortality was noted in either group. Procedure-related complications occurred in 3 patients (6%) following TPVI. Blood transfusion was required in 1 patient (2%) following TPVI and in 20 patients (49%) following PVR ($p < 0.0001$). TPVI patients demonstrated early improvement in RV systolic parameters whereas PVR patients showed post-operative decline in RV function. PV reintervention was required in 10 (21%) and 5 (12%) patients following TPVI and PVR, respectively ($p = 0.2$). Infective endocarditis (IE) occurred in 6 patients (13%) following TPVI and 3 patients (7%) following PVR ($p = 0.4$). Two patients (4%) died following TPVI due to IE, accounting for all deaths in this group. One patient (2%) died in the PVR group

due to cardiogenic shock. At 7-year follow-up, the freedom from a composite endpoint including death, IE, and PV reintervention was 43% and 82% in the TPVI and PVR group (p = 0.04), respectively.

Conclusions: In Ross patients who require PV reintervention, TPVI as compared to PVR is associated with a shorter hospital stay, less requirement for blood transfusion and faster improvement in RV systolic parameters. However, on the intermediate to long term, TPVI may carry a higher rate of major adverse cardiac events.

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49. The Aortic Root and Arch Do Not Dilate Over Time After Aortic Valve and Ascending Aorta Replacement in Patients with Bicuspid Aortic Valves

Sonya K. Hui[1], Chun-Po Steve Fan[2], Shakira Christie[1], *Christopher M. Feindel[1], *Tirone E. David[1], Maral Ouzounian[1]

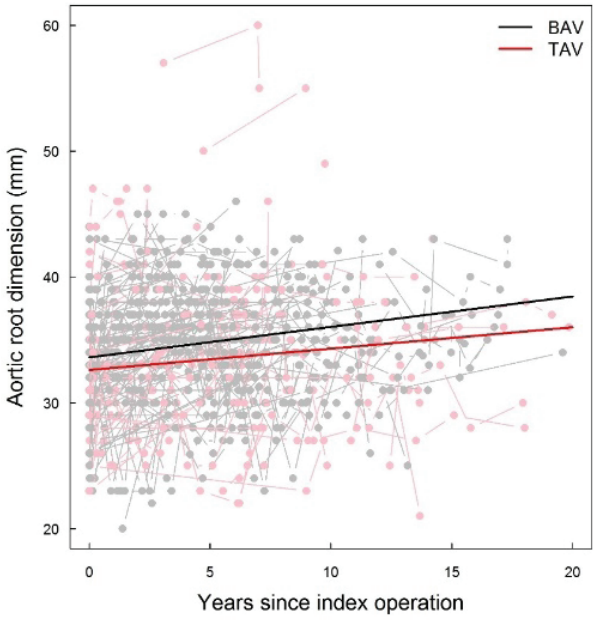
[1]University of Toronto, Toronto, ON, Canada; [2]Hospital for Sick Children, Toronto, ON, Canada

Invited Discussant: *Y. Joseph Woo

Objective: Whether the aortopathy associated with bicuspid aortic valve (BAV) disease occurs as a result of genetic or hemodynamic factors remains controversial. The genetic axiom has been used to justify more aggressive aortic resection in patients with BAV. The objective of this study was to describe the natural history of the remaining sinus segments and aortic arch in patients with bicuspid vs tricuspid aortic valves (TAV) following aortic valve and ascending aorta replacement.

Methods: From 1990 to 2010, 406 patients (269 BAV and 137 TAV) underwent elective replacement of their aortic valve and ascending aorta at a single institution. Patients with aortic dissection, active endocarditis, previous aortic surgery, or Marfan syndrome were excluded. All available imaging reports (echocardiogram, CT, and MRI) at baseline and during follow-up were reviewed. 70.6% of BAV and 58.4% of TAV patients had at least one measurement of the root and/or the arch following the index operation. The median follow-up was 7.9 (4.3–11.6) years.

Results: Patients with BAV were younger (BAV: 65 [55–71] vs TAV: 70 [65–76], p < 0.001) and more were male (BAV: 74.7% vs TAV: 58.4%, p < 0.001). Baseline aortic root and arch diameter were comparable between groups. Patients with BAV had more replacement of non-coronary sinus at the time of surgery (BAV: 36.1% vs TAV 19.7%, p < 0.001), but less use of circulatory arrest for an open distal anastomosis (BAV: 38.3% vs TAV 52.6%, p < 0.001). In patients with BAV, aortic root diameter increased at a small but clinically negligible rate over time (0.242 mm/year; 95% CI [0.157, 0.327], p < 0.001) that was not different compared to patients with TAV (p = 0.39) (Figure). Arch dimension at last known follow-up was similar between groups (BAV: 33 ± 14 mm vs TAV: 34 ± 6 mm, p = 0.75) and was not different between those who had aortic replacement with a cross-clamp in place or under circulatory arrest (p = 0.24). During the follow-up period, 18 patients underwent a reoperation, the majority (89%) for a degenerated bioprosthetic aortic valve. At the time of reoperation, 10 patients had their root replaced and 2 also had their arch replaced. Of the 406 patients in the study cohort, only one underwent a reoperation for a primary indication of aortic aneurysmal disease 22 years following the index operation. There were no differences in cumulative incidence rates of cardiac (p = 0.37) or aortic reoperation (p = 0.14) between patients with BAV and TAV.



Conclusion: This work represents the largest natural history study to date assessing aortic root and arch dimensions with follow-up imaging data in patients after aortic valve and ascending aorta replacement. These data indicate that if the root and arch are not dilated at the time of surgery, the risk of enlargement over time is minimal, negating the need for prophylactic root or arch replacement procedures in patients with either bicuspid or tricuspid aortic valves.

Late-Breaking Clinical Trial

LB8. Biatrial Maze Procedure Versus Pulmonary Vein Isolation in the CTSN Randomized Trial of Surgical Ablation of Atrial Fibrillation During Mitral Valve Surgery

*Eugene H. Blackstone[1], Helena L. Chang[2], Jeevanantham Rajeswaran[1], Michael K. Parides[2], Hemant Ishwaran[3], Liang Li[4], John Ehrlinger[1], Annetine C. Gelijns[2], Alan J. Moskowitz[2], Marissa A. Miller[5], *Michael Argenziano[6], Joseph J. DeRose, Jr.[7], *François Dagenais[8], *Gorav Ailawadi[9], *Peter K. Smith[10], *Michael A. Acker[11], *Michael J. Mack[12], *Patrick T. O'Gara[13], *A. Marc Gillinov[1]

[1]Cleveland Clinic, Cleveland, OH; [2]Icahn School of Medicine at Mount Sinai, New York, NY; [3]University of Miami, Miami, FL; [4]MD Anderson Cancer Center, Houston, TX; [5]National Heart, Lung, and Blood Institute, NIH, Bethesda, MD; [6]Columbia University , New York, NY; [7]Montefiore Medical Center, Bronx, NY; [8]Quebec Heart and Lung Institute, Québec, QC, Canada; [9]University of Virginia, Charlottesville, VA; [10]Duke University, Durham, NC; [11] University of Pennsylvania, Philadelphia, PA; [12]The Heart Hospital Baylor, Plano, TX; [13]Brigham and Women's Hospital, Boston, MA

Invited Discussant: *James R. Edgerton

4:05 pm – 5:35 pm **MCS/Transplant Session** Room 306, Hynes
5 minute presentation, 7 minute discussion

Moderators: *Anelechi C. Anyanwu and *Vivek Rao

50. Impact of Initial Pump Positioning on Pump Thrombosis: Insights from the PREVENT Study

◆Ahmet Kilic[1], John Ransom[2], *Simon Maltais[3], *Benjamin Sun[4], John W. Entwistle, III[5], Stephen Bailey[6], *Ranjit John[7], *Charles T. Klodell[8], *Igor Gregoric[9], Brett Sheridan[10], Joyce Chuang[11], David J. Farrar[11], Kartik Sundareswaran[11], Robert Adamson[12]

[1]Ohio State University, Columbus, OH; [2]Baptist Health Heart and Transplant Institute, Little Rock, AR; [3]Mayo Clinic, Rochester, MN; [4]Minneapolis Heart Institute, Minneapolis, MN; Thomas Jefferson University, Philadelphia, PA; [6]Allegheny General Hospital, Pittsburgh, PA; [7]University of Minnesota, Minneapolis, MN; [8]University of Florida, Gainesville, FL; [9]Memorial Hermann – Texas Medical Center, Houston, TX; [10]California Pacific Medical Center, San Francisco, CA; [11]St. Jude Medical, Pleasanton, CA [12]Sharp Memorial Hospital, San Diego, CA

Invited Discussant: *Ashish S. Shah

Objective: The PREVENtion of HeartMate II pump Thrombosis through clinical management (PREVENT) study was a multicenter, prospective investigation to evaluate the rate of pump thrombosis (PT) with adoption of a uniform set of surgical practices for left ventricular assist device (LVAD) implantation. We sought to evaluate the baseline anatomic characteristics of pump implantation and their impact on PT.

Methods: Chest X-Rays (CXRs) at baseline and at 6 months were prospectively obtained per protocol in patients enrolled into the PREVENT study. Out of the 300 patients enrolled, 237 patients had an available CXR immediately post implantation for assessment. An independent radiologist evaluated all CXRs and evaluated pump pocket depth, pump angle relative to the spine, inflow cannula (IC) angle relative to the pump and IC angle relative to the vertical. Suboptimal pump position at baseline implantation was defined as pocket depth ≤8 cm (10th percentile), pump angle relative to spine ≤70° (10th percentile), IC angle relative to pump ≤46° (5th percentile) or IC angle relative to vertical ≤0°. In addition to baseline characteristics and CXRs, patients were followed for serum lactate dehydrogenase (LDH) levels (elevation defined as ≥2.5 x upper normal limit of lab value), clinical evidence of hemolysis and confirmed PT.

Results: Average age was 57 ± 13 years, 81% were male, 78% destination therapy (DT), and 81% in INTERMACS profiles 1–3 at the time of implantation. There were 11 cases of confirmed PT over the study period for a 4.6% PT rate at 6 months. There were 56 (24%) patients who had a suboptimal pump position at the time of implantation. Baseline characteristics and CXR parameters for patients with suboptimal vs normal pump position as well as outcomes following implantation are shown in the Table. Patients with sub-optimal pump position at baseline had a significantly elevated rate of confirmed PT (11% vs 3%, p = 0.02), evidence of major hemolysis (14% vs 4%, p = 0.03), and higher incidence of elevated LDH (28% vs 12%, p = 0.01) compared to patients with a normal pump position.

Table: Baseline Parameters and Outcomes in Patients with Suboptimal vs Normal Pump Position

	Suboptimal Pump Position (n = 56)	Normal Pump Position (n = 178)	p-Value
Age	58 ± 12	56 ± 13	0.36
BMI (kg/m^2)	31 ± 7	29 ± 6	0.08
Male	48 (86%)	142 (80%)	0.43
Pocket depth (cm)	11.2 ± 4.3	13.4 ± 3.1	<0.01
Pump angle relative to spine (°)	80 ± 19	90 ± 11	<0.01
IC angle relative to pump (°)	69 ± 19	69 ± 11	0.49
IC angle relative to vertical (°)	30 ± 20	21 ± 8	<0.01
Clinical evidence of hemolysis	8 (14%)	8 (4%)	0.03
Confirmed pump thrombosis	6 (11%)	5 (3%)	0.02

Conclusions: Suboptimal positions in LVAD implantation are associated with a higher risk of hemolysis and elevated LDH levels with resultant higher PT rates as compared to normal positions at initial implantation.

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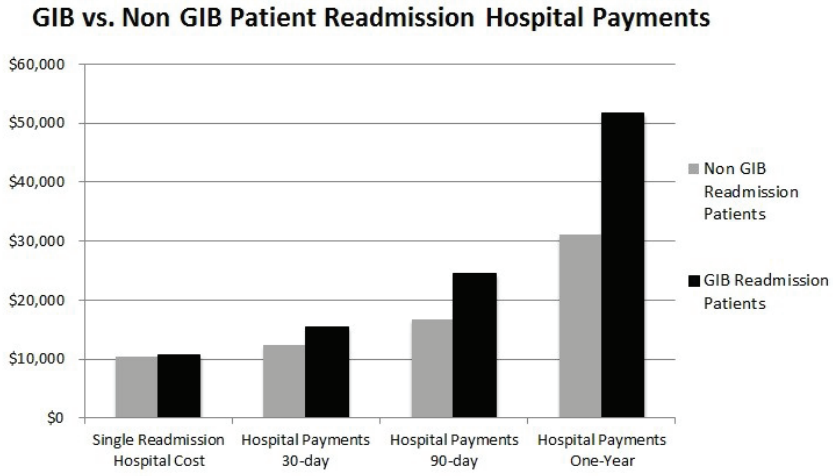
51. The High Cost of Gastrointestinal Bleeding in LVAD Patients: Impact of Readmissions on Financial Burden and Patient Morbidity

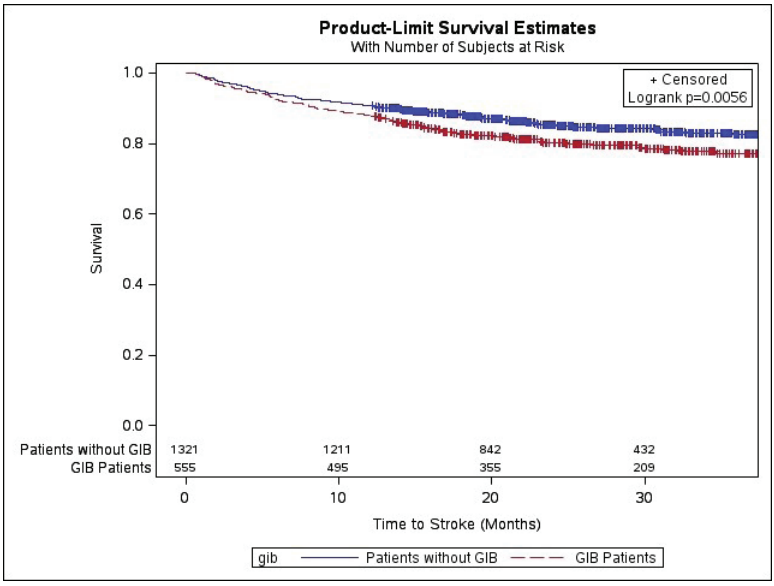
Danielle Savino, Fenton McCarthy, Danielle Spragan, Taylor Dibble, Desmond Graves, Keith Dufendach, Katherine McDermott, Peter Groeneveld, *Nimesh Desai
University of Pennsylvania, Philadelphia, PA

Invited Discussant:

Objective: While the high prevalence of gastrointestinal bleeding (GIB) complications in Left Ventricular Assist Device patients has been well documented, the clinical consequences and financial burden of GIB has yet to be fully examined. This study aims to characterize the financial impact of GIB in LVAD patients as well as the impact on future patient morbidity.

Methods: Medicare carrier claims were used to identify all patients undergoing LVAD implantation between January 2010 and December 2012 (n = 2,208), excluding terminal explant and heart transplant patients. Medicare Provider Analysis and Review (MEDPAR) files between 2010 and 2013 were used to determine principle diagnosis codes, hospital costs, and Medicare payments for individual readmissions. Hospital costs were estimated using hospital cost-to-charge-ratios. Comorbidities present on implantation were assigned using International Classification of Diseases, Ninth Revision (ICD-9) codes and a modified Elixhauser comorbidity index. ICD-9 diagnosis codes present on MEDPAR files were used to determine cause of readmission.





Results: This study included 2,208 LVAD Medicare patients, with 1,876 (85%) surviving index hospitalization. Of those surviving index hospitalization, 1,769 (94%) patients were readmitted for any cause, with a total of 7,748 readmissions over the 3-year follow-up period. The three leading causes of readmission were cardiac complications, gastrointestinal bleeding (GIB), and mechanical complications. Five hundred fifty-five (30%) patients were readmitted for a GIB, and 1,141 (15%) of total readmissions were due to GIB. Patients with GIB were more likely to be female, have perivascular disease, COPD, and renal failure. Noteably, GIB patients had a 33% higher relative risk of stroke ($p < 0.01$). A multivariate logistic regression model indicated that GIB is a predictor of stroke in LVAD Medicare patients (OR: 1.42,

95% CI [1.09–1.84]). GIB patients who also experienced a stroke had increased hospital readmission payments compared to GIB readmissions not associated with stroke (median [IQR] $25,700 [$12,600–$49,500] vs $10,600 [$6,400–$19,200], p < 0.01). The one-year excess hospital payment for GIB patients was $50,000.

Conclusions: Gastrointestinal bleeding is a significant cause of morbidity, readmission and increased cost in Medicare LVAD patients. It is associated with a significantly higher risk of stroke, and an excess hospital payment of $50,000 in the first year post implant.

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52. Posttransplant Outcomes in Patients on Venoarterial Extracorporeal Membrane Oxygenation: A Comparison with Population on Continuous-Flow Left Ventricular Assist Device Support

Shinichi Fukuhara, Trung Tran, Jiho Han, Koji Takeda, *Yoshifumi Naka, ◆Hiroo Takayama
Columbia University, New York, NY

Invited Discussant:

Objective: Venoarterial extracorporeal membrane oxygenation (ECMO) use is common as a bridge-to-decision intent, while extremely infrequent as a bridge-to-transplant (BTT) among adults. We sought to investigate if BTT strategy with ECMO is a viable option.

Methods: United Network of Organ Sharing provided de-identified patient level data. Between 2003 and 2016, 26,016 adult heart recipients (aged ≥18 years) were identified. Retransplantations for graft failure were excluded from the analysis. Of these, 107 (0.4%) were bridged with ECMO directly to transplant and 6,148 (23.6%) were bridged with continuous-flow left ventricular assist device (CF-LVAD).

Results: Patients in ECMO group were younger (44.3 ± 15.2 vs 53.2 ± 12.2 years old, p < 0.001), more likely to have severely disabled/moribund functional status (88.3 vs 32.1%, p < 0.001), blood type A (47 vs 38%, p = 0.019), shorter length of time on the wait list (123 vs 305 days, p < 0.001), less likely to have ischemic etiology (31.8 vs 41.0%, <0.001), and more frequently mechanically ventilated at time of transplant (39.3 vs 0.7%, p < 0.001) than did patients in CF-LVAD group. Kaplan-Meier analysis demonstrated estimated posttransplant survival of 73.1 ± 4.4 vs 93.1 ± 0.3 at 90-day (p < 0.001) and 67.4 ± 4.9 vs 82.4 ± 0.6% at 3 years (p < 0.001) in ECMO and CF-LVAD group, respectively (Figure A). Analysis of a propensity matched cohort, adjusting recipient age, status 1A, dialysis, MELD-XI score, mechanical ventilation, inotropic support, functional status, ischemic etiology, Black race, gender mismatch, donor recipient weight ratio, ischemic time, donor age and expanded criteria donor, still demonstrated a lower survival rate at 90 days (73.1 ± 4.4 and 86.9 ± 2.4, p = 0.001) in ECMO group, but not at 3 years (67.4 ± 4.9 and 69.3 ± 3.7%, p = 0.16) (Figure B). Among the 107 ECMO patients, multivariable logistic regression analysis showed MELD-XI score (OR: 1.94 per 5-point of increase, 95% CI [1.00–3.76], p = 0.050) to be the sole contributor to the 90-day mortality. ECMO-supported patients with a high MELD-XI (>17 [67th percentile]) were associated with dismal posttransplant outcomes compared to those with a low MELD-XI score (<13 [33rd percentile]) (90-day survival: 54.4 ± 8.8 vs 85.0 ± 6.2%, p < 0.001, 3-year survival: 49.5 ± 9.4 vs 73.5 ± 8.2, p < 0.001).

Figure 1A: Unadjusted three-year Kaplan-Meier curve in each group

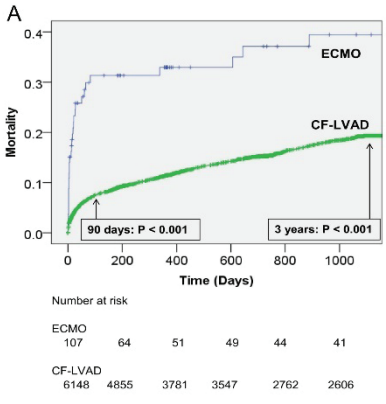
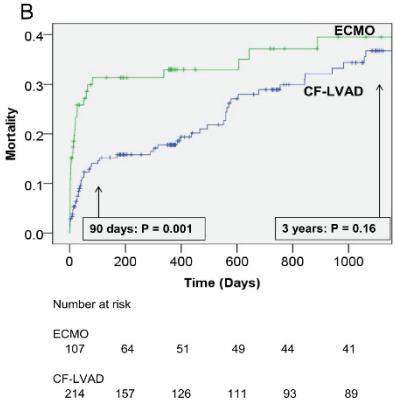


Figure 1B: Three-year Kaplan-Meier curve of the propensity-matched cohort in each group



Conclusions: Patients received heart transplantation during ECMO support was associated with increased early posttransplant mortality compared with those supported with CF-LVAD, especially subjects with a high MELD-XI score as the mid-term mortality exceeding 50%. This fact may have important implications in establishing organ allocation rules.

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53. High-Risk Conventional Cardiac Surgery in Patients with Profound Left Ventricular Dysfunction – A Proposed Treatment Algorithm in the Mechanical Circulatory Support Era

Nassir M. Thalji, *Simon Maltais, David L. Joyce, *Lyle D. Joyce, *Richard C. Daly, Shannon M. Dunlay, *John M. Stulak

Mayo Clinic, Rochester, MN

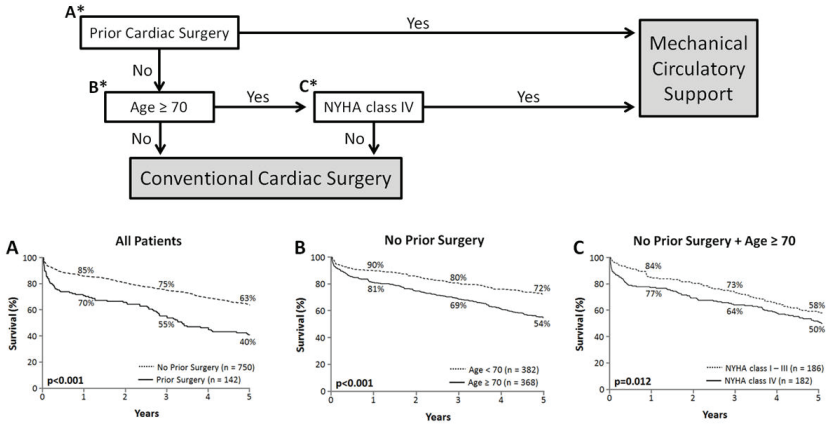
Invited Discussant: David A. D'Alessandro

Objective: Cardiac surgery in patients with severe left ventricular (LV) dysfunction is associated with increased morbidity and mortality. Mechanical circulatory support (MCS) may offer a viable alternative to conventional surgery (CS) in this challenging group, yet there is incomplete characterization of patients in whom MCS may be of greatest benefit. We sought to evaluate outcomes and stratify operative risk in patients who underwent CS that otherwise would have met criteria for MCS therapy.

Methods: We studied 892 consecutive patients ≥18 years who had conventional coronary and/or valve surgery at our institution from 1993 to 2014, and in whom preoperative LV ejection fraction (EF) was ≤25%. We excluded those with transcatheter valve interventions or major concomitant procedures. Logistic and Cox Regression analyses identified determinants of operative and long-term mortality, respectively. Kaplan-Meier methods were used to estimate long-term survival.

Results: Median (IQR) age was 70 years (62–76), and 80% (716) were men. NYHA IV symptoms were present in 46% (411), and 16% (142) had prior cardiac surgery. CABG was performed in 78% (695), aortic valve surgery in 32% (289) and mitral valve surgery in 15% (133). Multiple procedures were performed in 25% (225). Operative mortality was 7.5% (67). NYHA IV (OR: 1.88, p = 0.033), prior cardiac surgery (OR: 2.13, p = 0.017), peripheral vascular disease (PVD) (OR: 2.55, p = 0.001), emergent status (OR: 2.68, p = 0.024), and need for intra-aortic balloon pump (IABP) (OR: 4.95, p < 0.001) independently predicted operative death (C = 0.80). Risk imparted by presence of both NYHA IV and prior surgery was additive, with operative death 4-times more likely than patients free of both factors (OR: 3.95, p = 0.003). Median follow-up was 5 years, with 83%, 71% and 59% survival overall at 1, 3, and 5 years, respectively. Exploring determinants of late mortality, when adjusting for age, male sex, PVD, IABP use and NYHA IV symptoms, prior surgery conferred a 60% increase in the hazard of late death (HR: 1.59, p < 0.001). In subset analysis of those without prior surgery (750), late mortality risk was independently and significantly increased in patients ≥70 years (HR 1.86, p < 0.001), especially if NYHA IV symptoms were concurrently present (HR: 2.25, p < 0.001). Models accounting for surgery type (CABG, aortic valve surgery, mitral valve surgery) consistently demonstrated that procedure performed did not predict long-term outcome.

Figure 1. Management and Outcomes of Patients with LVEF ≤25% Referred to Cardiac Surgery



Conclusions: Although conventional cardiac surgery may be performed safely in carefully selected patients with severe LV dysfunction, a history of prior cardiac surgery and/or NYHA IV symptoms—particularly in those ≥70 years—confers significant and sustained survival disadvantages. Further stratification of this challenging group is necessary to optimize outcomes. Best practice for a subset of this population should include consideration for MCS therapy (Figure).

54. Ten-Year Experience with Continuous-Flow External Ventricular Assist Device: Evolution and Improving Outcomes in the Treatment of Refractory Cardiogenic Shock

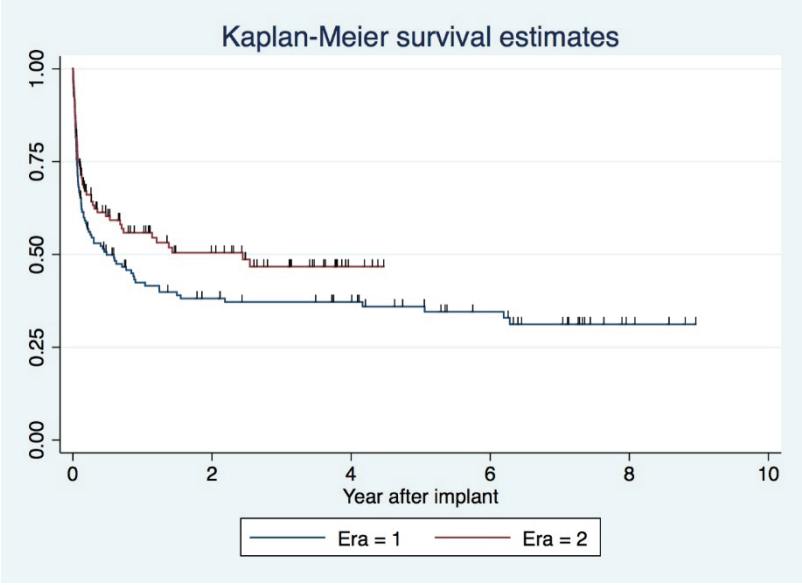
Koji Takeda, Arthur R. Garan, Veli K. Topkara, Jiho Han, *Paul Kurlansky, Melana Yuzefpolskaya, Maryjane A. Farr, Paolo C. Colombo, *Yoshifumi Naka, ◆Hiroo Takayama

Columbia University, New York, NY

Invited Discussant: *Stephan W. Schueler

Objective: The use of percutaneous mechanical circulatory support (MCS) has increased in the treatment of refractory cardiogenic shock. However, there remain limitations in flow capability, ventricular unloading effect, and durability. We reviewed our single-center experience with continuous-flow external ventricular assist device (VAD), CentriMag (St. Jude Medical Inc., St. Paul, Minnesota) VAD, to determine the role of temporary VAD for cardiogenic shock in the contemporary MCS era.

Methods: We retrospectively reviewed 264 patients who underwent CentriMag VAD insertion between January 2007 and July 2016. To investigate the change in indication, device configuration, and outcomes, the cohort was divided into 2 groups: 2007–2011 (Era 1, n = 137) and 2012–2016 (Era 2, n = 127). We analyzed early and late outcomes.



Results: The mean age of cohort was 55 ± 13 years and 71% were male. The cause of cardiogenic shock was acute decompensated heart failure in 60 (21%), acute myocardial infarction in 70 (27%), postcardiotomy shock in 57 (22%), graft failure post-heart transplantation in 36 (14%), right ventricular failure post-durable VAD in 24 (9.1%), myocarditis in 12 (4.6%), and others in 5 (1.9%). Eighty-seven (33%) were converted from percutaneous MCS for further stabilization. Device configuration was biventricular VAD in 61%, isolated right VAD in 24%, isolated left VAD in 7.6%, and minimally invasive VAD in 8%. Median duration of support was 17 days (IQR: 10–30). The 30-day mortality was 29%. Destinations after the CentriMag VAD included myocardial recovery in 35%, durable VAD in 23%, and heart transplantation in 11%. The overall survival was 49% and 39% at 1 and 5 years. Indication and device configuration significantly changed over time. Patients in Era 1 were likely to have more postcardiotomy shock (31% vs 19%, $p = 0.03$), less use of preoperative percutaneous MCS (19% vs 48%, $p < 0.01$), and less use of minimally invasive VAD configuration (2.9% vs 17%, $p < 0.01$) compared to patients in Era 2. The bridge to next destination rate was similar between groups. In-hospital mortality significantly improved (Era 1: 50% vs Era 2: 37%, $p = 0.03$). Overall survival at 3 years was 37% in Era 1 and 47% in Era 2 ($p = 0.08$) (Figure).

Conclusion: Changes in practice patterns using CentriMag VAD improved early and late outcomes in a variety of refractory cardiogenic shock. Flexibility in the use of both percutaneous MCS and temporary VAD as the situation demands is necessary to treat this sickest population.

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55. Early Circulatory Support with Extracorporeal Membrane Oxygenation Improves Outcomes After Severe Graft Dysfunction

Pierre-Emmanuel Noly[1], Erwan Flecher[2], Mélanie Hebert[1], Marion Mauduit[2], Yoan Lamarche[1], Amandine Martin[2], Jean-Philippe Verhoye[2], *Michel Carrier[1]

[1]Montreal Heart Institute, Montreal, QC, Canada; [2]Rennes Hospital, Rennes, France

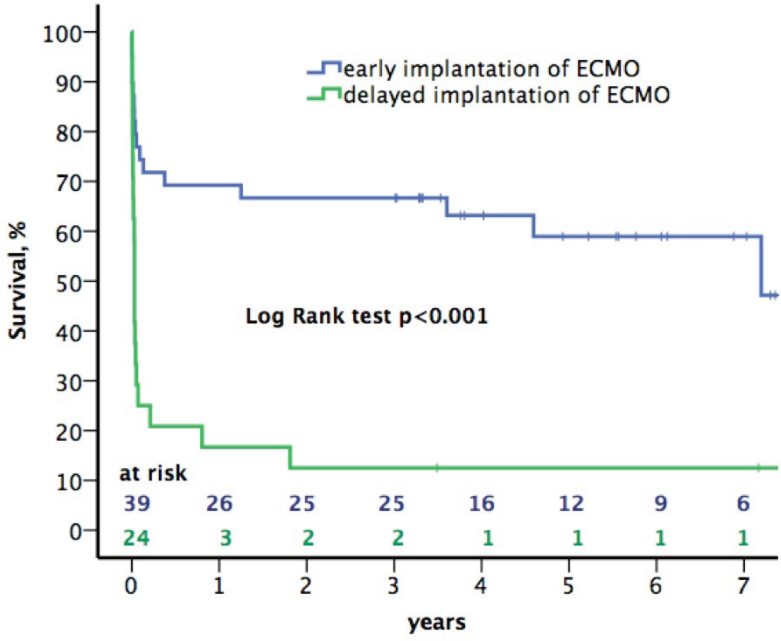
Invited Discussant: *Pavan Atluri

Objective: Primary or secondary graft dysfunction (GD) is the main cause of early mortality after orthotopic heart transplantation (OHT). We hypothesize that early implantation of temporary circulatory support with veino-arterial extracorporeal membrane oxygenation (V-A ECMO) in patients who had post-transplant PGD is associated with a better survival. The purpose of this study was to compare characteristics and outcomes of patients who underwent an early implantation versus a delayed implantation of ECMO after PGD.

Methods: All patients who received a V-A ECMO for severe graft dysfunction after OHT in two institutions between 2003 and 2013 were retrospectively reviewed. Among the 280 patients who underwent OHT, 63 patients (22%) needed ECMO. Patients were divided in two groups: early group (n = 39; implantation before 24 hours) and delayed group (n = 24; implantation after 24 hours).

Results: In the entire cohort, the mean age was 48 ± 13 years and 84% were male. The aetiologies of graft failure were right heart failure without (n = 33/63–52%) or with severe pulmonary hypertension (n = 26/63–25%), primary graft failure

(n = 24/63–38%). Fourteen patients had ECMO before OHT: 12 patients (38%) were in the early group and 2 (8%) in the delayed group (p = 0.06). Other preoperative characteristics of recipients were not different between the two groups. Donor characteristics were also similar despite a longer ischemia time in the early group (245 ± 11 vs 189 ± 13 min, p = 0.001). The time between OHT and ECMO implantation was 3.2 ± 2 hours in the early group vs 38.2 ± 10.2 hours in the delayed group. In the early group, patients had longer cardiopulmonary bypass time (195 ± 9 vs 138 ± 9, p = 0.001) and lower doses of adrenalin and noradrenaline before ECMO implantation (0.62 ± 0.2 vs 2.6 ± 1.1 mg/h, p = 0.06 and 0.24 ± 0.1 vs 5.5 ± 2.1 mg/h, p = 0.003). Mean duration of support (7.3 ± 9.0 days) was similar in the 2 groups. Hospital mortality was significantly lower in the early group (n = 6/34–18% vs n = 11/24–58%, p = 0.003). There was no difference in terms of major complications of ECMO between the 2 groups. The 1-year survival was 67% in the entire cohort and was significantly higher in the early group (79% vs 16%, p = 0.006).



Conclusions: Early implantation of a temporary mechanical support with ECMO is associated with better survival in patients with severe GD after cardiac transplantation. Liberal use of ECMO in these patients should be promoted.

5:35 pm **Executive Session,** *AATS Members Only* Ballroom ABC, Hynes

2:00 pm – 5:35 pm **Aortic/Endovascular Surgery** Room 311, Hynes
Simultaneous Scientific Session
6 minute presentation, 8 minute discussion

Moderators: *Michael A. Borger, *Scott A. LeMaire, *Malakh Shrestha

56. Frozen Elephant Trunk and Total Arch Replacement for Type A Aortic Dissection: Competing Risk Analysis of Long-Term Outcomes in 1063 Patients

Wei-Guo Ma[1], Wei Zhang[1], Xu-Dong Pan[1], Jun Zheng[1], Jian-Rong Li[1], Bulat A. Ziganshin[2], Jun-Ming Zhu[1], *John A. Elefteriades[2], *Li-Zhong Sun[1]

[1]Capital Medical University, Beijing, China; [2]Yale School of Medicine, New Haven, CT

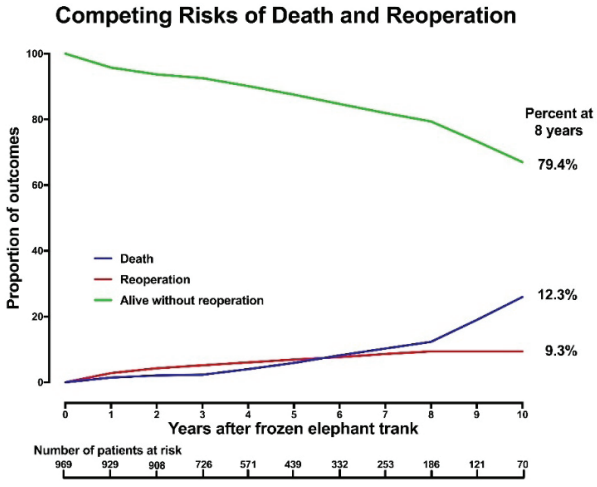
Invited Discussant: *Friedhelm Beyersdorf

Objective: The use of frozen elephant trunk (FET) and total arch replacement (TAR) technique in the management of type A aortic dissection (TAAD) remains controversial due to its technical complexity, potential death and paraplegia risks, and lack of long-term follow-up data. Our early results of FET + TAR have been reported but the long-term outcomes were not studied. We seek to analyze the long-term outcomes of FET + TAR and identify risk factors for late death and reoperation in such patients.

Methods: From April 2003 to August 2013, we performed FET + TAR for 587 acute (55.2%) and 476 chronic (44.8%) TAAD patients (age 46.4 ± 10.7 years; 856 men, 80.5%). Hypertension was seen in 747 (70.3%), Marfan syndrome (MFS) in 106 (10.0%), prior cardiac surgery in 109 (10.3%), and congestive heart failure in 8 (0.8%). Malperfusion syndrome was present in 145 patients (13.6%) (kidney in 12 cases [1.1%], brain 56 [5.3%], limb 85 [8.0%], and ≥2 organs 75 [7.0%]). Composite aortic root replacement was done in 326 patients (30.7%), aortic valve resuspension in 120 (11.3%), sinuses of Valsalva repair in 30 (2.8%), extra-anatomic bypass (EAB) in 54 (5.1%), CABG in 83 (7.8%) and MVR in 16 (1.5%).

Results: Early mortality was 7.2% (77/1063). Complications included spinal cord injury in 23 (2.2%), stroke in 24 (2.3%), renal failure in 52 (4.9%), low cardiac output in 23 (2.2%), reexploration for bleeding in 45 (4.2%), limb ischemia in 10 (0.9%), and distal new entry in 4 (0.4%). Risk factors for early death were acute TAAD (OR: 1.770, $P = 0.048$), age (years) (OR: 1.043, $P = 0.001$), congestive heart failure (OR: 11.643, $P = 0.004$), renal malperfusion (OR: 7.602, $P = 0.004$), malperfusion of ≥2 organs (OR: 2.345, $P = 0.024$), CABG (OR: 2.559, $P = 0.009$), EAB (OR: 4.883, $P < 0.001$), and CPB time (min) (OR: 1.008, $P < 0.001$). By April 2016, follow-up was complete in 98.2% (969/986) at mean 5.4 ± 2.7 years (0.3–13.1). Late death occurred in 100 patients (9.4%) and reoperations were done in 69 (6.5%), including thoracoabdominal aortic repair in 19 (1.8%) and TEVAR in 23 (2.2%). Kaplan-Meier survival and freedom from reoperation were 87.1% and 80.2%, and 93.1% and 90.6% at 5 and 8 years, respectively. Risk factors for late death were MFS (OR: 2.038, $P = 0.015$), chronic TAAD (OR: 1.914, $P = 0.003$) and low cardiac output after FET (OR: 7.916, $P = 0.014$). Risk factors for late reoperation were MFS (OR: 2.367, $P = 0.017$), EAB (OR: 2.990, $P = 0.015$), and acute renal failure after FET (OR: 3.343,

P = 0.022). Competing risk analysis showed that, at 5 and 8 years, the rates of late death and reoperation were 5.8% and 6.7%, and 12.3% and 9.3%; 87.5%, and 79.4% of patients were alive without reoperation, respectively.



Conclusion: The FET + TAR technique has achieved low rates of early death and paraplegia and excellent long-term survival and freedom from reoperation in this large series of patients with TAAD. These results argue favorably for the use of this extensive approach in the management of TAAD.

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57. Epidemiologic Analysis and Descriptive Assessment of Management Strategies for Thoracic Aortic Dissections and Thoracic Aortic Aneurysms — A Population Based Study

R. Scott McClure[1], Susan B. Brogly[2], Katherine Lajkosz[2], Darrin Payne[2], Stephen F. Hall[2], Ana P. Johnson[2]

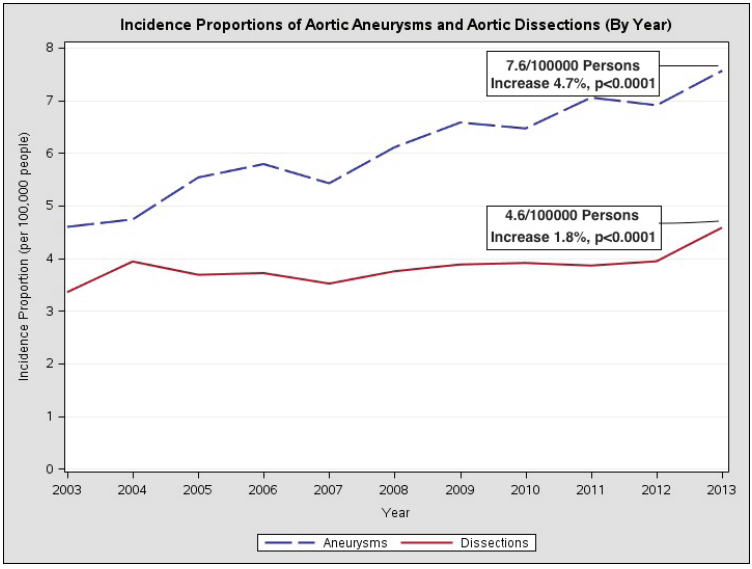
[1]University of Calgary, Calgary, AB, Canada; [2]Queen's University, Kingston, ON, Canada

Invited Discussant: *John A. Elefteriades

Objectives: We sought to determine hospital incidence, mortality, and the proportion of medical, endovascular, and surgical therapy utilized for the management of thoracic aortic dissections and thoracic aortic aneurysms.

Methods: Anonymously linked population-based health information accrued for persons residing in the province of Ontario, Canada (13 million persons) and stored in the Institute for Clinical and Evaluative Sciences (ICES) multilinked databases was queried for 2002–2014. Incident cases of thoracic aortic dissections and thoracic aortic aneurysms were identified. Descriptive data and treatment strategies (medical, endovascular, surgical) were assessed using ANOVA and chi square tests for age and gender differences. Linear and Poisson regression models were used to assess patient and hospital mortality trends over time. Specialty involvement in treatment was also assessed.

Results: There were 5,966 aortic dissections (Type A = 2,289, 38%; Type B = 3,632, 61%; Unknown 45 = 1%). Mean age was 66 ± 17 and 61% were men. Incidence proportion for all aortic dissection was 4.6/100,000 persons (Type A = 1.9/100000 persons; Type B = 2.7/100000). There were 9,392 thoracic aortic aneurysms. Mean age was 67 ± 15 and 64% were men. Incidence proportion for thoracic aortic aneurysms was 7.6/100,000 persons. The incidence of total aortic dissections ($p < .0001$), type A dissections ($p < .0001$) and thoracic aortic aneurysms ($p < .0001$) increased over the 12-year study but did not increase for type B dissections ($p = 0.54$). Only 51% (1,175/2,289) of Type A dissections made it to surgery. Type B dissection treatment was 83% (3,009/3,632) medical, 10% (361/3,632) surgery and 7% (262/3,632) endovascular. Thoracic aortic aneurysm treatment was 51% (4,791/9,392) surgery, 46% (4,278/9,392) medical and 3% (323/9,392) endovascular. Of known descending thoracic aortic aneurysms requiring intervention, 35% (323/924) were treated with a stent graft. Cardiac surgeons performed 83% and 88% of the surgeries respectively for aortic dissections and thoracic aneurysms, whereas vascular surgeons performed 91% of the endovascular procedures. All cause 3-year mortality decreased over the 12-year study period for both aortic dissections (44% to 36%, $p = .005$) and thoracic aneurysms (31% to 24%, $p < .0001$). All cause in-hospital mortality also decreased (aortic dissections from 33% to 28%, $p = .002$; thoracic aortic aneurysms from 9% to 6%, $p = .0002$). Women had worse outcomes than men at all time points over time ($p < .01$).



Conclusions: The incidence of aortic dissections and thoracic aortic aneurysms has increased over time but all cause in-hospital and 3-year outcomes have improved. Gender differences exist with men more likely to incur disease but women having higher mortality relative to men. Surgical management presides primarily with cardiac surgeons whereas endovascular treatment presides primarily with vascular surgeons.

58. Stroke Following Thoracic Endovascular Aortic Repair: Implications for Branched Endovascular Arch Repair

Arnoud V. Kamman[1], Bo Yang[2], David M. Williams[1], Karen M. Kim[1], Minhajuddin Khaja[3], Frans L. Moll[2], Kim A. Eagle[1], Santi Trimarchi[3], *Himanshu J. Patel[1]

[1]University of Michigan, Ann Arbor, MI; [2]University of Utrecht, Utrecht, Netherlands; [3]Policlinico San Donato IRCCS, San Donato Milanese, Italy

Invited Discussant: *Nimesh D. Desai

Objective: Stroke remains a dreaded complication after thoracic endovascular aortic repair (TEVAR). A contemporary assessment of clinical and radiographic factors in its occurrence is timely in the emerging era of branched arch TEVAR.

Methods: Patients undergoing distal arch or descending aorta TEVAR (2006–2015, n = 421) were identified. The mean age was 68.3 ± 14.0 years (52.0% male). Indications for TEVAR included fusiform (n = 189 [44.9%]) or saccular aneurysm (n = 27 [6.4%]), acute (n = 83 [19.7%]) or chronic (n = 40 [9.5%]) dissection, traumatic aortic injury (n = 38, 9.0%) and other indications (n = 44 [10.5%]). Ishimaru proximal landing zones were Zone 2 (n = 191 [45.4%]), Zone 3 (n = 130 [30.9%]), or Zone 4 (n = 100 [23.8%]). Despite an intended strategy of routine left subclavian artery (LSA) revascularization for all Zone 2 coverage, clinical circumstances prevented it in 35 (18.3%). Clinical data and a comprehensive evaluation of preoperative computed tomography, Doppler ultrasonography and intraoperative angiography were performed, including assessment of arch atheroma (≤ or >5 mm) and extracranial and intracranial vasculature.

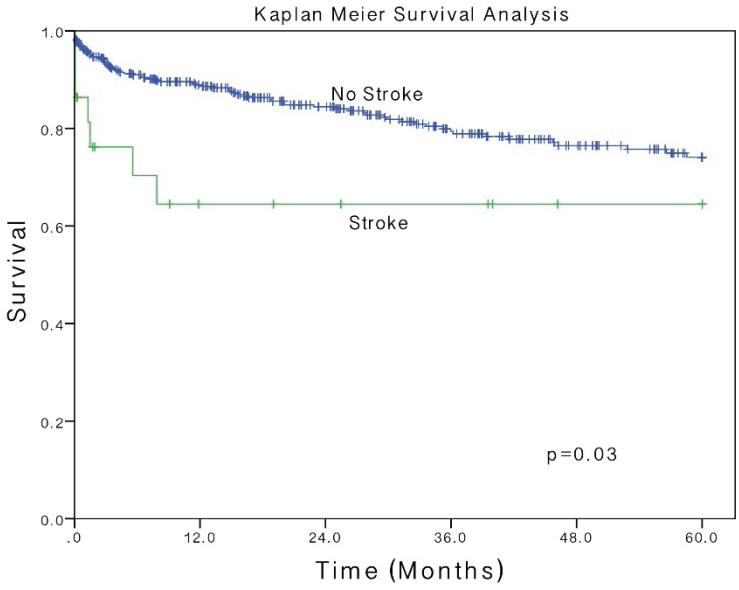


Figure: Kaplan-Meier analysis stratified by postoperative stroke after TEVAR shows a lower 5-year survival in the stroke group (64.7% versus 82.9%, log-rank, p = 0.03).

Results: Stroke occurred in 4.3% (n = 18). Fourteen (3.3%) occurred after TEVAR, 4 (1.0%) after LSA revascularization. Major stroke (modified Rankin Scale >3) was observed in 9 (2.1%). The mechanism was embolic (16), hemorrhagic (1), or related to hypoperfusion (1). Distribution was in the anterior (7), posterior (6), or combined circulation (5). All strokes were in the left hemisphere (11) or bilateral (7). Univariate analysis suggested arch pathology (p = 0.01), need for Zone 2 coverage (p = 0.06), procedural duration (255 ± 122 min vs 217 ± 118 min, p = 0.09), number of implanted components (2.6 ± 1.1 vs 2.0 ± 1.0, p = 0.01), and need for transfusion (p = 0.04) were associated with stroke. Importantly, inability to perform LSA bypass for Zone 2 (p = 0.7), arch atheroma >5 mm (p = 0.3), and an incomplete circle of Willis were not associated with stroke (p = 1.0). Independent predictors by multivariable analysis included arch pathology (OR: 6.107, p = 0.001) and number of implanted components (OR: 2.060, p = 0.001). Stroke occurrence was associated with a higher operative mortality (16.7% vs 4.2%, p = 0.048) and lower 5-year survival (64.7% vs 82.9%, Log-Rank p = 0.03; Figure).

Conclusion: Stroke occurs infrequently after TEVAR but is associated with reduced early and late survival. In this clinical and radiographic evaluation, the finding that it is primarily embolic in nature, and its risk factors relate to the location of underlying pathology and need for additional component implantation may have important implications for device development for the evolving technology of branched endovascular arch repair.

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59. The Impact of Chronic Kidney Disease on Outcomes After Crawford Extent II Thoracoabdominal Aortic Aneurysm Repair in 1003 Patients

*Joseph S. Coselli, Qianzi Zhang, Hiruni S. Amarasekara, Matt D. Price, Susan Y. Green, *Scott A. LeMaire

Baylor College of Medicine, Houston, TX

Invited Discussant: *Leonard N. Girardi

Objective: Patients who have chronic kidney disease (CKD) at the time of thoracoabdominal aortic aneurysm (TAAA) repair are vulnerable to worse outcomes after their surgery. The degree of impact CKD has on the outcomes of patients who undergo the most extensive repairs—who are likely to be at highest risk because of extended ischemic times and frequent visceral artery disease—is unknown. We sought to determine whether preoperative CKD was a predictor of poor outcomes in patients undergoing Crawford extent II TAAA repair.

Methods: CKD was defined as a preoperative estimated glomerular filtration rate (eGFR) less than 60 mL/min/1.73 m^2, in accordance with National Kidney Foundation NDQOI guidelines. We examined data collected prospectively and retrospectively regarding patients who underwent extent II TAAA repair from 1991 to 2016. Patients who were receiving dialysis before surgery (n = 17) and patients without eGFR data (n = 93) were excluded. We used univariate and multivariable analyses to compare patients with CKD (n = 399) and without CKD (n = 604). Adverse event, a composite endpoint, was defined as operative death or persistent stroke, paraplegia, paraparesis, or renal failure necessitating dialysis.

Results: Compared with patients without CKD, patients who presented with CKD were older (70 y [64–74] vs 61 y [48–68], $P < .001$) and had greater rates of comorbidities, including coronary artery disease, cerebrovascular disease, and peripheral vascular disease. Patients without CKD had a higher prevalence of both DeBakey type I (n = 176 [29.1%] vs n = 36 [9.0%]) and type III dissection (n = 193 [32.0%] vs n = 91 [22.8%]) and genetic disorders (n = 160 [26.5%] vs n = 16 [4.0%]). Patients with CKD had more visceral renal procedures (i.e., endarterectomy, stenting, or bypass) than those without (n = 218 [54.6%] vs n = 274 [45.4%]) Patients with CKD had greater rates of operative mortality, adverse event, stroke, renal failure, and spinal cord deficit than those without CKD. Multivariable modeling indicated that CKD independently predicted adverse event (OR: = 1.58, $P = .01$) and renal failure necessitating hemodialysis (OR: = 1.82, $P = .02$) after repair, but CKD was not a predictor of operative mortality. After adjustment for age, patients with CKD had substantially worse long-term survival than those without (74.2 ± 2.2% vs 86.3 ± 1.4% at 1 year and 53.5 ± 2.6% vs 72.0 ± 2.0% at 5 years, $P < .001$).

Table: 1,003 Crawford Extent II TAAA Repairs Stratified by Chronic Kidney Disease

Variable	All (n = 1,003)	With CKD (n = 399)	Without CKD (n = 604)	p-Value
Coronary artery disease	286 (28.5)	136 (34.1)	150 (24.8)	.002
Cerebrovascular disease	169 (16.9)	86 (21.6)	83 (13.7)	.001
Peripheral vascular disease	237 (23.6)	124 (31.1)	113 (18.7)	<.001
Visceral renal endarterectomy, stenting, or bypass	492 (49.1)	218 (54.6)	274 (45.4)	.004
Operative death	94 (9.2)	51 (12.8)	43 (7.1)	.003
Adverse event	186 (18.5)	105 (26.3)	81 (13.4)	<.001
Persistent stroke	33 (3.3)	22 (5.5)	11 (1.8)	.001
Persistent renal failure necessitating dialysis	76 (7.6)	47 (11.8)	29 (4.8)	<.001
Persistent paraplegia or paraparesis	76 (7.6)	40 (10.0)	36 (6.0)	.01

Conclusions: Extensive (extent II) open TAAA repair in patients presenting with CKD carries considerable risk of operative death and other complications. CKD was predictive of adverse events and persistent renal failure in these patients, and was associated with poorer long-term survival.

Aortic Surgery in the 21st Century: Have We Gone Too Far?

*D. Craig Miller, *Stanford University, Stanford, CA*

3:20 pm – 3:55 pm **Coffee Break in the Exhibit Hall**

60. Height Alone (Rather than Body Surface Area) Suffices for Risk Estimation in Ascending Aortic Aneurysm

Mohammad A. Zafar[1], Yupeng Li[2], Sven Peterss[3], John A. Rizzo[2], Paris Charilaou[1], Bulat A. Ziganshin[1], Maryann Tranquilli[1], *John A. Elefteriades[1]

[1]Yale University, New Haven, CT; [2]Stony Brook University, Stony Brook, NY; [3]Ludwig Maximilians University, Munich, Germany

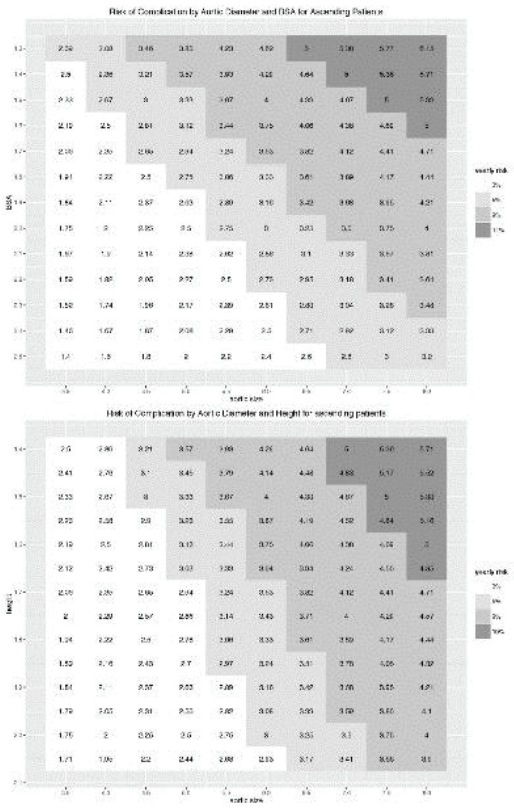
Invited Discussant: *T. Brett Reece

Objectives: In international guidelines, risk estimation for thoracic ascending aortic aneurysm (TAAA) is simply based on raw aortic diameter. Prior work by our group introduced and validated the Aortic Size Index (ASI)—aortic size divided by body surface area (BSA)—as a predictor of dissection, rupture and death. However, a patient's weight might not contribute substantially to aortic size and growth. The aim of this study is to evaluate the height based Aortic Height Index (AHI) for relative aortic size compared to the BSA- based ASI for risk estimation.

Methods: Data on 429 TAAA patients (mean age 61 ± 13 years, 67% male), treated between 1991 and 2015 at a single academic center, were retrospectively reviewed and followed up serially. Aortic diameters were remeasured in a standardized fashion, information regarding complications (rupture, dissection, and death) collected and the ASI (aortic diameter [cm] divided by body surface area [m^2]) as well as the AHI (aortic diameter [cm] divided by height [m]) calculated. Risk stratification analysis was performed and regression models were estimated to compare the predictive value of ASI and AHI.

Results: Patients were stratified into 4 categories of yearly risk of complications (dissection, rupture, and death) based on their ASI and AHI (Figure). The ASIs less than 2.63 cm/m^2, between 2.65 and 3.33 cm/m^2, between 3.41 and 4.71 cm/m^2, and greater than 4.71 cm/m^2 were associated with an annual risk of 3%, 5%, 9%, and 14%. The AHIs less than 2.94 cm/m, between 2.97 and 3.55 cm/m, between 3.57 and 4.71 cm/m and greater than 4.71 cm/m were comparably associated with a 3%, 5%, 9%, and 15% average yearly risk of complications.

Both ASI and AHI were shown to be significant predictors of risk of complications in regression analysis (statistically significant at $p < 0.05$). The variables used to capture risk categories had slightly greater statistical power in the AHI regression model compared to the ASI model. AHI categories 3.00–3.74 cm/m, 3.75–4.49 cm/m, and >4.50 cm/m showed a significantly increased risk with p-values of 0.01, 0.006, and 0.01, respectively. The overall fit of the model using AHI was slightly better, as well.



Conclusion: Measuring aortic size relative to biometric data is valid for risk estimation. Compared to indexes including weight, height-based ratios (excluding weight) yield quite similar results in evaluating the risk of complications in patients with TAAA.

61. Differences in Outcomes Between Mechanical and Non-Mechanical Valve Replacement following Repair of Acute Type A Dissection

Gabriel Loor[1], *Thomas G. Gleason[2], Truls Myrmel[3], Amit Korach[4], Santi Trimarchi[5], *Nimesh D. Desai[6], *Joseph E. Bavaria[6], Carlo De Vincentiis[5], Maral Ouzounian[7], Udo Sechtem[8], Daniel G. Montgomery[9], *Edward P. Chen[10], *Hersh Maniar[11], *Thoralf M. Sundt[12], *Himanshu J. Patel[9]

[1]University of Minnesota, Minneapolis, MN; [2]University of Pittsburgh, Pittsburgh, PA; [3]Tromso University Hospital, Tromso, Norway; [4]Hadassah Hebrew University, Jerusalem, Israel; [5]IRCCS Policlinico San Donato, San Donato, Italy; [6]University of Pennsylvania, Philadelphia, PA; [7]Toronto General Hospital, Toronto, ON, Canada; [8]Robert-Bosch Krankenhaus, Stuttgart, Germany; [9]University of Michigan, Ann Arbor, MI; [10]Emory University, Atlanta, GA; [11]Washington University, St. Louis, MO; [12]Massachusetts General Hospital, Boston, MA

Invited Discussant: *Thomas M. Beaver

Objective: Aortic valve replacement (AVR) is common in the setting of type A aortic dissection repair (TAAD). We sought to evaluate the association between prosthesis choice and outcomes in an international cohort.

Methods: We reviewed the International Registry of Acute Aortic Dissection (IRAD) interventional cohort to determine the relationship of valve choice to short and mid-term outcomes. Isolated leaflet repairs, resuspensions and valve sparing cases were excluded. Reoperation was defined as requiring a subsequent proximal or distal open procedure. A root replacement was defined as requiring either a Bentall, Cabrol or homograft.

Results: Between January 1996 and March 2016, 2,168 patients were entered into the IRAD interventional cohort. 364 patients undergoing TAAD repair required AVR with a mean age of 57 years. Patients requiring AVR were more likely to be male, younger, and more likely to have hypertension, a bicuspid valve and prior cardiac surgery. There was no significant difference in 5-year survival between patients requiring AVR and no AVR (91.4% vs 83.3%, $P = 0.356$) but a trend toward less reoperations (5.2% vs 12.8%, $P = 0.099$). The mechanical valve (MV) cohort consisted of 189 patients, of which, 151 (79.9%) had a root replacement. The nonmechanical valve (NMV) cohort consisted of 5 homografts and 160 biologic AVR with a total of 118 (71.5%) root replacements. Mean follow-up was 2.92 ± 1.75 years overall (2.46 ± 1.69 years for MV and 3.48 ± 1.8 years for NMV). Kaplan-Meier estimates of overall 5-year survival was 84.9% in the MV group compared with 98.3% in the NMV group ($P = 0.019$). There was no significant difference in 5-year freedom from reoperation (92.9% MV vs 96.7% NMV%, $P = 0.29$). The composite outcome of freedom from death, any reintervention (open/endo) or rupture was 80.3% in the MV cohort versus 85.1% in the NMV cohort ($P = 0.54$). Freedom from any progressive aortic dilatation was 40.5% in the MV group compared with 60.9% in the NMV group ($P = 0.16$).

Conclusions: Our study is the largest international cohort analysis comparing the effects of valve choice in patients requiring AVR at the time of TAAD repair. We show superior mid-term survival in patients receiving a biologic valve without a difference in reoperation rates. With the advent of less invasive options for dealing with structural valve degeneration, biologic valve is a reasonable option in TAAD patients requiring AVR.

62. Late Reoperations After Acute Type A Dissection: A Report from the Nordic Consortium for Acute Type A Aortic Dissection (NORCAAD) Study

Emily Pan[1], Ari Mennander[2], Arnar Geirsson[3], Anders Ahlsson[4], Simon Fuglsang[5], Emma Hansson[6], Vibeke Hjortdal[5], Anders Jeppsson[6], Shahab Nozohoor[7], Christian Olsson[8], Anders Wickbom[4], Igor Zindovic7, Tomas Gudbjartsson[3], Jarmo Gunn[1]

[1]University Hospital of Turku, Turku, Finland; [2]University Hospital of Tampere, Tampere, Finland; [3]Landspitali University Hospital, Reykjavik, Iceland; [4]Örebro University Hospital, Örebro, Sweden; [5]Skejby University Hospital, Aarhus, Denmark; [6]Sahlgrenska University Hospital, Gothenburg, Sweden; [7]Skane University Hospital, Lund, Sweden; [8]Karolinska University Hospital, Stockholm, Sweden

Invited Discussant: *Edward P. Chen

Objective: To describe the relationship between extent of repair and late reoperations on the aorta and aortic valve after type A aortic dissection.

Methods: Retrospective cohort study of 30-day survivors (n = 954) treated for type A aortic dissection at eight Nordic cardiothoracic centers between 2005 and 2014. Data was gathered from patient records and national registries. Late reoperations were available for 795 patients and they were divided into 3 groups according to distal anastomoses (ascending aorta, n = 577; hemiarch, n = 180; and total arch, n = 38) and 2 groups for proximal repair (aortic root replacement, n = 175; supracoronary repair, n = 620).

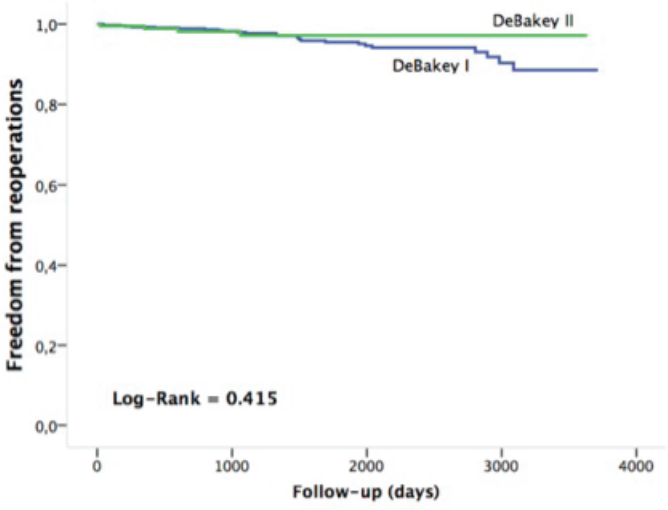


Figure: Freedom from reoperations according to initial DeBakey classification. DeBakey I involves both ascending and descending aorta, and DeBakey II involves alone ascending aorta.

Results: The mean follow-up was 3.7 ± 2.8 years. There were 25 reoperations on the proximal aorta and 30 on the distal aorta in 49 patients. Freedom from any reoperation at 5 years was 93.5%. Freedom from distal reoperation at 5 years was

*AATS Member ◆AATS New Member

95.9%, with no significant difference between groups (p = 0.11) or DeBakey classifications (p = 0.415; Figure). Freedom from proximal reoperation at 5 years was 97.6%, also with no difference between groups (p = 0.92). On Cox regression neither DeBakey classification nor the extent of proximal or distal repair predict freedom from reoperation.

Conclusions: In 30-day survivors surgically treated for acute type A aortic dissection, 5-year freedom from reoperation did not differ significantly irrespective of the initial extent of repair. This suggests that non-extensive repair at initial presentation is sufficient in most cases to ensure freedom from reintervention. However, longer-term or prospective data using stadardized protocols is required to confirm our findings.

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63. Total Aortic Arch Replacement with Frozen Elephant Trunk Technique – Results from Two European Institutes

Alessandro Leone[1], *Davide Pacini[1], Erik Beckmann[2], Andreas Martens[2], Luca Di Marco[1], Antonio Pantaleo[1], *Axel Haverich[2], ◆Roberto Di Bartolomeo[1], *Malakh Shrestha[2]

[1]S.Orsola-Malpighi Hospital, Bologna, Italy; [2]Hannover Medical School, Hannover, Germany

Invited Discussant:

Objective: Because total aortic arch replacement with the frozen elephant trunk (FET) is a complex surgical procedure, only studies with small numbers of patients are found in the literature. Here, we present the results with this technique from the experience of two European institutes.

Methods: Between January 2007 and March 2016, 302 patients were treated with the FET procedure in both institutes. Mean age was 61 ± 12 years with 232 (76.8%) male patients. In this series, two different prostheses have been used: a four-branched and a straight FET prosthesis. Indications for surgery included residual type A dissection (n = 99 [32.8.%]), chronic degenerative aneurysm (n = 93 [30.8%]), acute type A dissection (n = 65 [21.5%]), chronic type B dissection (n = 29 [9.6%]), chronic type A dissection (n = 12 [4%]), and acute type B dissection (n = 4 [.3%]). One hundred twenty-five cases (41.4%) were redo operations. Brain protection was achieved by antegrade selective cerebral perfusion (ASCP) and moderate hypothermia (26°C) in all cases.

Results: Seventy-seven patients (25.5%) underwent aortic root surgery, 39 (13%) received coronary artery bypass graft (CABG), and 33 (11%) aortic valve replacement. In-hospital mortality was 14.2% (43 patients). The mean cardiopulmonary bypass time was 235.2 ± 68 min, whereas mean cardiac ischemia, visceral ischemia, and ASCP times were 135.6 ± 59, 60 ± 20, and 90 ± 30 minutes, respectively. Postoperatively, permanent neurological deficit occurred in 31 (10.3%) patients, paraplegia in 19 (6.3%) patients, whereas renal failure, considered as temporary and permanent dialysis in 52 patients (17.2%). The mean ICU stay was 8.8 ± 11.5 days. Independent risk factors for mortality were re-thoracotomy for bleeding and postoperative dialysis, whereas CABG and re-thoracotomy for bleeding were risk factors for postoperative dialysis. Moreover, the four-branched FET prosthesis showed significantly lower cardiac and visceral ischemia times. Follow-up was 100% complete, the 1-year mortality rate was 12.4%, 43/259 (16.6%) patients

required endovascular completion at 8.1 ± 8.3 months after the first procedure, with 100% technical and procedural success.

Conclusions: The frozen elephant trunk technique has been increasingly used in the past decade; however, even if it remains a high-risk procedure, especially for complex aortic pathology, may offer a combined treatment for patients with complex disease of the thoracic aorta. Also, short-term results are favorable; however, long-term follow-up is warranted.

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64. Valve Sparing Root Replacement in Patients with Bicuspid Versus Tricuspid Aortic Valves

Maral Ouzounian, *Christopher M. Feindel, Cedric Manlhiot, Carolyn David, *Tirone E. David

University of Toronto, Toronto, ON, Canada

Invited Discussant: *Lars G. Svensson

Objectives: We sought to compare the outcomes of patients with bicuspid (BAV) versus tricuspid (TAV) aortic valves undergoing aortic valve-sparing surgery.

Methods: A total of 408 consecutive patients (BAV, n = 47; TAV, n = 361) underwent valve-sparing root replacement from 1988 through 2012 at a single institution. BAV patients were younger (40 ± 13 vs 48 ± 15, p < 0.001), were less likely to have NYHA III/IV heart failure (0% vs 17.5%, p = 0.007), and less likely to have Marfan syndrome (8.5% vs 44.3%, p < 0.001) that those with TAV. Patients were followed prospectively with aortic root imaging for a median of 8.4 (5.4–12.9) years.

Results: Reimplantation of the aortic valve was used in the majority of patients (BAV: 95.7%, TAV: 79.8%, p = 0.005); the remaining patients underwent the remodeling procedure. Primary leaflet repair was required more often in patients with BAV (79.6% vs 40.4%, p < 0.001). Specifically, more patients with BAV required cusp plication (BAV: 77.3% vs TAV: 33.4%, p < 0.001), whereas reinforcement of the free margin with Gore-Tex suture was similar between groups (BAV: 23.8% vs TAV: 26.5%, p = 0.85). Fewer patients with BAV underwent concomitant aortic arch replacement at the time of root surgery (12.2% vs 16.1%, p = 0.003). A total of 4 operative deaths occurred (BAV 0% vs TAV 1.4%, p = 0.001). Overall survival at 1, 5, and 10 years was higher in the BAV group (BAV: 100%, 100%, 100%; vs TAV: 96.9% [95.1–98.7], 93.9% [91.4–96.4], 86.6% [82.5–90.8]; p = 0.035). Cumulative rates of reoperation at 1, 5, and 10 years were similar between groups (BAV: 0%, 0%, 3.9% [0.3–16.8]; vs TAV: 0.3% [0.03–1.5], 0.3% [0.03–1.5], 2.2% [0.8–4.8]; p = 0.93). Similarly, cumulative rates of moderate or severe aortic insufficiency at 1, 5, and 10 years were similar between groups (BAV: 0%, 0%, 14.9% [2.2–38.9]; vs TAV: 0.3% [0.03–1.5]; 0.9% [0.3–2.5]; 3.7% [1.8–6.7]; p = 0.24). Following stratification of patients into tertiles of risk based on a propensity score, long-term freedom from death, aortic valve reoperation, and moderate or severe aortic insufficiency were similar between groups.

Conclusions: Although patients with BAV require more concomitant cusp repair, valve-sparing root replacement offers excellent clinical outcomes with both bicuspid and tricuspid valves.

65. The Fate of Abdominal Aorta After TEVAR in Chronic Debakey IIIb Aneurysms and Risk Factor Analysis – Is Residual Abdominal Aortic Dissection Stabilized After TEVAR?

Tae-Hoon Kim, Suk-Won Song, Kwang-Hun Lee, Min-Young Baik, Kyung-Jong Yoo, *Bum-Koo Cho

Yonsei University College of Medicine, Seoul, Republic of Korea

Invited Discussant:

Objective: Although thoracic endovascular aortic repair (TEVAR) is commonly used for chronic DeBakey IIIb (CDIIIb) aneurysm, the fate of abdominal aorta is poorly defined. We sought to identify the unfavorable factors for abdominal aortic expansion after TEVAR in patients with CDIIIb aneurysm.

Method: From 2012 to 2016, 70 patients underwent TEVAR for CDIIIb aneurysm. Twenty-nine patients underwent only TEVAR (TEVAR group) and 41 patients needed additional false lumen procedures (FLP) besides TEVAR (FLP group). Abdominal aortic diameter was measured at 3 different levels (celiac trunk [level A], renal artery [level B] and infrarenal aorta [level C]). Aortic expansion was defined as increase of total diameter (>5 mm) at each level (A, B, and C) and the aortic growth rate was defined as the absolute value of diameter change divided by imaging follow-up duration.

Result: There was no in-hospital mortality. Mean follow-up, and imaging follow-up duration was 26, and 17 months, respectively. Twenty-six (89.7%) of 29 patients in TEVAR group demonstrated complete thrombosis. Even though complete thrombosis was achieved, 5 (19.2%), 4 (15.4%) and, 7 (26.9%) of 26 patients demonstrated abdominal aortic expansion (>5 mm) at level A, B, and C, respectively. In TEVAR group, the mean aortic growth rate was 3.5 ± 5.7, 3.0 ± 4.6 and 4.3 ± 5.8 mm/yr at A, B, and C and there was no difference in the aortic growth rate between complete and partial thrombosis group (Figure A). Aorta remodeling at level C was significantly better in patients with FLP (–18.9 ± 66.9 vs 9.3 ± 8.7 mm/yr, p = 0.049) (Figure B). The number of intima tears was the independent risk factor for infrarenal aortic expansion (OR: 1.927, 95% CI [1.287–2.883], p = 0.001) (Table).

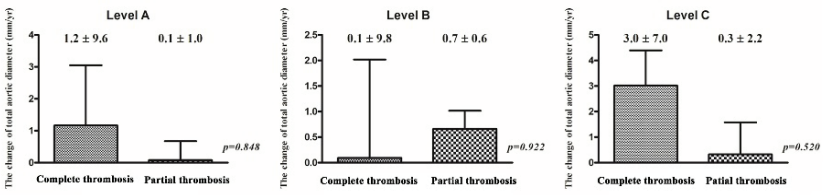


Figure 1: A) Comparison of the rate of aortic diameter change at 3 levels between complete thrombosis and partial thrombosis patients.

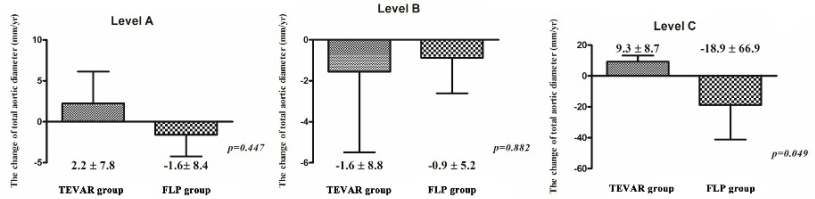


Figure 1: B) Comparison of the rate of l aortic diameter change at 3 levels between TEVAR group and FLP group.

Level A; celiac trunk, Level B; renal artery, Level C; maximum diameter of infrarenal aorta, TEVAR; thoracic endovascular aortic repair, FLP; false lumen procedure.

Table: Risk-Factor Analysis for Infrarenal Abdominal Aorta Growth.

	Aortic Growth (Infrarenal)			
Risk-Factor Analysis	**Yes (n = 45)**	**No (n = 25)**	*p-Value*	**Multivariate Regression OR (95% CI)**
Age, mean (SD), y	53.3 ± 11.0	57.6 ± 12.4	*0.137*	*P = 0.110* *OR: 0.958 [0.910–1.010]*
Male sex	34 (75.6)	21 (84)	*0.548*	
HTN	39 (86.7)	19 (76)	*0.325*	
DM	6 (13.3)	0 (0)	*0.082*	*p = 0.999*
CKD	1 (2.2)	1 (4)	*1.0*	
Smoking	20 (44.4)	14 (56)	*0.456*	
CAOD	4 (8.9)	0 (0)	*0.289*	*p = 0.999*
COPD	2 (4.4)	0 (0)	*0.534*	
Marfan SD	2 (4.4)	1 (4)	*1.0*	
Previous aortic surgery	25 (55.6)	11 (44)	*0.456*	
Supra-celiac stent deployment	32 (71.1)	16 (64)	*0.597*	
Complete thrombosis	39 (86.7)	22 (88)	*1.0*	
Pre-op aortic diameter (mm)				
Celiac	37.0 ± 6.9	36.1 ± 5.9	*0.592*	
Renal	31.9 ± 6.5	31.0 ± 5.7	*0.583*	
Max of infrarenal	31.2 ± 6.7	31.5 ± 13.3	*0.905*	
Intima tears (No.)	3.1 ± 2.1	1.6 ± 1.6	*0.002*	*p = 0.001* *OR: 1.927 [1.287–2.883]*
Large intima tears (No.)	0.8 ± 0.7	0.8 ± 1.0	*0.939*	
Visceral branches from FL (No.)	1.3 ± 1.0	1.3 ± 1.2	*0.848*	
False lumen procedure	26 (57.8)	15 (60)	*1.0*	

Conclusion: Abdominal aortic expansion in CDIIIb aneurysm can be frequently recognized even after successful TEVAR. The number of intima tears is the only risk factor of abdominal dissecting aneurysmal change. We suggest abdominal aorta should be carefully evaluated and additional procedures on the FL might be needed.

5:35 pm **Executive Session,** *AATS Members Only* Ballroom ABC, Hynes

2:00 pm – 5:35 pm **Congenital Heart Disease** Room 312, Hynes
Simultaneous Scientific Session
8 minute presentation, 10 minute discussion
Moderators: *Charles B. Huddleston and Damien J. LaPar

Insights from the Congenital Heart Surgeons' Society Anomalous Coronary Artery Database
*Marhsall L. Jacobs, Johns Hopskins Hospital, Baltimore, MD

66. Patients with Anomalous Aortic Origin of the Coronary Artery Remain at Risk Even After Surgical Repair

Shannon N. Nees, Jonathan N. Flyer, Anjali Chelliah, Jeffrey D. Dayton, David Kalfa, ◆Paul J. Chai, *Emile A. Bacha, Brett R. Anderson
Columbia University, New York, NY

Invited Discussant: *Ralph S. Mosca

Objective: Anomalous aortic origin of the coronary artery (AAOCA) is a rare anomaly associated with sudden cardiac death (SCD). Single-center studies describe surgical repair as safe, though medium- and long-term effects on symptoms and SCD risk remain unknown. We sought to describe medium-term outcomes of surgical repair of AAOCA.

Methods: We reviewed institutional records for patients who underwent surgery for AAOCA, 2001–2016. Follow-up data were obtained via phone calls and written questionnaires to patients and cardiologists. Patients with associated heart disease were excluded.

Results: In total, 45 patients underwent surgery for AAOCA (24 left, 21 right). Median age was 15.4 years (IQR: 11.8–19.1 yrs, range: 4 mos to 68 yrs). Most common symptoms were chest pain (n = 25 [56%]) and shortness of breath (SOB) (n = 13 [29%]). Cardiac arrest was the presenting symptom in 5 (11%) patients. Coronary unroofing was performed in 42 (93%), coronary translocation in 2 (4%) and removal of a fibrous sheath in 1 (2%). Early post-operative complications occurred in 10 (22%) patients, including post-pericardotomy syndrome (n = 6 [13%]), supravalvar aortic stenosis (n = 1 [2%]), transient arrhythmia (n = 1 [2%]), pleural effusion (n = 1 [2%]) and sternal wound infection (n = 1 [2%]). One patient who presented post-arrest went to and returned from the operating room on ECMO. Median length of stay was 4 days (IQR: 4–5, range: 3–42 days). Follow-up data were available for 38 (84%) patients over a median of 1.1 years (IQR: 0.3–3.0 yrs, range: 10 days to 9 yrs). Of 32 patients with symptoms at presentation, 23 (72%) had resolution post-operatively. Of 6 patients who were initially asymptomatic, 4 (67%) developed post-operative symptoms. Of those with follow-up testing, 1/32 (3%) had evidence of ischemia on ECG and 4/25 (16%) had evidence of ischemia on stress test. Of 4 patients with abnormal stress tests, 1 (25%) had SOB with exertion

and is currently exercise restricted and 3 (75%) were asymptomatic and cleared for exercise. Two (4%) patients required reoperation. The first experienced a cardiac arrest 6 years post-surgery despite a negative stress test. Noninvasive imaging was concerning for stenosis. Intraoperative examination revealed fibrosis around the left coronary orifice. The second patient had recurrent chest pain 3 months post-surgery. Significant stenosis was found at the anomalous left coronary orifice on catheterization and coronary bypass was performed. Both patients were asymptomatic at 0.5 and 3 years after the second operation, respectively.

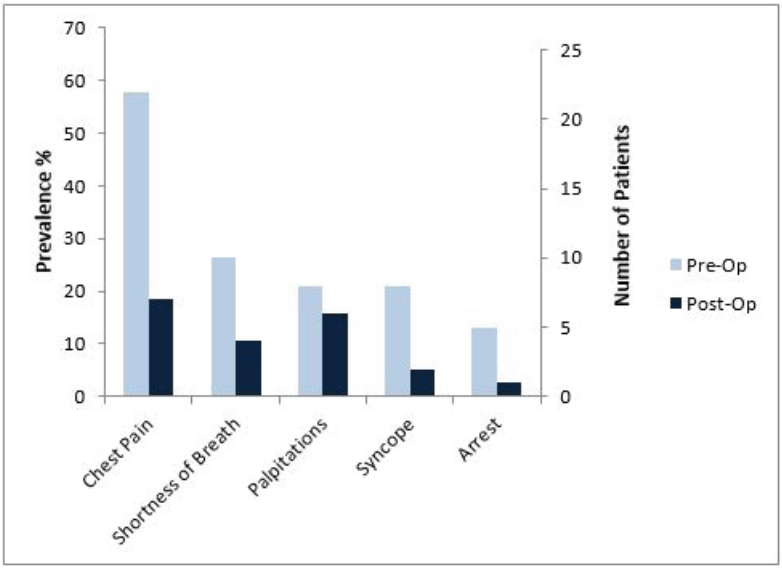


Figure 1. *Change in symptoms of ischemia.* Bar chart depicts the change in prevalence of symptoms pre- and post-operatively. Includes patients in whom both pre- and post-operative data are available (n=38).

Conclusions: Surgical repair of AAOCA is generally safe and significant early post-operative complications are rare. Restenosis of the anomalous coronary orifice can occur and patients may be at risk of SCD even after operative repair. Patients should be monitored longitudinally for signs and symptoms of ischemia, though current testing might not always predict clinical events.

67. Selection of Prosthetic Aortic Valve and Root Replacement in Young Patients Less Than Thirty Years of Age

Rita K. Milewski, Andreas Habertheuer, *Joseph E. Bavaria, Stephanie Fuller, *Wilson Szeto, *Nimesh Desai, Varun Korutla, Prashanth Vallabhajosyula

University of Pennsylvania, Philadelphia, PA

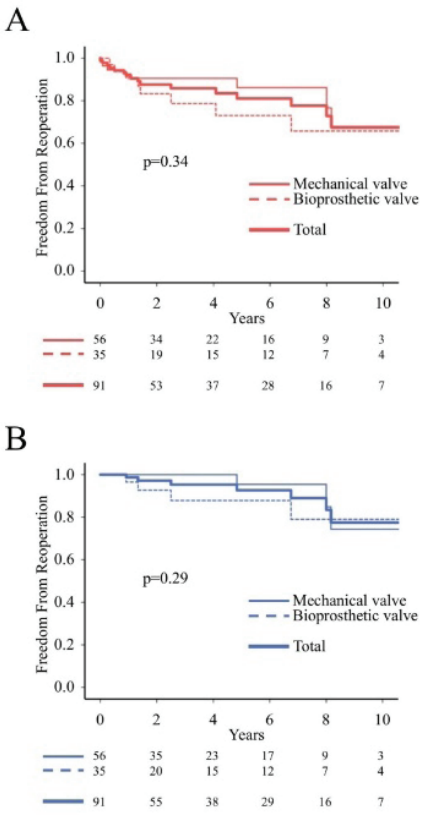
Invited Discussant: *Glen Van Arsdell

Objective: Valve repair or replacement with pulmonary autograft is an established option for young patients with aortic valve disease with or without ascending aortopathy. However, long-term outcomes in young patients undergoing prosthetic aortic valve/root replacement are not well studied. We assessed our single institution experience with prosthetic aortic valve/root replacement in patients age less than 30 years.

Methods: From 1998 to 2016, 91 patients (n = 54/91, 59.3% with bicuspid aortic valve) between the ages of 16 and 29 (mean age 25.0 ± 2.9 years, 70.3% male) underwent aortic valve (AVR, n = 51/91), aortic valve and supracoronary aorta (AVSAAR, n = 4/91), or aortic root (ARR, n = 36/91) replacement. Freedom from reoperation was evaluated both by inclusion and exclusion of endocarditis events. Total follow-up was 396 patient years. Prospectively maintained aortic valve database was retrospectively reviewed.

Results: Indications included primary aortic stenosis/insufficiency in 61.5% (n = 56/91), Marfan syndrome in 11.0% (n = 10/91), and endocarditis in 27.5% (n = 25/91). Indications for reoperation included patient-prosthesis mismatch in 2.2% (n = 2/91), prosthetic valve degeneration in 7.7% (n = 7/91), and prosthetic valve endocarditis in 9.9% (n = 9/91). The 30-day/ in-hospital mortality was 3.3 % (n = 3/91), all endocarditis cases. Stroke rate was 1.1% (n = 1/91, mechanical) and renal failure was 1.1% (n = 1/91, biovalve). Overall valve replacement included 38.5% (n = 35/91) bioprosthetic/biologic and 61.5 % (n = 56/91) mechanical valves. There was a trend towards improved in-hospital survival in patients receiving bioprosthetic valve (p = 0.07). Median follow-up was 52.24 months. Overall freedom from aortic valve reoperation at 1, 5, and 10 years was: 92%, 81%, 67% including endocarditis cases, and 99%, 93%, 77% excluding endocarditis cases. There was no significant difference in reoperation between bioprosthetic/biologic and mechanical valves either including (log rank p = 0.34) (Figure A) or excluding (log rank p = 0.29) endocarditis cases (Figure B). Overall survival at 1, 5, and 10 years was 94%, 94%, 89%, with increased mortality in prosthetic valve endocarditis cases (1- and 5-year survival of 56% and 56%) (p < 0.0001). Mid- and long-term survival (exclusive of endocarditis) was similar in patients with mechanical versus bioprosthetic/ biologic valves (mechanical = 94% and 86% and bioprosthetic/biologic = 94% and 94%, respectively at 5 and 10 years, log rank p = 0.8).

Figure 1 Freedom from reoperation (A) inclusion of endcarditis events (B) exclusion of endocarditis events



Conclusions: Aortic valve and root replacement is associated with good long-term freedom from aortic valve reoperation and survival in patients under 30 years. The choice of mechanical versus biological valve does not affect freedom from reoperation rates in this young cohort at 10 years. It will be important to understand >20% reoperative rate at 10 years in this young patient cohort.

3:20 pm – 3:55 pm **Coffee Break in the Exhibit Hall**

68. Outcomes of the Arterial Switch Operation in ≤2.5 kg Neonates: A 10 Year Study

Michael Salna, ◆Paul J. Chai, David M. Kalfa, Yuki Nakamura, Ganga Krishnamurthy, Marc Najjar, Amee Shah, Stephanie Levasseur, Brett R. Anderson, *Emile A. Bacha

Columbia University, New York, NY

Invited Discussant: *V. Mohan Reddy

Objectives: While low birth weight is a known risk factor for mortality in congenital heart lesions and may consequently delay surgical repair, outcomes in low weight neonates undergoing the arterial switch operation (ASO) have not been well described. Our primary objective was to determine whether there were any differences in outcomes between infants weighing less than or equal to 2.5 kg and those weighing more than 2.5 kg at the time of surgery.

Methods: We retrospectively analyzed outcomes in low weight neonates (weighting less than or equal to 2.5 kg) undergoing the arterial switch operation from 2005 to 2014 at our institution. In-hospital and long-term mortality, post-operative complications, the need for early reintervention, and post-operative lengths of stay were assessed as outcomes. The mean follow-up time was 33.0 ± 41.7 months.

Table: Characteristics and Outcomes of ASO Patients Stratified by Operative Weight

	Overall (n = 220)	**>2.5 kg (n = 189)**	**≤2.5 kg (n = 31)**	**p-Value**
Age at operation (days)	6 (4–8)	6 (4–8)	6 (4–11)	0.229
Male gender (%)	135 (61.4%)	117 (61.9%)	18 (58.1%)	0.695
Birth weight (kg)	3.26 (2.80–3.52)	3.31 (3.02–3.59)	2.38 (1.88–2.49)	**<0.001**
Weight at operation (kg)	3.22 (2.80–3.60)	3.34 (3.00–3.64)	2.30 (1.95–2.40)	**<0.001**
Premature birth (%)	29 (13.2%)	14 (7.4%)	15 (48.4%)	**<0.001**
TGA subtype (%)				0.259
TGA, intact ventricular septum	123 (55.9%)	107 (56.6%)	16 (51.6%)	
TGA, ventricular septal defect	71 (32.3%)	57 (30.2%)	14 (42.8%)	
TGA, VSD LVOTO	1 (0.5%)	1 (0.5%)	0 (0%)	
Taussig-Bing	25 (11.3%)	24 (12.7%)	1 (3.2%)	
Patient Outcomes				
Complications (%)				
Cardiovascular	35 (15.9%)	30 (15.9%)	5 (16.1%)	1.000
Pulmonary	11 (5.0%)	9 (4.8%)	2 (6.5%)	1.000
Neurologic	6 (2.7%)	4 (2.1%)	2 (6.5%)	0.201
Vocal cord paralysis	13 (5.9%)	11 (5.8%)	2 (6.5%)	1.000
Sepsis	3 (1.4%)	3 (1.6%)	0 (0%)	1.000
Early reintervention (%)	3 (1.4%)	2 (1.1%)	1 (3.2%)	0.367
In-hospital mortality (%)	5 (2.3%)	4 (2.1%)	1 (3.2%)	0.536
Post-op ICU length of stay (days)	9 (6–14)	8 (6–13)	14 (7–18)	**0.010**
Total length of stay (days)	14 (11–20)	14 (11–20)	19 (13–26)	**0.002**
Post-discharge mortality (%)	0 (0%)	0 (0%)	0 (0%)	1.000

ASO = Arterial Switch Operation; VSD = Ventricular Septal Defect; LVOTO = Left Ventricular Outflow Tract Obstruction. Data are presented as median (interquartile range) unless otherwise specified.

Results: A total of 220 neonates underwent the arterial switch operation from 2005 to 2014 with 31 (14%) patients weighing ≤2.5 kg at the date of surgery. Neonates weighing ≤2.5 kg at surgery had significantly lower birth weights and were more likely to be premature but there was no difference in age at the time of surgery between the two groups. In-hospital mortality was 3.2% (n = 1) in the ≤2.5 kg group compared with 2.1% (n = 4) in the >2.5 kg group (p = 0.536) with no surgeon-specific differences. Compared with neonates >2.5kg, the low weight group had significantly longer post-operative ICU lengths of stay (median: 19 days [IQR: 13–26 days] vs 14 days [IQR: 11–20 days]). Rates of early reintervention and post-operative complications were also comparable between the two groups (Table 1). Amongst a cohort of eight neonates weighing <2.0 kg, in-hospital mortality occurred in one patient but there was a significantly higher incidence of cardiovascular complications compared with patients weighing >2kg (n = 4 [50%] vs n = 31 [15%], p = 0.024). There was no mortality in any of the patients at the date of most recent follow-up.

Conclusion: The arterial switch operation can be performed safely in neonates weighing less than 2.5 kg and yields comparable results to infants weighing more than 2.5 kg. Imposed delays for corrective surgery may not be necessary for low weight infants with transposition of the great arteries.

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69. Reoperation for Coronary Artery Stenosis After Arterial Switch Operation

Joon Chul Jung, Eung Re Kim, Ji Hyun Bang, Jae Gun Kwak, Woong-han Kim

Seoul National University Hospital, Seoul, Republic of Korea

Invited Discussant: *Charles D. Fraser, Jr.

Objective: Coronary artery stenosis can be a cause of delayed reoperation after arterial switch operation (ASO). We investigated freedom from reoperation, risk factors for reoperation and results of reoperation.

Methods: Between 2003 and 2016, 77 consecutive patients who underwent arterial switch operation and survived early postoperative period were included. We reviewed their diagnosis, coronary artery pattern, coronary artery anomaly, coronary artery transfer technique for risk-factor analysis. We analyzed reoperation techniques and operative results.

Results: Diagnosis included d-TGA with IVS (32/77 [41.6%]), d-TGA with VSD (32/77 [41.6%]), d-TGA with CoA (4/77 [5.2%]), d-TGA with IAA (3/77 [3.9%]), Taussig-bing anomaly (2/77 [2.6%]), Taussig-bing anomaly with CoA (3/77 [3.9%]), Taussig-bing anomaly with IAA (1/77 [1.3%]). Coronary artery pattern included usual (1AD,Cx;2R, 61/77 [79.2%]), LCx from RCA (1AD;2Cx,R, 5/77 [6.5%]), inverted (1R;2AD,Cx, 4/77 [5.2%]), intramural left main coronary artery (LMCA) (2AD,Cx;2R, 3/77 [3.9%]), single LCA (1AD,Cx,R, 2/77 [2.6%]), single RCA (2AD,Cx,R, 2/77 [2.6%]). Coronary artery anomaly included intramural LMCA (3/77 [3.9%]) and high take-off LMCA (2/77 [2.6%]). Coronary artery transfer technique included Trap door (68/77 [88.3%]), punch out (5/77 [6.5%]), modified Aubert (3/77 [3.9%]), tube reconstruction (1/77 [1.3%]). There was no late death during follow-up period. Total 6 patients underwent reoperation for coronary artery stenosis. Freedom from reoperation at 5-year and 10-year were 93.9% and 89.4%. In multivariate analysis, intramural

LMCA and high take-off LMCA were significant risk factors for reoperation (relative hazard ratio 14.3 (95% CI [2.1–96.4], p = 0.006) and 36.4 (95% CI [2.7–482.2], p = 0.006)). Reoperation techniques included coronary artery os un-roofing (3/6 [57.1%]), cut-back angioplasty (1/6 [14.3%]), ostioplasty (2/6 [28.6%]). All patients who underwent un-roofing for intramural LMCA and cut-back angioplasty had no acute complication, death, or restenosis during 23.0–62.6 months of follow-up period. However, two patients who underwent ostioplasty needed additional reoperation for coronary artery restenosis within 2 months.

Conclusion: In arterial switch operation, intramural LMCA and high take-off LMCA were significant risk factors for reoperation. In patients with intramural LMCA, coronary artery os un-roofing can be considered during initial arterial switch operation. The results of reoperation were good with un-roofing and cut-back angioplsaty techniques.

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70. Laryngeal Ultrasound Detects a High Prevalence of Vocal Cord Paresis After Aortic Arch Repair in Neonates and Young Children

Melissa G.Y. Lee, Johnny Millar, Elizabeth Rose, Aleesha Jones, Dora Wood, Taryn L. Luitingh, Johann Brink, *Igor E. Konstantinov, ◆Christian P. Brizard, *Yves d'Udekem

Royal Children's Hospital, Parkville, Australia

Invited Discussant: *Scott A. Bradley

Objective: To determine, 1) the prevalence of vocal cord paresis after aortic arch repair or Norwood-type procedure via sternotomy, and 2) the effectiveness of non-invasive laryngeal ultrasound in detecting vocal cord paresis compared with gold standard invasive laryngoscopy.

Methods: Twenty-seven patients who had an aortic arch repair (22/27 [81%]) or Norwood-type procedure (5/27 [19%]) via sternotomy between April 2015 and October 2016 underwent a laryngeal ultrasound 48–72 hours after endotracheal extubation. Fourteen patients (14/27, 52%) also consented to a laryngoscopy. Primary arch diagnoses were coarctation of the aorta in 52% (14/27), isolated hypoplastic aortic arch in 22% (6/27), hypoplastic left heart syndrome in 15% (4/27), and interrupted aortic arch in 11% (3/27). Median age at surgery was 5 days (IQR: 3–10). Median intubation time was 3 days (IQR: 2–8). Two patients (2/27, 7%) required an arch reoperation for arch reobstruction prior to extubation.

Results: Left vocal cord paresis was present in 58% (14/24) and 57% (8/14) on laryngeal ultrasound and laryngoscopy, respectively, and an additional 3 patients had an inconclusive result on laryngeal ultrasound (Figure). The degree of vocal cord paresis on laryngeal ultrasound was partial in 29% (4/14) and full in 71% (10/14). There was agreement between the results of laryngoscopy and the results of laryngeal ultrasound in all cases. Patients who required preoperative endotracheal intubation had a higher prevalence of vocal cord paresis on laryngeal ultrasound compared to patients who did not require preoperative intubation (100% [7/7] vs 41% [7/17], p = 0.02). After excluding the 7 patients who required preoperative intubation, patients who underwent an arch repair had a higher prevalence of vocal cord paresis on laryngeal ultrasound compared to patients who underwent a Norwood-type procedure (54% [7/13] vs 0% [0/4], p = 0.1).

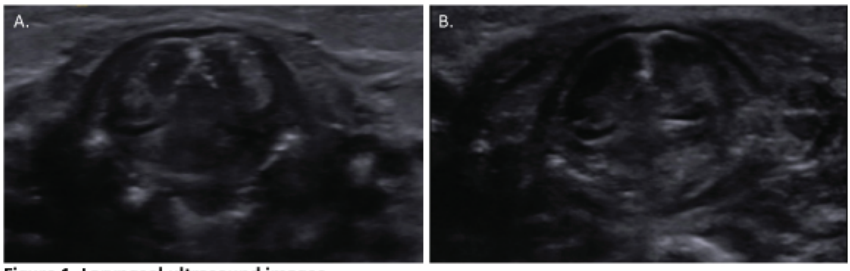

Figure 1. Laryngeal ultrasound images
A. Normal vocal cord function – symmetrical abduction
B. Left vocal cord paresis – asymmetrical abduction

Conclusions: There is a high prevalence of vocal cord paresis after aortic arch repair via sternotomy. Strategies to preserve left recurrent laryngeal nerve function should be explored. Laryngeal ultrasound seems to be an effective and noninvasive method to detect vocal cord paresis in neonates and young children.

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71. Management of Aortic Aneurysms Following Repair of Congenital Heart Disease

*Christian Pizarro, Gina M. Baffa, Majeed A. Bhat, Ryan Robert Davies, Kristi Fitzgerald
Alfred I. duPont Hospital for Children, Wilmington, DE

Invited Discussant: *Duke E. Cameron

Objective: Progressive aortic root dilatation has been documented during follow-up of children after repair of congenital heart disease (CHD). A significant knowledge gap exists regarding the natural history and management of this issue. We report our early experience with surgical intervention for aortic root dilatation following surgery for CHD.

Methods: Contemporary review of indications, timing of surgery and outcomes among patients with aneurysmal dilatation of the aortic or neo-aortic root following repair of CHD who underwent surgical intervention at a single institution (2005–2015). Patients with known connective tissue disorders were excluded.

Results: Nineteen patients underwent aortic intervention following surgery for CHD at a median age of 14 years (5–21) and median weight of 46.8 (20–103). The most common congenital diagnosis was HLHS in 7, transposition of the great arteries in 6, and aortic coarctation/IAA in 4 patients. Previous intervention included Fontan completion in 7, aortic valvuloplasty in 5, arterial switch procedure in 4 and repair of aortic arch/coarctation in 4 patients. Ten patients had an abnormal aortic valve (bicuspid 8, unicuspid 2). Median aneurysm size was 48 mm (40–70); aortic root and ascending aorta z-scores were 6.2 (4.4–13) and 6.4 (5.4–9.5), respectively. Indications for intervention included progressive aortic dilatation in all, plus significant aortic or neo-aortic valve regurgitation in 10, aneurysmal growth in 8, pulmonary artery stenosis in 6, recurrent chest pain in 2 and tracheal compression in 1. A valve-sparing aortic root replacement and a Bentall were the procedures most commonly performed (7 cases respectively). A tailoring procedure was performed in 4 patients. Associated procedures were common, including aortic arch

replacement in 9, pulmonary arterioplasty in 5, a tricuspid valve repair, cryo Maze and Konno in 1. Histological findings included moderate to severe cystic medial degeneration and micro-dissection. A genetic abnormality associated with aneurysmal disease was newly identified in 5 cases. Median cardiopulmonary bypass and aortic cross clamp were 194 (103–264) and 105 minutes (62–172), respectively. Median ICU and hospital stay were 2 (1–4) and 7 (5–12) days. There was no operative mortality. At median follow up of 58 months, there were three late deaths, all survivors remain in functional class I and free of aortic regurgitation.

Conclusions: Despite high complexity, management of aortic aneurysmal disease following repair of CHD can afford excellent outcomes. Use of valve-sparing root techniques can effectively restore aortic and neo-aortic valve competency. Genetic screening should be performed routinely in order to inform timing of intervention and subsequent screening for aneurysmal disease.

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72. Outcomes of Patients Undergoing Surgical Repair of Multiple Ventricular Septal Defects: A 22-Year Study of 157 Patients

Michael Daley[1], ◆Christian P. Brizard[1], *Igor E. Konstantinov[1], Johann Brink[1], Andrew Kelly[2], Bryn O. Jones[1], Diana Zannino[3], *Yves d'Udekem[1]

[1]Royal Children's Hospital, Melbourne, Australia; [2]Women's and Children's Hospital, Adelaide, Australia; [3]Murdoch Children's Research Institute, Melbourne, Australia

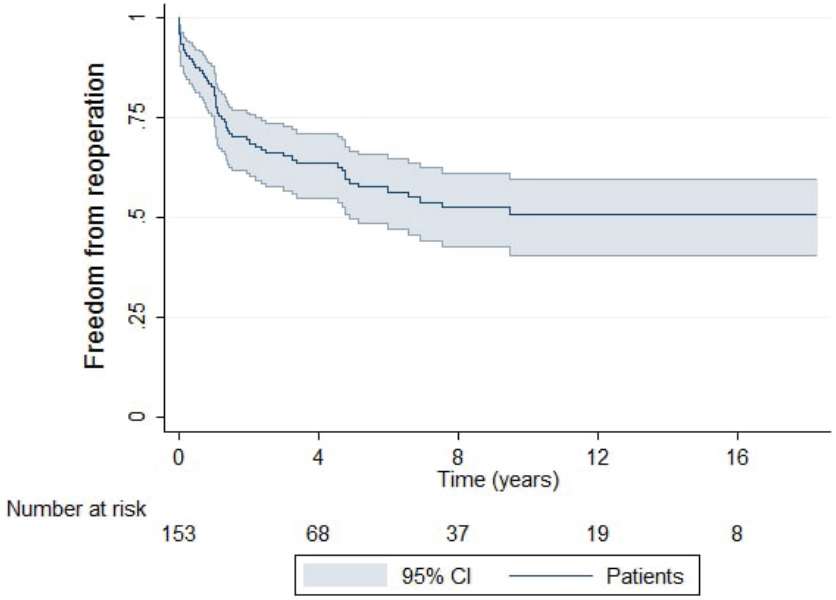
Invited Discussant: *Richard D. Mainwaring

Objective: Surgical treatment of multiple ventricular septal defects (VSDs) remains technically challenging. Residual defects, complete heart block and ventricular dysfunction have been reported as common complications but late outcomes of these procedures have not yet been defined.

Methods: From 1988 to 2015, 157 consecutive patients underwent surgical repair of multiple VSDs at a median age of 2.2 months (2 days to 16.2 years). Sixty-nine patients (44%) had exclusively multiple VSDs, 62 patients (39%) had multiple VSDs with concomitant intracardiac anomalies, and 26 patients (17%) had multiple VSDs with aortic arch anomalies. Initial operations involved 150 VSD closures in 102 patients: direct closure (46), patch closure (88), sandwich technique (13), perventricular device closure (3). Pulmonary artery banding was performed in 83 patients. Fifty-four patients had banding only and 45 had an absorbable polydioxanone band. Eighteen patients (11%) required a ventriculotomy: right (15), left (2) or both (1).

Results: Operative mortality was 1% (2/157). Mean follow-up was 8 ± 6 years (1 day to 22 years). Survival was 94% (95% CI [88%–97%]) at 18 years. Ten patients required reoperation during hospital stay and 52 after hospital discharge consisting in 40 operations related to banding, and 50 additional procedures on the VSDs: direct closure (4), patch closure (38), and sandwich technique (8), with 13 patients requiring a ventriculotomy: right (10), left (1), both (2). Freedom from late reoperation related to residual VSDs was 51% (95% CI [41%–60%]) at 15 years (**Figure**). Thirty-one of the 45 patients treated with an absorbable PA band (69%) underwent

only one procedure. At last follow-up, six patients (4%) were on antifailure therapy for significant VSD , whereas complete closure of the VSDs was observed in 89 patients (58%). Pacemaker implantation was ultimately required in 14 patients (9%). Follow-up left ventricular end-systolic and diastolic diameter Z-scores was available in 75 patients and was reported to be a mean 0.6 ± 1.6 and 0.9 ± 1.8, respectively. No deleterious impact of a ventriculotomy could be detected.



Conclusions: Surgical treatment of multiple VSDs can be performed with excellent short- and long-term survival and normal late functional outcome. Half of the patients may require more than one procedure and the rate of pacemaker implantation is ultimately higher than reported with single VSDs. The use of absorbable pulmonary artery bands, limited ventriculotomies and sandwich techniques are useful adjuncts to the array of techniques necessary to treat patients with multiple VSDs.

5:35 pm **Executive Session,** *AATS Members Only* Ballroom ABC, Hynes

2:00 pm – 5:35 pm **General Thoracic Surgery** Room 302/304, Hynes
Simultaneous Scientific Session:
Practice Management and Economics
8 minute presentation, 10 minute discussion

Moderators: *Ke-Neng Chen and *Thomas A. D'Amico

73. The Impact of Enhance Recovery After Surgery Protocol Compliance on Morbidity from Resection for Lung Cancer: Experience from a UK Specialist Center

Luke J. Rogers[1], David Bleetman[2], David E. Messenger[3], Natasha A. Joshi[3], L. Wood[3], N.J. Rasburn[3], T. Batchelor[3]

[1]Derriford Hospital, Plymouth, United Kingdom; [2]Barts Heart Centre, London, United Kingdom; [3]Bristol Royal Infirmary, Bristol, United Kingdom

Invited Discussant: *Virginia R. Litle

Objectives: Enhanced recovery after surgery (ERAS) programs in gastrointestinal surgery have been associated with improved short term outcomes compared to standard care alone. Maximising ERAS protocol compliance has been shown to be a key predictor of successful outcome. The adoption of ERAS programs in thoracic surgery is relatively recent with limited outcome data. This study aimed to determine which elements of an ERAS program were predictive of morbidity in patients undergoing resection for malignancy in a high volume, specialist center.

Methods: In this prospective cohort study, data were collected on consecutive patients undergoing lung resection for malignancy within an ERAS program between May 2012 and June 2014 at a regional referral center in the United Kingdom. All patients followed a standardized, 14 element ERP protocol. Key data fields included protocol compliance with individual elements, pathophysiological and operative factors. 30-day morbidity was taken as the primary outcome measure and classified according to the Clavien-Dindo system. Logistic regression models were devised to identify independent risk factors for morbidity.

Results: A total of 583 patients underwent lung resection, of which 428 patients (73.4%) underwent video-assisted thoracoscopic surgery (VATS). Wedge resections and lobectomies were performed in 237 patients (40.7%) and 331 patients (56.8%), respectively. There were 209 patients (20.9%) with a thoracoscore of ≥2%. Complications were experienced by 201 patients (34.5%), with 57 patients (9.8%) experiencing a major complication (Clavien-Dindo III and IV). The median postoperative length of stay was 4 days (range: 1–67 days), and 6 patients (1.0%) died within 30 days of surgery. There was an inverse relationship between protocol compliance and morbidity (p = 0.002) (Table). Lobectomy (OR: 1.87, 95% CI [1.26–2.78], p = 0.002), ≥2 resections (OR: 2.06, 95% CI [1.22–3.47], p = 0.007), administration of antibiotics at induction (OR: 0.37, 95% CI [0.15–0.93], p = 0.035), early mobilization (OR: 0.62, 95% CI [0.42–0.93], p = 0.020), and protocol compliance with ≥12 elements (OR: 0.60, 95% CI [0.39–0.91], p = 0.016) were independent predictors of morbidity.

Table: Association Between Overall ERAS Protocol Compliance and Morbidity

Compliance with Number of ERP Elements (% Compliance)	Number of Patients	Morbidity (%)
9 (64.3)	3	2 (66.7)
10 (71.4)	29	13 (44.8)
11 (78.6)	104	46 (44.2)
12 (85.7)	218	78 (35.8)
13 (92.9)	202	60 (29.7)
14 (100)	12	2 (16.7)

Conclusions: Increased overall compliance with the ERAS protocol compliance was associated with a reduction in morbidity. Administration of antibiotics at induction and early mobilization (within 24 hours of surgery) were the individual protocol elements most strongly predictive of morbidity.

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74. The Economic Impact of a Nurse Practitioner Directed Lung Cancer Screening, Incidental Pulmonary Nodule, and Tobacco Cessation Clinic

Christopher R. Gilbert[1], Joelle T. Fathi[1], Rob Ely[1], Hannah Modin[2], Candice L. Wilshire[1], Ralph W. Aye[1], *Alexander S. Farivar[1], ◆Brian E. Louie[1], Eric Vallieres[1], Jed A. Gorden[1]

[1]Swedish Cancer Institute, Seattle, WA; [2]Northwell Health Center for Learning and Innovation, New Hyde Park, NY

Invited Discussant: Betty C. Tong

Objective: Lung cancer screening programs (LCSP) have become increasingly prevalent within the United States after the National Lung Screening Trial results and recent approval by Center for Medicare & Medicaid Services (CMS). Although regulatory and related requirements exist for LCSPs, the economic feasibility of these programs has been poorly described. We aimed to review the financial impact after programmatic implementation of Advanced Registered Nurse Practitioner (ARNP)–led programs of Lung Cancer Screening and Tobacco Related Diseases, Incidental Pulmonary Nodule Clinic, and Tobacco Cessation Services.

Methods: We reviewed revenue related to our programs from 8/2013 to 8/2016. The program is led by an independently practicing ARNP, employed within the Division of Thoracic Surgery and Interventional Pulmonology, with 1.0 full-time equivalent dedicated to administrative and clinical management of the programs. Encounters were queried for charges related to outpatient evaluation and management (E&M) codes, professional fees for procedures (Current Procedure Terminology [CPT]), and facility charges related to procedures (Diagnosis-Related group [DRG] and Ambulatory Payment Classification [APC]). Relative value units (RVUs) associated with encounters were abstracted when appropriate. Revenue was normalized utilizing 2016 CMS data tables. RVUs were applied against the national conversion factor (35.8043) and RVUs associated with ARNP billing were adjusted at 85%.

Results: Our program evaluated 694 individuals, of which 75% (518/694) are enrolled within the LCSP. Overall revenue associated with the program was $733,336 (Table). E&M visits generated revenue of $168,372 (5,440.17 RVUs), of which $149,655 (4,917.41 RVUs) was solely generated by the ARNP. Within our population, 48 (7%) patients underwent 75 procedures/operations (bronchoscopy: 11; transthoracic needle aspiration: 16; lung resection: 19; endoscopy: 13; foregut surgery: 9; non-thoracic surgery: 7) for abnormal imaging or newly identified disease. This generated professional CPT revenue amounting to an additional $60,015 (1,676.19 RVUs). Facility revenue (DRG and APC) from these procedures/operations added $504,949 into the healthcare system.

Table: Total Revenue

Revenue Type	Cases	RVU	Conversion Factor	ARNP Rate	Estimated Medicare Reimbursement
Inpatient hospital revenue (DRG)	31				$432,419
Ambulatory procedure revenue (APC)	41				$72,530
Physician procedures (CPT)	58	1676.19	35.8043		$60,015
Outpatient E&M—consulting physicians	152	522.76	35.8043		$18,717
Outpatient E&M—ARNP	2,577	4,917.41	35.8043	85%	$149,655

Conclusions: We have identified that an ARNP-led program of lung cancer screening, incidental nodules, and tobacco cessation services can provide additional revenue opportunities for a Thoracic Surgery and Interventional Pulmonology Division as well as a healthcare system. The current median annual wage of an ARNP is $98,190 and the cost associated directly to their salary (and benefits) may remain neutral or negative, the larger economic benefit can be realized within the division and institution. This potential additional revenue appears related to evaluation of newly identified diseases and subsequent evaluations, procedures and/or operations.

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75. Intraoperative Costs of VATS Lobectomy Can Be Dramatically Reduced Without Compromising Outcomes

Michael T. Richardson, Leah M. Backhus, *Mark F. Berry, Kelsey C. Ayers, Mehran Teymourtash, *Joseph B. Shrager

Stanford University, Palo Alto, CA

Invited Discussant: *Thomas K. Waddell

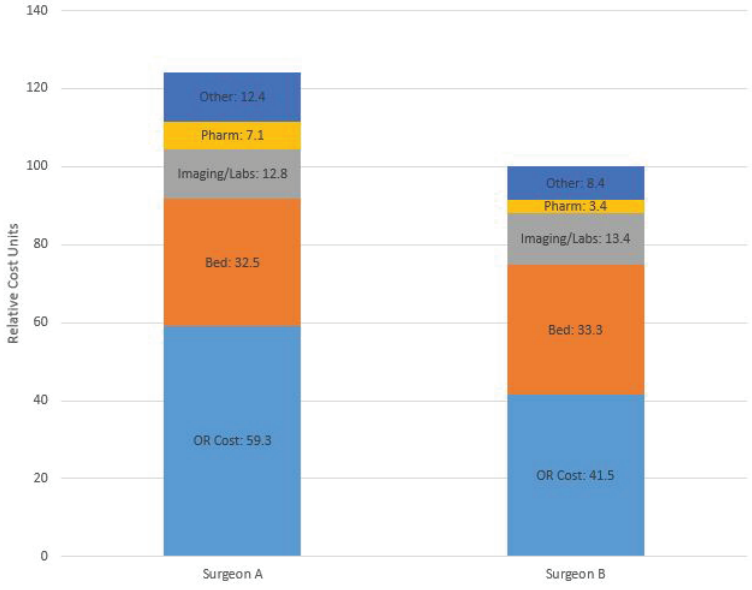
Objectives: To determine if surgeon selection of instrumentation/adjuncts during VATS lobectomy impacts costs and, if so, whether making cost-reducing choices increases morbidity/mortality.

Methods: Retrospective review of all VATS anatomic lung resections (intention-to-treat) performed by two surgeons (A: less cost-conscious; B: cost-conscious) at a single institution 2009–2014. Hospital costs were collected by finance personnel and divided into intraoperative and postoperative costs. Clinical outcomes were collected from a prospective divisional database. Costs/outcomes were compared

between the surgeons and drivers of cost differences identified. Our institution agreed to provide relative, but not absolute, cost data.

Results: 170 VATS lobectomies were performed (100 surgeon A; 70 surgeon B). There were no differences in FEV1%, age, or major comorbidities between the groups (all $p > 0.05$). Eleven cases (6%) converted to thoracotomy (6 A, 5 B, $p = 0.76$). Mean total hospital costs/case were 24% percent greater for surgeon A than B ($p = 0.0026$). The cost of intraoperative supplies was the main driver of this total cost difference and was 85% greater for surgeon A than B ($p < 0.0001$), accounting for 63% of the difference in overall cost between the surgeons. Stapling devices were the greatest single component of intraoperative costs for both surgeons, and absolute stapler costs were 48% greater for surgeon A than surgeon B. However, the largest driver of the inter-surgeon difference in intraoperative cost was the selection/use of non-stapler supplies including commercial introducers, energy devices, and sealants. Use of these discretionary adjuncts accounted for 55% of the difference in intraoperative supply cost between surgeons. Surgeon A's operations took 25% longer than B's ($p < 0.0001$), but costs of operating room time accounted for only 11% of the difference in total cost. Surgeon A's overall VATS lobectomy costs/case were similar to those of thoracotomy-lobectomies (n = 100) performed over the same time period, whereas surgeon B's VATS lobectomy costs/case were 24% less than thoracotomy-lobectomies. Postoperative outcomes after VATS lobectomy, including chest tube duration, air leak duration, length of stay, and major complications were no different (all $p > 0.20$) between the low- and high-cost surgeons.

Figure 1. Relative hospital costs associated with VATS lobectomy by 2 surgeons, according to accounting category.



Note that greater OR Cost is the primary driver of Surgeon A's greater overall cost.

Conclusions: Costs of VATS lobectomy are highly variable between surgeons and heavily influenced by discretionary use of disposable equipment. Surgeons can substantially reduce intraoperative, and thus overall, costs of VATS lobectomy, without compromising outcomes, by minimizing use of products with unproven benefits and utilizing less expensive options where possible. Implementing this approach renders costs of VATS lobectomy far less than those of lobectomy via thoracotomy.

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76. Financial Impact of Adapting Robotics to a Thoracic Practice in an Academic Institution

*Abbas E. Abbas, Sam Weprin, Kimberley Muro, Charles Bakhos, *Larry Kaiser

Temple University, Philadelphia, PA

Invited Discussant: *Robert J. Cerfolio

Objectives: In the current healthcare environment, there is increasing pressure on all providers to deliver high-quality care to more people at less cost. This mandate directly competes with the adoption of new and costly technology that may improve patient care. The increase in robotic surgery over the last decade has resulted in numerous studies touting its benefits and thus pressuring hospitals to acquire this modality in order to remain competitive. Robotic assisted thoracic surgical procedures (RATS) have been shown by some to be more expensive than conventional endoscopic or open surgery. We initiated this study to assess the financial impact of RATS compared to robotic non-thoracic surgery in an academic institution.

Methods: A retrospective IRB-approved study was performed for all patients who underwent a robotically assisted surgical procedure in fiscal years (FY) 2014 and 2015. Surgical volume, operative time, length of stay (LoS), case mix index (CMI), direct and indirect costs, hospital charges, surgical charges, and contribution margin (CM) were collected for the thoracic surgery service in addition to other services which performed more than 20 robotic cases a year. Direct costs included salaries, robotic disposable supplies, allocated robotic depreciation, maintenance and nonrobotic instrument expense. Financial performance for both inpatient and outpatient procedures were also analyzed.

Results: In FY 2014, 101 inpatient RATS (total institutional 519) were performed with mean CMI of 2.94 and mean LoS of 5.96 days. Net Revenue was $3,383,220 with Direct Costs of $1,839,847, Indirect Cost of $1,507,774, CM of $ 1,133,430 and Net gain of $35,598. This compared favorably with 3 other high-volume services that showed net losses or smaller gains. In FY 2015, 157 inpatient RATS (total institutional 627) were performed with mean CMI of 2.69 and mean LoS of 5.6 days. Net Revenue was $5,874,982, with Direct Costs of $2,764,357, Overhead Cost of $2,708,433, CM of $2,669,375 and Net gain of $411,593. This again compared favorably with 4 other high-volume services that showed net losses or smaller gains. In FY 2014 and FY 2015, we performed 18 outpatient RATS procedures. These were associated with a negative CM of $(1,091) and net loss of $(62,727).

Conclusions: High acuity services such as thoracic surgery drive higher CM per case as long as variable costs, especially LoS, are kept low. Procedures with lower CMI may not provide a high enough CM to offset the fixed and variable costs. Robotic surgical cases performed in the outpatient setting may incur significant losses as the reimbursement does not cover the direct costs. Hospitals should preferentially allocate robotic resources to inpatient procedures with higher CMI and work to decrease overall LoS.

3:20 pm – 3:55 pm **Coffee Break in the Exhibit Hall**

3:30 pm – 3:50 pm
General Thoracic Deep Dive Session: Impact of Quality on the Future of Surgery for Early Stage Lung Cancer
See page 74 for details.

AATS CT Theater I
Booth 106, Exhibit Hall
Not for Credit

General Thoracic Surgery Simultaneous Scientific Session: Lung Transplant and Lung Failure

Moderators: *Hiroshi Date and *Dan Kreisel

77. Lung Transplantation in the Era of Lung Allocation Scoring: A Single Center Experience of 1500 Patients

Keki Balsara, *Alexander Krupnick, Ramsey Hachem, Elbert Trulock, Chad Witt, Derek Byers, Roger Yusen, *Bryan Meyers, G. Alexander Patterson, *Varun Puri, *Daniel Kreisel

Washington University, St. Louis, MO

Invited Discussant: *John D'Cunha

Objective: Over the past 30 years, lung transplantation has emerged as the definitive treatment for end-stage lung disease. In 2005, the lung allocation score (LAS) was introduced as a way by which organs would be allocated based on disease severity. The number of transplants performed annually in the United States continues to increase as centers have become more comfortable expanding donor and recipient criteria ad have more facile with the perioperative and long-term management of these patients. We report a single-center experience with lung transplants, looking at patients before and after the introduction of LAS.

Methods: We retrospectively reviewed 1,500 adult lung transplants at a single center performed between 1988 and 2016. Patients were separated into two groups, before and after the introduction of LAS—Group 1 (April 1988–April 2005; 792 patients) and Group 2 (May 2005–September 2016; 708 patients).

Results: Differences in demographic data were noted over these periods reflecting changes in allocation of organs. Group 1 patient average age was 48 ± 13 years and 404 (51%) were men. Disease processes included emphysema (412 [52%]), cystic fibrosis (144 [18.2%]), pulmonary fibrosis (128 [16.1%]) and pulmonary vascular

disease (57 [7.2%]). Double lung transplant (615 [77.7%]) was performed more frequently than single lung transplant (177 [22.3%). Group 2 average age was 50 ± 14 years and 430 (59%) were men. Disease processes included pulmonary fibrosis (335 [46%]), emphysema (188 [25.8%]), cystic fibrosis (127 [17.7%]) and pulmonary vascular disease (11 [1.6%]). Double lung transplant (681 [96.2%]) was performed more frequently than single lung transplant (27 [3.8%]). Overall incidence of grade 3 primary graft dysfunction (PGD) in Group 1 was significantly lower at 22.1% (175) than in Group 2 at 31.6% (230) ($p < .001$). Nonetheless, overall hospital mortality was not statistically different between the two groups (4.4% vs 3.5%, $p < 0.4$). Most notably, survival at 1 year was statistically different at 646 (81.6%) for Group 1 and 665 (91.4%) for Groups 2 ($p < .02$).

Conclusions: Patient demographics over the study period have changed with an increased number of fibrotics transplanted. Additionally, more aggressive strategies with donor/recipient selection appear to have resulted in a higher incidence of primary graft dysfunction. This does not, however, appear to impact patient survival on index hospitalization or at 1 year. In fact, we have observed a significant improvement in survival at 1 year in the more recent era. This suggests that continued expansion of possible donors and recipients, coupled with a more sophisticated understanding of primary graft dysfunction and long-term chronic rejection, can lead to increased transplant volume and prolonged survival.

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78. Extracorporeal Life Support As a Bridge to Lung Transplantation: Experience of a High-Volume Transplant Center

Konrad Hoetzenecker, Laura Donahoe, Jonathan C. Yeung, Eddy Fan, Niall D. Ferguson, Lorenzo Del Sorbo, *Marc de Perrot, Andrew Pierre, *Kazuhiro Yasufuku, Lianne Singer, *Thomas K. Waddell, *Shaf Keshavjee, *Marcelo Cypel

University of Toronto, Toronto, ON, Canada

Invited Discussant: *Frank D'Ovidio

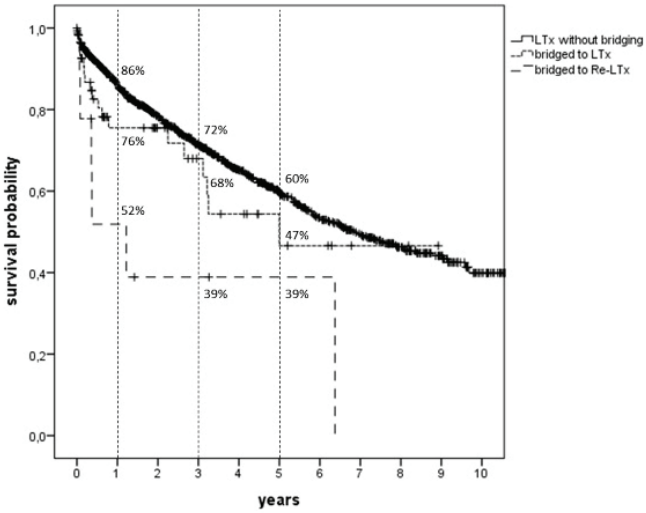
Objective: Extracorporeal life support (ECLS) is increasingly used to bridge deteriorating patients awaiting lung transplantation (LTx); however, few systematic descriptions of this practice exist. We therefore aimed to review our institutional experience over the past 10 years.

Methods: In this case series, we included all adults who received ECLS as a bridge to lung transplant. Data were retrieved from patient charts and our institutional ECLS and transplant databases. All analyses were conducted using SPSS 23 (SPSS Inc., Chicago, USA).

Results: Between December 2006 and September 2016, 1,111 lung transplants were performed in our institution. ECLS was employed in 71 adults (mean age 38 (range: 18–62) with the intention to bridge to LTx; of these 11 (16%) were bridged for retransplantation. The mean duration of ECLS prior to LTx was 14 days (range: 0–95). The most common underlying diagnoses were cystic fibrosis (n = 26 [37%]), followed by pulmonary fibrosis (n = 16 [23%]) and pulmonary hypertension (n = 13 [18%]). We used a single dual-lumen venous cannula in 32% of patients. Eight of

13 patients (62%) with pulmonary hypertension were bridged by central PA/LA Novalung. In 13 patients (18%) the bridging mode had to be switched at least once. Twenty-five patients (35%) were extubated while on ECLS, and 14 (20%) were tracheostomized during ECLS bridging. Twenty-six patients (37%) could be mobilized: fully ambulatory/treadmill (n = 14; 20%), bed exercises (n = 6 [8%]), stand/steps (n = 4 [6%]), dangle (n = 2 [3%]). Sixty-three (89%) of the patients survived to LTx. Survival rates by intention to treat were 66% (1-year), 58% (3-year) and 48% (5-year). Survival after transplantation in shown in the Figure. Survival was significantly lower in patients undergoing ECLS bridge to retransplantation as compared to first LTx. Median survival was 15 months (95% CI [0–31] vs 60 months (95% CI [37–83]; p = 0.045). Although no other specific factor determining a successful bridging could be identified, there were more immobile patients in the group, which did not reach LTx (88 vs 60%).

Figure 1



Patients at risk

bridged to LTx	54	28	22	15	11	6	5	2	2	0	0
Bridged to Re-LTx	9	4	2	2	1	1	1	0	0	0	0
LTx without bridging	1048	805	635	508	381	286	207	157	101	60	49

Conclusions: In our single-center experience, survival of ECLS bridge to retransplantation was low and strict patient selection in this group continues to be warranted. ECLS bridge to first lung transplant leads to very good short- and long-term outcomes in carefully selected patients.

79. Early Initiation of Extracorporeal Membrane Oxygenation for Influenza Associated Adult Respiratory Distress Syndrome Improves Survival

Desiree A. Steimer, Omar Hernandez, Kaitlyn J. Lingle, Rajasekhar Malyala, Patrick R. Aguilar, Brian Lima, *David Mason, Gary S. Schwartz

Baylor University, Dallas, TX

Invited Discussant: *Walter Klepetko

Objective: To identify characteristics associated with a survival benefit for patients that developed adult respiratory distress syndrome (ARDS) secondary to Influenza A (H1N1 or non-H1N1) or B and were treated with venovenous extracorporeal membrane oxygenation (ECMO).

Methods: A retrospective review was performed on a prospectively collected database of all patients treated with ECMO at a single institution. Patients requiring ECMO support for ARDS secondary to influenza infection between 2013 and 2016 were included. Depending on patient stability, patients were either cannulated at the referring hospital and transported on ECMO or cannulated at our center. All patients received Oseltamivir for 10 days.

Primary endpoint was 30- and 90-day survival. Secondary endpoints included time from hospital admission to initiation of ECMO, duration of ECMO support, Intensive Care Unit (ICU) and hospital length-of-stay (LoS), duration of mechanical ventilation and secondary organ dysfunction.

Results: During the study period, 21 patients were supported with venovenous ECMO for ARDS secondary to influenza. Subtyping of influenza virus was performed with the majority of patients having Influenza A, H1N1 (n = 11) or Influenza A, non-H1N1 (n = 8); only two patients had Influenza B.

76% of patients (n = 16) were weaned from ECMO and successfully decannulated. Survival to discharge was 57% (n = 12); all patients who were discharged were alive at 30 and 90 days. The H1N1 subset of patients had a 72% survival to discharge (n = 8).

Cannulation within 48 hours of admission was associated with a long-term survival of 80%, compared to 50% if cannulated between 2–5 days after admission and 29% if cannulated greater than 5 days after admission.

Mean duration of ECMO was 9.9 ± 4.5 days. Mean ventilator days was 24 (±11). Mean ICU LoS was 23.4 12.7 days and hospital LoS was 27.7 ± 17 days. 52% of the patients in our series developed renal failure requiring dialysis (n = 11) and 45% of those patients recovered renal function prior to discharge (n = 5).

Conclusions: Venovenous ECMO has been established as an accepted treatment modality for patients with influenza-associated ARDS. Early initiation of ECMO is associated with increased long-term survival. Patients with ARDS secondary to influenza should be referred to an ECMO-capable center, ideally with initiation of ECMO within 48 hours of admission.

80. Management of Bronchial Stump in Lobar Lung Transplantation

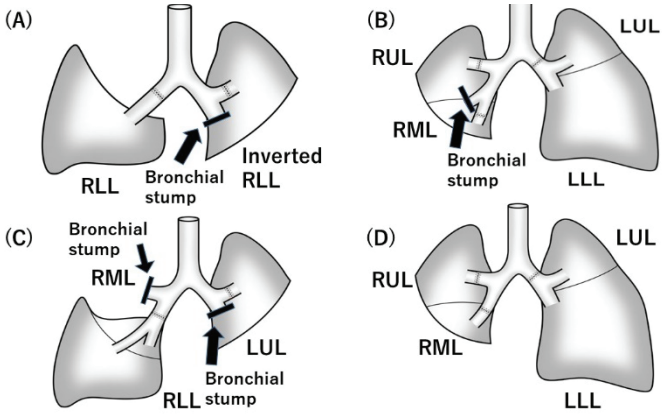
Hidenao Kayawake, ◆Toyofumi Fengshi Chen-Yoshikawa, Akihiro Aoyama, Hideki Motoyama, Masatsugu Hamaji, Kyoko Hijiya, *Hiroshi Date

Kyoto University, Kyoto, Japan

Invited Discussant: *Walter Weder

Objective: Lung transplantation was developed for saving lives of patients with end-stage pulmonary disease. In lung transplantation, there are two types of lobar lung transplantation (LLT): living-donor lobar lung transplantation (LDLLT) and deceased-donor lobar lung transplantation (DDLLT). In LLT, the managements and the complications of bronchial stumps are of great concern. Herein, we retrospectively reviewed the managements of bronchial stumps in lobar lung transplantation.

Methods: Between June 2008 and August 2016, 145 lung transplantations (72 LDLLTs and 73 deceased-donor lung transplantations) were performed. Among them, there were 80 LLTs (72 LDLLTs and 8 DDLLTs). The managements of bronchial stumps in 80 LLTs and the outcomes of them were retrospectively reviewed.



Results: In 72 LDLLTs, there were 14 cases in which the bronchial stumps were left. They consisted of 12 inverted LDLLTs and 2 single LDLLTs with contralateral pneumonectomy. In the former 12 cases, the anastomosis was performed between the inverted graft and the left recipient's bronchus (Figure A). Therefore, the bronchial stumps of left lower lobe of the recipients were left. In the latter two cases, the left main bronchus's stumps were left. These stumps were stapled and reinforced by suturing, and there were no complications. In 8 DDLTs, 11 lobectomies of donors were performed. They consisted of one right upper lobectomy, four right middle lobectomies, two right lower lobectomies, three left upper lobectomies, and one left lower lobectomy. Among these cases, two right middle lobectomies were performed after implantation; therefore, these two stumps of the donors were left and reinforced by suturing. In the remaining six cases, our policy for bronchial anastomoses was that we avoided remaining the bronchial stumps of the donors (Figure B–D). In three cases in which donor lobectomies were performed in back table, the anastomoses were separately and peripherally performed between

the main bronchus or the intermediate bronchus of the recipients and the lobar bronchus of the donors without any stumps left. In the remaining three cases the anastomoses were performed between the lobar bronchus of the donors and recipients, and the stumps of the recipients were left. There were no complications with bronchial stumps.

Conclusions: Although additional procedures such as reinforcement of the stumps or separated anastomoses were often necessary for LLTs, the management of bronchial stumps in LLTs were successfully performed.

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81. A Propensity Score Matched Study of Lung Transplant Surgery and Concomitant Coronary Artery Bypass Surgery

*Yoshiya Toyoda, Suresh Keshavamurthy, Jesus Gomez-Abraham, Tomo Yoshizumi, Francis Cordova, Kartik Shenoy, Albert J. Mamary, Brian O'Murchu, Riyaz Bashir, Gerard Criner, Huaqing Zhao, Abul Kashem

Temple University, Philadelphia, PA

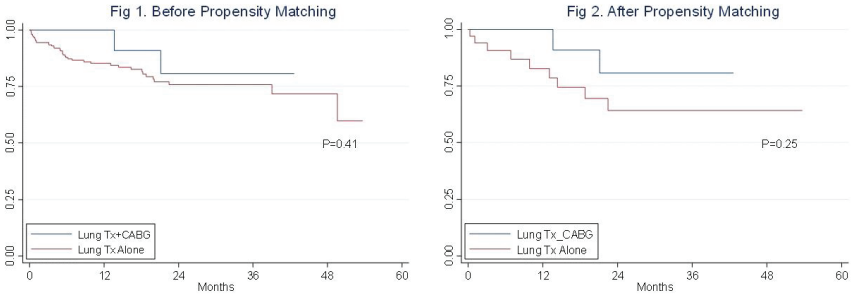
Invited Discussant: *R. Duane Davis

Objective: Our center reported earlier feasibility of concomitant coronary artery bypass surgery (CABG) during Lung Transplantation (LTx) procedure. Despite relative contraindication in CAD patients, our results showed excellent outcome, although propensity score matching was lacking in our previous study. The purpose of this study was to perform a propensity score matching in two groups of LTx patients with or without CABG and compare the survival outcome in them following additional surgical procedures during LTx.

Methods: We performed 240 consecutive lung transplants from March, 2012 to August, 2016 and LTx+ CABG (n = 17) and without CABG (n = 223). After propensity score matched with similar age, height, weight, BMI, and other similarity. seventeen patients of LTx+ CABG and 34 patients of LTx alone without CABG were available to compare for statistical significances using STATA Inc.

Results: The recipients' age and height were similar 66 ± 1 vs 66 ± 1 years (p = 0.852) and 67 ± 1 vs 67 ± 1 inches (p = 0.699) in both groups. LAS was similar in both groups (60 ± 5 vs 60 ± 4, p = 0.889) Donors' age and height were similar 35 ± 2 vs 34 ± 2 (p = 0.681) and 67 ± 1 vs 66 ± 1 (p = 0.487). When compared for significance between the gender in recipients (3 F, 14 M vs 8 F, 26 M), there were no differences (p = 0.238) between the two groups. Similarly, donor gender did not have any significance (p = 0.223). There were no differences between the lung transplant procedures (DLT vs others; p = 0.120), no differences in medical diagnoses (COPD, IPF, others; p = 0.454), and no differences in surgical incisions (AA, CL, MS; p = 0.255). Median LoS was similar for both groups (18 days; p = 0.223). CPB, ECMO, and other adopted procedures did not have any significance when compared (p = 0.372). Survival rate was 100% during 12-months in LTx+CABG group and 80% during 3 years. LTx patients alone without CABG had 97% survival at 1 month, 94% at 3 months, 91% at 6 months, 83% at 12 months, and 74% at 3 years. Log-rank test for equality of survivor functions was p = 0.215.

All CABGs (bypass grafts = 1–3) were performed on a beating heart without cardioplegic cardiac arrest, with off-pump (n = 7), with cardiopulmonary bypass (n = 7), and with veno-arterial extracorporeal membrane oxygenation (n = 3). Surgical approaches were determined based on the surgical exposure to the lung and coronary arteries, consisting of median sternotomy (n = 7), anterior thoracotomy (n = 7) and clamshell (n = 3). The left internal mammary artery (LIMA) was used in 92% (11 out of 12 patients) to LAD and the saphenous vein grafts were used (n = 15) to all other cases.



Conclusions: Our propensity score matched study showed parallel outcomes in lung transplantation with concomitant CABG with excellent results. By carefully conducted surgical strategies, including off-pump versus on-pump, a variety of surgical approaches, and choice of conduits, Lung Tx plus CABG would be a good option in selected patients.

5:35 pm **Executive Session,** *AATS Members Only* Ballroom ABC, Hynes

WEDNESDAY MORNING, MAY 3, 2017

7:30 am – 9:35 am **Adult Cardiac Surgery** Room 302/304, Hynes
Simultaneous Scientific Session
5 minute presentation, 7 minute discussion

Moderators: *Clifford Barlow, *Friedrich W. Mohr, *Craig R. Smith

82. Triage and Optimization: A New Paradigm in the Treatment of Massive Pulmonary Embolism

Chetan Pasrija, Anthony Kronfli, Maxwell Raithel, Francesca Boulos, Mehrdad Ghoreishi, Gregory J. Bittle, Lewis Rubinson, Michael A. Mazzeffi, *James S. Gammie, *Bartley P. Griffith, Zachary N. Kon
University of Maryland, Baltimore, MD

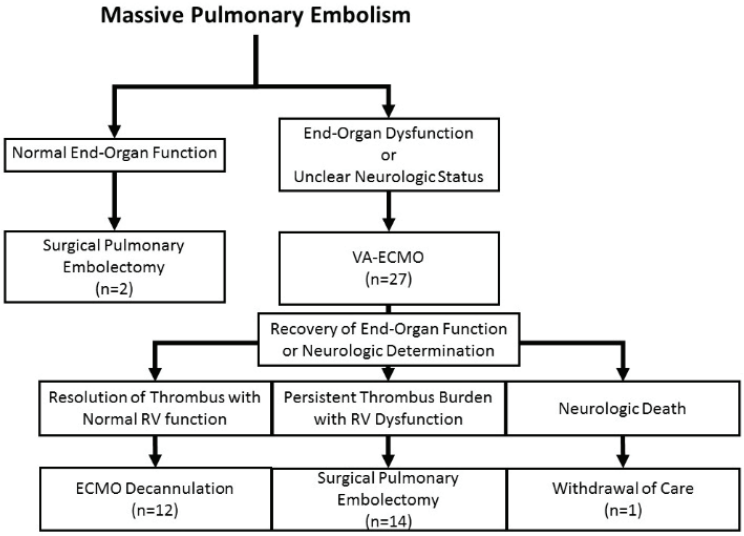
Invited Discussant: *Lyle D. Joyce

Objectives: Massive pulmonary embolism (MPE) remains a highly fatal condition, with in-hospital mortality rates of 15–80%. Although veno-arterial extracorporeal membrane oxygenation (VA-ECMO) and surgical pulmonary embolectomy have previously been reported in the management of MPE, the outcomes remain less than ideal. We hypothesized that the institution of a protocolized approach of triage and optimization utilizing VA-ECMO would result in improved outcomes compared to historical surgical management.

Methods: All consecutive patients with a confirmed MPE that were referred to the cardiac surgery service at a single institution were retrospectively reviewed. Patients were stratified by era of care: historical control (2010–2014) versus a protocolized approach (2015–2016). In the control group, the primary planned intervention was surgical pulmonary embolectomy. In the protocol group, patients were strictly treated based on the algorithm in the Figure. The primary outcome was 1-year survival.

Results: Fifty-five patients (control: 26; protocol: 29) were identified, with a median age of 55 years. All patients had an RV/LV ratio >1.0, with a median troponin of 1.0 ng/mL, and NT-proBNP of 2,995 pg/mL. There was no significant difference in the number of preconsultation arrests (control: 23% vs protocol: 24%, p = NS) or rate of neurologic dysfunction at consultation (38% vs 41%, p = NS). All patients in the control group underwent surgical pulmonary embolectomy with a median time from consultation to surgery of 4 hours. In the protocol group, 2/29 (7%) patients were deemed appropriate for direct surgical pulmonary embolectomy, with the remaining 27/29 (93%) patients utilizing VA-ECMO with a median duration of 5.7 days. Of the protocol patients supported with VA-ECMO, 26/27 (96%) recovered end-organ function with neurologic status determined to be appropriate for further care. Overall in the protocol group, 11/29 (38%) of patients required anticoagulation alone, and 16/29 (55%) of patients ultimately required surgical pulmonary embolectomy, with a significantly longer time from consultation to surgery of 84 hours (p < 0.005). Among patients undergoing surgical embolectomy, 15% of the

control group compared to no patients in the protocol group suffered an intraoperative arrest (p = NS). One-year survival was significantly lower in the control group compared to the protocol group (77% vs 97%, p < 0.05), with 4/6 (67%) deaths in the control group secondary to persistent neurologic dysfunction. There were no deaths post-embolectomy in the protocol group.



Conclusions: A protocolized strategy involving the aggressive institution of VA-ECMO appears to be an effective method to triage and optimize MPE patients to recovery or intervention. Implementation of this strategy, compared to an early, aggressive surgical approach, appears to reduce the morbidity and mortality associated with MPE.

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83. Mid-Term Outcomes in 850 Patients Treated with Aortic Valve Neo-Cuspidization Using Glutaraldehyde-Treated Autologous Pericardium

*Shigeyuki Ozaki, Isamu Kawase, Hiromasa Yamashita, Shin Uchida, Mikio Takatoo, Nagaki Kiyohara

Toho University, Tokyo, Japan

Invited Discussant: *J. Michael DiMaio

Objective: We previously reported the short-term results of original aortic valve. We evaluated the mid-term results with the longest follow-up of 9.5 years.

Methods: From April 2007 through December 2015, 850 patients were treated with aortic valve neo-cuspidization using autologous pericardium. Medical records

of these patients were retrospectively reviewed. Procedure is based on the independent tricuspid replacement by autologous pericardium. The distance between commissure is measured with original sizing apparatus and then pericardial cusp is trimmed using original template and sutured to annulus.

Results: There were 600 patients with aortic stenosis, and 250 with aortic regurgitation (AR). Two hundred nineteen patients showed bicuspid aortic valves, 27 showed unicuspid valves, and 2 showed quadricuspid valves. There were 431 males and 419 females. Mean age was 68.2 ± 14.3 years old. Preoperative echocardiography revealed peak pressure gradient averaged 68.9 ± 36.3 mmHg with aortic stenosis. Surgical annular diameter was 20.9 ± 3.3 mm. There was no conversion to the prosthetic valve replacement. There were 16 in-hospital mortalities. Post-operative echocardiography revealed peak pressure gradient averaged 19.5 ± 10.3 mmHg one week after surgeries and 15.2 ± 6.3 mmHg 8 years after surgeries. Fourteen patients needed reoperation (13: infective endocarditis). Freedom from moderate AR was 94.3%. The mean follow-up period was 42.0 ± 26.3 months. Freedom from reoperation was 91.6% with 108 months follow-up.

Conclusions: The mid-term outcomes of aortic valve neo-cuspidization using autologous pericardium were satisfactory in 850 patients with various aortic valve diseases. However, further randomized, multicentric prospective studies are needed to confirm the results of the current study.

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84. Role of Transcatheter Versus Surgical Mitral Valve Procedures in High-Risk Patients with Recurrent Mitral Valve Disease

Dave G. Cervantes, Norihiko Kamioka, Jessica Forcillo, Talal Al-Atassi, Ronnie Ramadan, Stamatios Lerakis, Chandanreddy Devireddy, Douglas Murphy, Jeffrey Miller, *Robert A. Guyton, *Michael Halkos, Emeka Ndubisi, Vasilis Babaliaros, *Vinod H. Thourani

Emory University, Atlanta, GA

Invited Discussant: *Vinay Badhwar

Objective: Repeat mitral valve surgery is associated with significantly increased mortality and morbidity. Transcatheter-based mitral intervention (TMVR) may represent a less invasive alternative. The objective of this study was to compare outcomes of redo surgical mitral valve repair/replacement (SMVR) vs TMVR and to determine whether transcatheter-based approaches are viable options for patients requiring subsequent mitral valve procedures.

Methods: In a retrospective review, 28 high-risk patients who underwent TMVR after a previous open mitral valve surgery (8 pts with prior ring and 20 with a prior bioprosthesis) were compared to 175 patients who underwent redo SMVR between January 2007 and August 2016. Operative characteristics and clinical outcomes were analyzed. All patients were followed up to October 1, 2016.

Results: Patients were older in the TMVR group compared to the surgical group (mean age 69 ± 3.0 years vs 60 ± 1.2, p = 0.003). Patients who underwent TMVR had a higher STS-PROM (13.3% vs 7.4%, p = 0.007), more symptomatic heart failure (NYHA class III/IV: 28/28 pts [100%] TMVR vs 112/175 [64.0%] SMVR, p < 0.001)], and a greater number of previous mitral valve surgeries (3+ surgeries: 9/28 [32.1%] TMVR

vs 13/175 [7.4%] SMVR, p < 0.0001). No patients undergoing TMVR required cardiopulmonary bypass and the majority were done using transfemoral/transseptal techniques. There were no significant differences in mortality between the two groups at 30 days (3/28 [11%] for TMVR vs 12/175 [7%] for SMVR, p = 0.81) or 1 year (3/11 [11%] for TMVR vs 22/175 [13%] for SMVR, p = 0.82). Similarly, there were similar results between groups for postoperative stroke (p>0.999 for both 30d and 1 year) and readmissions at 30 days (1/28 [3.6%] for TMVR vs 14/175 [8%] for SMVR, p = 0.7) and 1 year (50/175 [29%] for TMVR vs 5/28 [18%] for SMVR, p = 0.36). Patients who underwent TMVR had a shorter hospital stay (p = 0.01), a shorter ICU course (p = 0.039), shorter ventilatory time (p = 0.003), fewer RBC transfusions (p = 0.005), less postoperative atrial fibrillation (p < 0.0001), and less reoperations for bleeding (p = 0.007). TMVR patients did, however, require more procedures for paravalvular leak (3/28 [10.7%] TMVR vs 3/175 [1.7%] SMVR, p = 0.018).

Variable	SMVR (n = 175)	TMVR (n = 28)	p-Value
Demographics			
Age, mean [range]	60.57 [16–87]	69.86[21–86]	**0.003**
STS-PROM, % (Mean ± SEM)	8.31 ± 0.78	13.27 ± 2.01	**0.02**
STS-PROMM, % (Mean ± SEM)	35.71 ± 1.7	49.89 ± 4.04	**0.0019**
LVEF, % (Mean ± SEM)	52.22 ± 0.84	46.39 ± 2.76	**0.015**
Postoperative Outcomes			
Postprocedural length of stay (days)	10.88 ± 0.69	6.464 ± 0.88	**0.01**
Length of ICU stay (hours)	144.8 ± 15.17	65.66 ± 14.65	**0.039**
Length of ventilation (hours)	69.79 ± 11.09	24.3 ± 10.19	**0.003**
Blood transfusion (# units)	6.347 ± 0.82	1.2 ± 0.45	**0.005**
Bleeding requiring reoperation	11 (7.7%)	0 (0%)	**0.0068**
New onset A fibrillation	45 (31%)	2 (7%)	**<0.0001**

Conclusions: Patients requiring a reoperative mitral valve procedure have excellent one year outcomes from either SMVR or TMVR. However, TMVR patients had lower morbidity, and resource utilization. TMVR represents a viable alternative to redo SMVR in certain high-risk patient populations.

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85. Training the Cardiothoracic Surgeon of the Future: The Power of Live Animal Operating and Tailored Bootcamps in the UK Cardiothoracic Training Programme

Louise Kenny[1], Karen Booth[1], Sridhar Rathinam[2], Gary Reynolds[1], Narain Moorjani[3]
[1]Freeman Hospital, Newcastle, United Kingdom; [2]University Hospital of Leicester, Leicester, United Kingdom; [3]Papworth Hospital, Cambridge, United Kingdom

Invited Discussant: *Jennifer S. Lawton

Objective: Escalating legislative, medico-legal factors, and the older, comorbid patient population pose challenges to training in the current era. In the United Kingdom, a pioneering 6-year simulation-focused program of continuous learning has been established for all cardiothoracic trainees to run parallel to training in

the workplace. Intensive surgical training occurs on live anaesthetised animals to provide the highest-fidelity simulation. Live-animal operating allows the trainees to practice and, importantly, to err, in astonishingly realistic conditions without the implications of patient safety reporting, targets, time pressures, or risks. Content is mapped to core curriculum for the level of training. We sought to evaluate the transfer of technical skill, confidence, and knowledge to the workplace following live-animal operating in the first year of specialized cardiothoracic training.

Methods: Tailored OSATS matrices were used to assess competence in two core skills (pulmonary wedge and CPB management) in theatre by a consistent educational supervisor pre- and post-course. Supervisor questionnaires using Likert scaling (1–5) were completed after the training intervention to assess impact on confidence, knowledge, and application of material covered. As an indirect but important measure of competence, supervisor confidence to allow autonomy in surgical practice was quantified.

Results: Twenty-first year candidates of varying levels of experience at the start of their training participated. Statistically significant improvement was seen following live-pig operating for both core skills: pulmonary wedge resection ($p < 0.01$) and CPB management ($p < 0.05$). The Figure demonstrates the Likert ranking of improvement in learning domains following the simulation. 91.5% of Supervisors felt at least noticeably more confident to allow the trainee more autonomy in clinical decisions and operating. 83.4% of supervisors felt time out of clinical work to attend the course was beneficial.

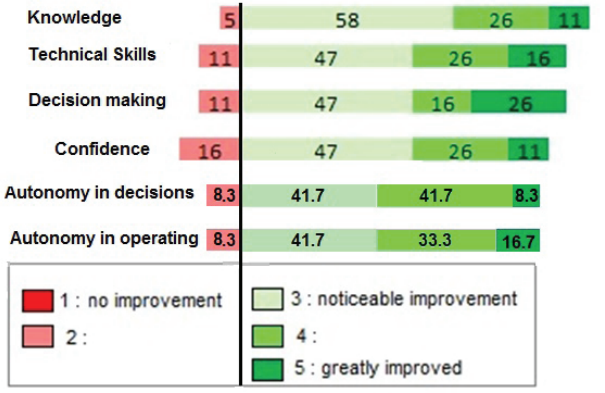

Figure 1: demonstrating supervisor questionnaire results in likert scale scores of improvement in learning domains and activity following live animal operating simulation training (% of trainees)

Conclusions: Live-animal operating provides trainees with high-fidelity simulation opportunities to develop skills and confidence. We have objectively shown there is positive transfer of these skills to the human patient in all learning domains. The trainee-trainer relationship with its complexities of trust in competence is fundamental to progress the training surgeon who must at some point be permitted to practice autonomously. Following the simulation, trainers felt more confident to allow trainees more autonomy to take decisions and perform technical aspects

of the operation which is an indirect measure of perceived competence of the trainee. This tailored training is an opportunity for positive evolution of the supervisor relationship and multifaceted development of the training surgeon on the path to confident, competent, autonomous practice.

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86. Teaching Operative Cardiac Surgery in the Era of Increasing Patient Complexity: Can It Still Be Done?

George Tolis, Jr., Philip J. Spencer, Jordan P. Bloom, Serguei Melnitchouk, David A. D'Alessandro, Mauricio A. Villavicencio, *Thoralf M. Sundt, III
Massachusetts General Hospital, Boston, MA

Invited Discussant: Spencer Melby

Objective: As educators, it is our responsibility to teach the next generation operative surgery, whereas as clinicians we have to provide the highest level of care to our patients. This is an ever-increasing challenge given the large number of patients with multiple comorbidities, the loss of more straightforward cases to percutaneous interventions, and pressure from public reporting requirements. Prior studies have investigated outcomes when trainees participate in surgery compared with outcomes of patients operated by attending staff. No study to date has compared outcomes of similar cases performed entirely ("skin-to-skin") by the resident to those performed entirely by staff to confirm the safety of this practice. We therefore examined cases done entirely by the cardiothoracic resident and compared them to a matched sample of cases done entirely by a single attending surgeon.

Methods: An IRB approved, prospective longitudinal database was created capturing comprehensive data on consecutive patients undergoing cardiac operations from July 2014 to October 2016 by a single surgeon. Patients were stratified based on whether the attending surgeon or trainee performed the operation skin-to-skin. All procedures were performed via median sternotomy. Patients were excluded from the analysis if there was overlap in any portion of the procedure by either the trainee or the attending.

Results: One hundred consecutive cases (82 CABG, 9 AVR, 7 CABG+AVR, 2 other) performed by the resident (Group R) were matched by procedure 1:1 to nonconsecutive cases done by the attending surgeon (Group A). Patients in Group A were similar to those in Group R with respect to age (69 years vs 66 years, $p = 0.06$), female gender (18% vs 19%, $p = 0.86$), BMI (28.3 vs 27.9, $p = 0.6$), ASA classification (3 vs 3, $p = 0.8$), LVEF (56.2% vs 58.3%, $p = 0.27$), and diabetes mellitus (29% vs 39%, $p = 0.14$). Cardiopulmonary bypass times were longer in Group R (96.5 min vs 49.5 min, $p < 0.001$) as were aortic cross-clamp times (78 min vs 39 min, $p < 0.001$). There were no significant differences in red blood cell transfusions (17% vs 12%, $p = 0.32$), re-explorations (2% vs 1%, $p = 0.57$), stroke (2% vs 2%, $p = 1.0$) or length of stay (6 days vs 6 days, $p = 0.9$). There was a single deep sternal wound infection requiring muscle flap closure in Group A. There were no in-hospital or 30-day deaths.

Conclusion: Our data indicate that trainees can be educated in operative surgery under the current paradigm despite longer operative times without sacrificing outcome quality. It is reasonable to expect academic programs to continue providing trainees significant experience as primary operating surgeons.

87. Sutureless Aortic Valves Versus Transcatheter Aortic Valve in Patients with Severe Aortic Stenosis and Intermediate Risk Profile: A Propensity Match Comparison in the Real World

*Claudio Muneretto[1], Alberto Repossini[1], Lorenzo Di Bacco[1], ◆Roberto Di Bartolomeo[2], Carlo Savini[2], Gianluca Folesani[2], Manfredo Rambaldini[3], Maurizio Tespili[4], Juan Pablo Maureira[5], Francois Laborde[6], Thierry Folliguet[7]

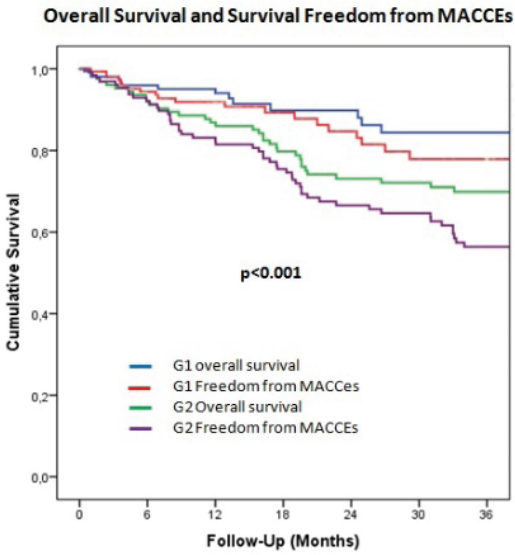
[1]University of Brescia, Brescia, Italy; [2]University of Bologna, Bologna, Italy; [3]Carlo Poma Hospital of Mantova, Mantova, Italy; [4]Azienda Ospedaliera Bolognini, Seriate, Italy; [5]CHU de Nancy, Nancy, France; [6]Institut Mutualiste Montsouris, Paris, France; [7]Centre Hospitalo-Universitaire Brabois ILCV, Nancy, France

Invited Discussant: Mattia Glauber

Objective: PARTNER II trial depicted comparable outcome of transcatheter aortic valve (TAVR) versus standard surgical valve replacement (sAVR) in patients with severe aortic stenosis and intermediate-risk patients. Recently, sutureless rapid deployment valves (SV) became a viable alternative to standard bioprostheses and European clinical experience showed their capability to significantly reduce the length of cross-clamping and extracorporeal circulation time with the tendency to reduce the incidence of major postoperative complications. This multi-institutional European study compares the outcome of patients with aortic stenosis and intermediate-risk profile who underwent isolated sutureless versus TAVR aortic valve implant.

Methods: From 2012 to 2015, 492 consecutive patients with intermediate-risk (STS score from 4% to 10%) and isolated aortic stenosis entered the study (SV = 237; TAVR = 195). A minimally invasive approach through mini-sternotomy was performed in all patients underwent SV implant. An adjusted analysis using Inverse Probability Weighting (IPW) based on Propensity Score was performed and two balanced groups were obtained: SV = 192 patients (G1); TAVR = 153 patients (G2). Primary study end points included overall survival at 30 days and at 36 months. Secondary study end points included incidence of composite adverse events (MACCEs: Cardiac death, stroke, PM implant, acute MI, paravalvular leak >2+, device failure requiring reoperation) at 30 days and at 36 months.

Results: The 30-days mortality was significantly lower in SV group (G1 = 2.1% vs G2 = 5.8%, p = 0.02) as well as incidence of permanent PM implantation (G1 = 6.5% vs G3 = 14.7%, p < 0.001) and peripheral vascular complications (G1 = 0% vs G2 = 8.8%, p < 0.001). Two patients (1.0%) in G1 and three patients in G2 underwent early reoperation due to device failure. Stroke/TIA incidence was 2.0 % in G1 and 7.2% in G2 (p = 0.008). Early significant perivalvular leak (>grade II) was observed in 3.6% in G1 and 11.1% in G2 (p < 0.001). At mean follow-up of 36 months, overall survival and the survival freedom from MACCEs were significantly better in patients undergoing SV (G1 = 85.4 ± 3.2% vs G2 = 68.4 ± 5.2% p = 0.001) (G1 = 81.4 ± 4.7% vs G2 = 57.1 ± 7.8% p < 0.001). Cardiac death occurred in 3.1% (G1) and 9.8% (G2); stroke in 4,2% (G1) and 7.8% (G2); MI in 1.0% (G1) and 3.6% (G2). At multivariate Cox Regression Analysis identified TAVR and chronic renal failure (CRF) as independent predictor for mortality (TAVR—HR: 3.1, CI = [1.2–5.3], p = 0.005) (CRF—HR: 7.8, CI [3.9–11.9], p < 0,001).



Conclusions: The use of sutureless rapid deployment valves significantly improved the outcomes of patients with isolated aortic stenosis and intermediate risk profile, when compared with TAVR. The use of TAVR in this subset population significantly increased the incidence of major post-operative complications and significantly decrease early and late survival.

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88. Oral Anticoagulation Is Not Necessary Following Cox-MAZE IV Procedure for Persistent Atrial Fibrillation Discharged in Sinus Rhythm

Takashi Murashita[1], Lawrence M. Wei[1], Mohamad Alkhouli[1], Callum R. Hamilton[2], Robert Hull[1], *J. Scott Rankin[1], *Vinay Badhwar[1]

[1]West Virginia University, Morgantown, WV; [2]University of Pittsburgh, Pittsburgh, PA

Invited Discussant: *Ko Bando

Objective: Warfarin and novel anticoagulants have inherent risks. In the absence of clear evidence-based guidelines, anticoagulation following surgical ablation (SA) for atrial fibrillation (AF) is generally administered until documentation of stable normal sinus rhythm (NSR) between 2 and 6 months postoperatively. This study examines the outcomes of patients discharged following SA for persistent AF with antiplatelet therapy only.

Methods: From October 2011 to April 2016, 246 patients underwent bi-atrial open Cox-Maze IV procedures for persistent AF. Stand-alone and concomitant cases were included; mechanical valve replacement and chronic venous disease patients necessitating anticoagulation were excluded, resulting in a study cohort of 189 consecutive patients discharged on only antiplatelet therapy. Left atrial appendage

management was by endocardial double-layer longitudinal suture closure in all cases. Follow-up was by guideline-directed 24-hour Holter monitoring in 100%. In addition to outcome and rhythm end-points on and off anti-arrhythmic drugs (AAD), neurologic end-points were defined as any deficit of abrupt onset that did not resolve within 24 hours.

Results: Mean age was 67.0 ± 11.0 years, and 76% had NYHA Class III or IV symptoms preoperatively. Concomitant mitral and/or tricuspid valve operations were performed in 80%, multiple valves in 57%, 23% included coronary bypass grafting, 15% were reoperations, 17% were performed via a minimally invasive right thoracotomy approach, and 11% were stand-alone operations. All 189 patients were discharged in NSR without mortality or neurologic event. Median follow-up was 18 months (range: 9–53) with 144 greater than 1 year. The 1 and 3 year survival rates were 91.5% and 82.8%, respectively. Ninety percent (170/189) were in sinus rhythm, 87% were free from AADs, and 80% were free from anticoagulation at last follow-up. Neurologic end-point was reached in one patient in <1 year (1/189 [0.5%]) and in four patients >1 year (4/144, 2.8%). Of the four late events, three were found in the patients who had AF recurrence. Thirty-seven patients (19.6%) were placed on anticoagulation during the follow-up period, 13 of whom (35.1%) developed major bleeding complications, two of whom died.

Conclusions: Discharging patients on antiplatelet therapy following successful Cox-Maze IV for persistent AF appears to be safe with a 1-year neurologic event rate of less than 1%. Adherence to guideline-directed follow-up and maintenance of rhythm end points are essential for optimal outcomes.

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89. Concomitant Cox-Maze IV Procedure Is Associated with Improved Long-Term Survival in Patients with a History of Atrial Fibrillation Undergoing Cardiac Surgery: A Propensity Matched Study

Farah N. Musharbash, Matthew R. Schill, Laurie A. Sinn, Richard B. Schuessler, Spencer J. Melby, *Hersh S. Maniar, *Marc R. Moon, *Ralph J. Damiano, Jr.
Washington University, St. Louis, MO

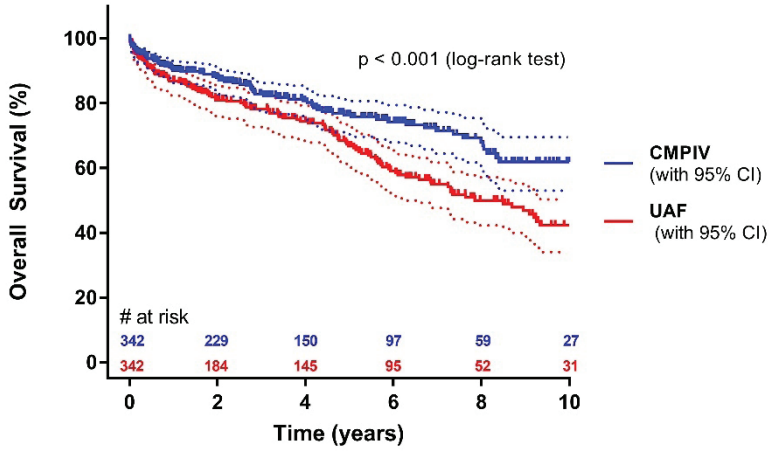
Invited Discussant: *Niv Ad

Objective: Atrial fibrillation (AF) is the most common cardiac arrhythmia and is independently associated with an increased risk of mortality. The Cox-Maze IV procedure (CMPIV) performed concomitantly with other cardiac surgical procedures is effective for ablating AF. However, little data exists on the long-term survival outcomes of patients undergoing a concomitant CMPIV.

Methods: Patients with a history of AF undergoing cardiac surgery (excluding LVAD, transplant, trauma, TAVR, stand-alone surgical ablation) were retrospectively reviewed from January 2001 to March 2016 (n = 1,948). Patients were stratified into two groups: patients receiving a concomitant CMPIV (CMPIV; n = 438), and patients with untreated AF (UAF; n = 1,510). Preoperative variables were compared between the two groups. To account for baseline and procedure-related differences, propensity score matching was conducted using a logistic model with

nearest neighbor algorithm and a 0.1 caliper. The covariates used in the propensity model included 22 out of the original 23 preoperative variables, including the type of operation being performed. After matching, excellent covariate balance was achieved (standardized difference <10% for all covariates) and the sample remaining contained 684 patients (342 pairs). Preoperative and perioperative outcomes as well as long-term survival were compared between the matched groups.

Results: All preoperative variables were similar between the matched groups. Perioperative data showed that the CMPIV group had a longer cross clamp time (97 ± 29 vs 87 ± 38 min, $p < 0.001$), longer bypass time (193 ± 43 vs 132 ± 53 min, $p < 0.001$), and a higher rate of pacemaker implantation (41 [12%] vs 18 [5%], $p = 0.002$). The proportion of patients with a major complication, defined as reoperation for bleeding, permanent stroke, pneumonia, mediastinitis, renal failure requiring dialysis, or need for intra-aortic balloon pump, were similar between CMPIV and UAF (77 [23%] vs 60 [18%], $p = 0.126$). However, median ICU length of stay was longer for CMPIV (3.6 days [1–58] vs 2.2 days [1–105], $p < 0.001$), as was the median hospital length of stay (11 days [1–82] vs 8 days [1–146], $p < 0.001$). Thirty-day mortality was similar between CMPIV and UAF (10 [3%] vs 14 [4%], $p = 0.534$). Using Kaplan-Meier analysis, long-term survival was higher for the CMPIV group (Figure; $p < 0.001$). Survival at 10 years was 62% for CMPIV and 42% for UAF. After further adjusting for all covariates used in the matching model, in addition to the treatment (CMPIV/UAF) and propensity score, the hazard ratio for CMPIV was 0.58 (95% CI: 0.43–0.78, $p < 0.001$).



Conclusions: For selected patients with a history of AF undergoing cardiac surgery, concomitant CMPIV did not add significantly to postoperative morbidity or mortality, and was associated with significantly improved long-term survival.

Late-Breaking Clinical Trials

LB9. Off-Pump Versus On-Pump Coronary Artery Bypass Grafting: Insights from the Arterial Revascularization Trial

Umberto Benedetto[1], Doug Altman[2], Stephen Gerry[2], Alastair Gray[2], Belinda Lees[2], Marcus Flather[3], *David Taggart[2]

[1]University of Bristol, Bristol, United Kingdom; [2]University of Oxford, Oxford, United Kingdom; [3]University of East Anglia, Norwich, United Kingdom

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LB10. The Effect of an Additional Radial Artery on Single and Bilateral Internal Thoracic Artery Grafts – Insights from the Arterial Revascularization Trial

*David Taggart[1], Marcus Flather[2], Doug Altman[1], Stephen Gerry[1], Alastair Gray[1], Belinda Lees[1], Umberto Benedetto[3]

[1]University of Oxford, Oxford, United Kingdom; [2]University of East Anglia, Norwich, United Kingdom; [3]University of Bristol, Bristol, United Kingdom

Invited Discussant *David Yuh

9:35 am – 9:45 am **Coffee Break**

WEDNESDAY MORNING, MAY 3, 2017

7:30 am – 9:35 am **Congenital Heart Disease** Room 306, Hynes
Simultaneous Scientific Session
5 minute presentation, 7 minute discussion

Moderators: ◆Paul J. Chai and *Jennifer C. Hirsch-Romano

90. Staged Ventricular Recruitment via Atrial Septation Alone in Patients with Borderline Ventricles and Large Ventricular Septal Defects

Olubunmi Oladunjoye, Puja Banka, Gerald Marx, Roger Breitbart, *Pedro del Nido, ◆Sitaram Emani

Boston Children's Hospital, Boston, MA

Invited Discussant: *Emile A. Bacha

Objective: Patients with borderline ventricular size and ventricular septal defect (VSD) including double-outlet right ventricles and unbalanced atrioventricular canal defects who have previously undergone single-ventricle palliation may be candidates for staged ventricular recruitment to maximize ventricular growth with the ultimate goal of eventual biventricular conversion. The aim of this study was to determine the impact of atrial septation alone; i.e., diverting flow into the hypoplastic ventricle, upon ventricular growth in patients with borderline right or left ventricles and VSD who had previously undergone single ventricle palliation.

Methods: Patients with borderline ventricles and VSD who underwent recruitment procedure with fenestrated atrial septation alone without VSD closure between 2009 and 2016 were retrospectively reviewed. Patient demographics, diagnosis, surgical procedures and outcomes were abstracted from medical record and left

and right heart volumes from pre- and post-recruitment cardiac magnetic resonance (CMR) examinations. Pre- and post-recruitment values were then compared using Wilcoxon Signed Ranks test.

Results: A total of 16 patients underwent staged ventricular recruitment via atrial septation as the sole procedure at median age of 19.4 (IQR: 8.1–44.4) months. Among the group, 11 (68.8%) were females and 12 (75%) had borderline left ventricles. Time between pre- and post-recruitment CMR examination was 10.3 (IQR: 8.4–12.5) months. The median indexed ventricular diastolic volume increased from 30.7 (IQR: 24.4–35.4) ml/m^2 to 44.4 (IQR: 38.4–58.0) ml/m^2 after the recruitment procedures ($p < 0.01$), whereas the median indexed systolic volume increased from 12.3 (IQR 9.5–17.0) ml/m^2 to 19.5 (IQR 16.0–28.2) ml/m^2 after recruitment ($p < 0.01$). There was also an increase in the median indexed stroke volume from 18.2 (IQR: 13.8–20.1) ml/m^2 to 29.1 (IQR: 21.3–31.8) ml/m^2 ($p < 0.01$). Indexed ventricular mass of the ventricle went from 22.7 (IQR: 18.0–30.4) g to 27.3 (IQR: 18.2–31.7) g but it was not statistically significant ($p = 0.333$). Biventricular conversion was achieved in 10 patients (62.5%), 4 (25.0%) are yet to undergo conversion, one patient underwent Fontan completion and atrial septectomy and only one was listed for transplant, as the patient was not fit for single ventricle palliation or biventricular conversion. There were no complications related to the procedure.

Conclusions: Staged ventricular recruitment by fenestrated atrial septation to divert flow into the hypoplastic ventricle, without VSD closure can result in growth of the hypoplastic ventricle enabling subsequent biventricular conversion in a subset of patients. Further studies are needed to identify candidate patients who may be best suited to this approach.

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91. Planned Growth of Hypoplastic Cardiac Structures to Achieve Improved Long-Term Outcomes

Daniel Labuz[1], Lee Pyles[2], James Berry[3], *John Foker[3]

[1]Oregon Health Sciences University, Portland, OR; [2]West Virginia University, Morgantown, WV; [3]University of Minnesota, Minneapolis, MN

Invited Discussant: *Thomas L. Spray

Objective: Congenital heart defects (CHD) may include hypoplastic valves, ventricles and/or vessels which complicate repairs and compromise long-term outcomes. Our hypotheses were that, 1) hypoplastic structures are developmental rather than primarily genetic in origin and, 2) the correct biomechanical signal would induce catch up growth. Our corollary hypothesis was that the signal is flow, not pressure. The first-stage operations, therefore, were designed to increase flow and induce growth. Once sufficient growth had occurred, a secondary operation completed the repair. We report the results for flow induced growth of hypoplastic structures in three types of CHD repairs that led to improved outcomes such as two-ventricle repairs (2VRs).

Methods: Three groups of CHD patients with associated hypoplastic structures were reviewed: Unbalanced atrioventricular canal defects (UAVC); Pulmonary atresia with intact ventricular septum (PAIVS); and Coarctation of the aorta (CoA). Evaluation was by pre- and postoperative echocardiographic analysis, which was converted to Z-scores (Table). Operations included creating restrictive septal defects to increase flow through hypoplastic AV valves and ventricles (UAVC, PAIVS) and the relief of obstruction (principally CoA patients) which increased aortic valve and arch flow. No operation required circulatory arrest. All procedures increased flow through the hypoplastic structures.

Results: Follow-up evaluation found virtually all (85/90) hypoplastic structures reached normal size and the remaining five showed significant growth and were within one SD of normal. Subsequent growth had proceeded normally and few required cardiac medications (Table). In no case was a single-ventricle repair track needed.

Growth of Hypoplastic Structures Seen With CHD

	Pre OP	Post OP (< 1 yr f/u)	Most Recent (3-14 years)	No Cardiac Medications
Group:- UAVC AV Valve	**Z= -4.5 ± 1.7**	**Z= -0.3 ± 0.9**	**Z= 0.2 ± 0.7**	15/18
(# hypoplastic)	(11/22)	(0/5)	(0/18)	
Ventricle	**Z= -4.2 ± 1.6**	**Z= -2.4 ± 1.2**	**Z= -0.7 ± 1.1**	15/18
(# hypoplastic)	(21/22)	(3/6)	(2/18)	
Group:- PAIVS Tricuspid Valve	**Z= -3.7 ± 1.6**	**Z= -3.1 ± 0.9**	**Z= 0.0 ± 1.1**	N/A
(# hypoplastic)	(16/19)	(5/7)	(1/17)	
R Ventricle	**Z= -5.1 ± 2.5**	**Z= -1.4 ± 1.9**	**Z= 0.5 ± 1.3**	N/A*
(# hypoplastic)	(18/19)	(2/7)	(1/17)	
Group:- CoA Aortic Valve	**Z= -3.1 ± 1.8**	**Z= -1.2 ± 1.3**	**Z= -0.9 ± 1.5**	12/15
(# hypoplastic)	(8/15)	(2/14)	(3/15)	
Transverse Arch	**Z= -3.6 ± 1.3**	**Z= -1.0 ± 1.5**	**Z= -0.7 ± 0.9**	15/21
(# hypoplastic)	(22/22)	(4/19)	(1/21)	

UAVC: Unbalanced A-V canal defect; PAIVS: Pulmonary atresia with intact ventricular septum; CoA: Coarctation of the aorta in infancy.
Z= Z-score (standard deviations below (-) or above (+) expected).
*At 5 year f/u, 8/8 RVs studied had normal EF (74.5 +/- 8.1 %)

Conclusions: 1) Operations designed to increase flow through hypoplastic structures reliably induced catch up growth in UAVC, PAIVS and CoA lesions. 2) The growth response supported that underdevelopment was the cause of hypoplasia and flow was the growth signal which could reverse it. 3) Growth induction reliably allowed 2VRs in UAVC and PAIVS patients and avoided extended arch repairs in CoA. 4) Following catch up growth of the hypoplastic lesions, the outlook improved to that of patients with balanced AVCs and normal-sized RVs in pulmonary stenosis. 5) Once normal size was reached, growth continued normally, producing a durable result. 6) Normal-sized but previously hypoplastic structures still allowed adequate function and reduced the need for cardiac medications.

Staged Ventricular Recruitment – Strategies to Rehabilitate Borderline Ventricles

◆Sitaram Emani, *Boston Children's Hospital, Boston, MA*

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92. Surgical Algorithm and Results for Repair of Pulmonary Atresia/Ventricular Septal Defect/Major Aortopulmonary Collaterals

*Frank L. Hanley, *Richard Mainwaring, William L. Patrick, Steve Roth, Komal Kamra, Lisa Wise-Faberowski

Stanford University, Stanford, CA

Invited Discussant: *Christian P. Brizard

Objective: Pulmonary atresia with ventricular septal defect and major aortopulmonary collaterals (PA/VSD/MAPCAs) is a complex and heterogeneous form of congenital heart disease. There is an ongoing controversy regarding the optimal treatment of PA/VSD/MAPCAs. The purpose of this study was to summarize our algorithm and surgical results for PA/VSD/MAPCAs.

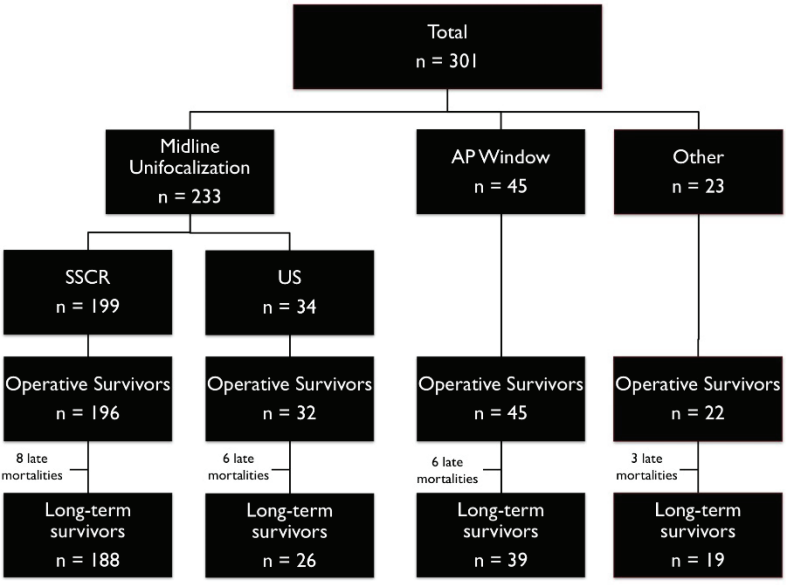
Methods: This was a retrospective review of 301 patients (2001–2016) undergoing primary surgical treatment of PA/VSD/MAPCAs. Excluded from this analysis were patients who had undergone prior surgical treatment at another institution and patients with single ventricle and MAPCAs. There were three surgical pathways, including: 1) Mid-line unifocalization (n = 233), 2) Creation of an aortopulmonary window (n = 45), and 3) Other (n = 23).

Results: For the 233 patients who underwent mid-line unifocalization, 199 (85.4%) had a single stage complete repair (including complete unifocalization with closure of the VSD and right conduit). The average right ventricle to aortic pressure ratio following complete repair for these 199 patients was 0.36 ± 0.09.

There were 34 patients who underwent a mid-line unifocalization and did not undergo single stage complete repair. These patients underwent an initial unifocalization and shunt and 22 have subsequently had a complete repair.

Forty five patients underwent an aortopulmonary window, of whom 33 have subsequently undergone complete repair. There were 23 patients who had complex anatomy and underwent procedures other than described above. Seventeen of these patients have subsequently undergone complete repair. Thus, for the patients currently eligible, 271 (92.4%) have achieved complete repair.

For the 72 patients who underwent a staged complete repair, the average right ventricle to aortic pressure ratio was 0.39 ± 0.07. This was slightly higher compared to those patients who underwent single-stage complete repair ($p < 0.05$). There were a total of 6 (2.0%) operative mortalities at the initial surgical procedure, and 23 (7.6%) late mortalities (as summarized in the figure). The combined early and late mortality was 3.2 X lower in patients who underwent single-stage complete repair compared with all other initial procedures ($p < 0.01$).



Conclusions: The data demonstrate that more than 90% of patients with PA/VSD/MAPCAs underwent complete repair, with average right ventricular pressures less than 40% systemic. The overall mortality was significantly lower in the subgroup of patients who were able to undergo single-stage complete repair. These results demonstrate the favorable early- and mid-term outcomes that can be achieved in this heterogeneous group of patients with PA/VSD/MAPCA.

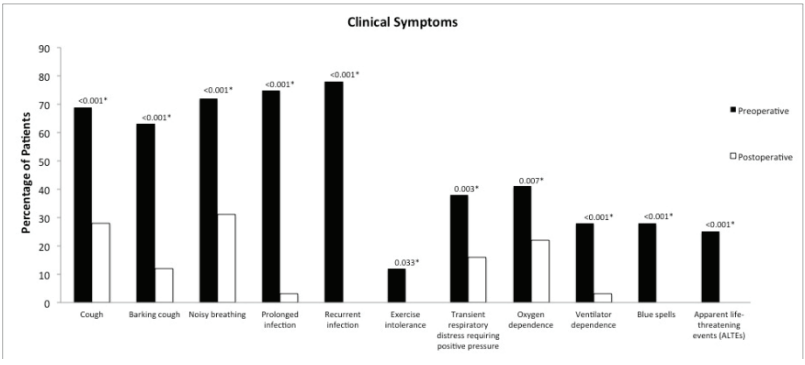
93. Descending Aortopexy and Posterior Tracheopexy for Severe Tracheomalacia and Left Mainstem Bronchomalacia

Hester F. Shieh, C. Jason Smithers, Thomas E. Hamilton, David Zurakowski, Gary A. Visner, Michael A. Manfredi, Russell W. Jennings, Christopher W. Baird
Boston Children's Hospital, Boston, MA

Invited Discussant: *Michael E. Mitchell

Objective: In severe tracheomalacia, posterior tracheopexy has been shown to improve airway patency by addressing posterior membranous tracheal intrusion. Its effectiveness can be limited by left mainstem bronchomalacia from compression between the descending aorta and pulmonary artery. Posterior descending aortopexy can be used to relieve this left mainstem compression. We review a series of patients who underwent descending aortopexy and posterior tracheopexy for severe symptomatic tracheobronchomalacia with posterior intrusion and left mainstem compression to determine if there were resolution of clinical symptoms and bronchoscopic evidence of improvement in airway collapse.

Methods: All patients who underwent both descending aortopexy and posterior tracheopexy at our institution from October 2012 to October 2016 were retrospectively reviewed. Clinical symptoms, tracheomalacia scores based on standardized dynamic airway evaluation, and persistent airway intrusion requiring reoperation were collected. To determine tracheomalacia scores, the tracheobronchial tree was evaluated on bronchoscopy by anatomical region and open airway with a standardized scoring system. The percentage of open airway was scored out of 100 for each anatomical region (upper, middle, and lower trachea; right and left mainstem bronchi). Data were analyzed by the Wald and Wilcoxon signed-ranks tests.



Results: Thirty-two patients (63% male) underwent descending aortopexy and posterior tracheopexy at median (IQR) age 18 months (6–40). 66% were associated with esophageal atresia (EA) and 69% with cardiac disease. 63% had a prior EA repair and 19% had a prior anterior aortopexy. Median (IQR) follow up was 3 months (1–7). There were statistically significant improvements in clinical symptoms postoperatively, including cough, noisy breathing, prolonged and recurrent respiratory infections, ventilator dependence, blue spells, and apparent life-threatening events (ALTEs) (all $p < 0.001$), as well as exercise intolerance ($p = 0.033$), transient respiratory distress requiring positive pressure ($p = 0.003$), and oxygen

dependence (p = 0.007) (Figure). Total tracheomalacia scores (median [IQR]) on bronchoscopy improved significantly from 215 (145–268) to 450 (360–475) (p < 0.001), with significant segmental improvements in the middle (p = 0.003) and lower (p < 0.001) trachea, and the right (p = 0.011) and left (p < 0.001) mainstem bronchi. Two patients (6%) had persistent airway intrusion requiring reoperation with anterior aortopexy or tracheopexy. There was no mortality.

Conclusions: Descending aortopexy and posterior tracheopexy are effective in treating severe tracheobronchomalacia and left mainstem compression with significant improvements in clinical symptoms and degree of airway collapse on bronchoscopy.

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94. Early and Mid-Term Results of Autograft-Sparing/Ross Reversal: A One-Valve Disease Need Not Become a Two-Valve Disease

Syed T. Hussain, David Majdalany, Robert D. Stewart, Antoine Addoumieh,
*Eugene H. Blackstone, Gosta B. Pettersson
Cleveland Clinic, Cleveland, OH

Invited Discussant: *Giovanni Battista Luciani

Objective: Risk of reoperation and loss of a second native valve are major drawbacks of the Ross operation. Allograft or composite root replacement for a failed autograft leaves the patient with an allograft in the pulmonic position that is subject to further deterioration and need for a subsequent technically-demanding reoperation. Rather than sacrifice the failed autograft, it is reused, placing it back into the native pulmonary position: "Ross reversal." We reviewed our early and mid-term results of this operation.

Methods: From 9/2006 to 10/2016, 39 patients underwent reoperation for autograft dysfunction. The autograft was successfully salvaged in 35 patients, by Ross reversal in 30, David procedure in 4, and autograft repair in 1. The autograft could not be salvaged in 4 patients, 1 each due to previous subcoronary autograft implantation, a failed autograft repair with aortic valve replacement, attempted David procedure, and poor autograft quality. Medical records were reviewed for patient characteristics, prior operations, indications for reoperation, hospital outcomes, and echocardiographic findings for the 30 patients undergoing successful Ross reversal.

Results: Mean age was 45 ± 13 years (range: 18–67 years) and 26 were male. Median interval between original Ross procedure and Ross reversal was 12.5 years (range: 5–19 years). All 30 patients had autograft dysfunction with regurgitation and/or root dilatation. 21 patients also had an indication for reoperation on the pulmonary allograft. 22 were first-time reoperations; 5, second-time; 1, third-time; and 2, fourth-time. Eight previous reoperations were performed in 6 patients for pulmonary allograft dysfunction, including three in one patient. The autograft was excised and replaced into the native pulmonary position followed by either aortic root replacement with a composite root or an allograft. 12 concomitant procedures were performed, including 5 hemiarch replacements; 6 patients required brief hypothermic circulatory arrest. There was no in-hospital or operative

mortality. One patient required reoperation for bleeding. Another had abdominal aorta injury from use of an endo-clamp. There was no other major postoperative morbidity and median postoperative hospital stay was 8.0 days (range: 4–41 days). None of the patients required reoperation in the follow-up period (median 1.7 years, range: 1 month to 10 years). On echocardiography, 21 patients had excellent pulmonary valve function, whereas 9 developed mild-to-moderate regurgitation or pressure gradient that is clinically well tolerated.

Conclusions: Ross reversal can be performed with low morbidity and good pulmonary valve function in the majority of patients. This may provide some reassurance to patients considering the Ross operation, and weakens the argument that the Ross procedure transforms a single-valve disease into a two-valve disease.

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95. Surgical Unroofing of Hemodynamically Significant Myocardial Bridges in a Pediatric Population

Katsuhide Maeda, Daniel J. Murphy, Ingela Schnittger, Jennifer A. Tremmel, *Frank L. Hanley, Robert Scott Mitchell, Ian S. Rogers

Stanford University, Stanford, CA

Invited Discussant: ◆Paul J. Chai

Objective: Although myocardial bridges are generally regarded as incidental findings, it has been reported that adults patients with symptomatic myocardial bridges refractory to medical therapy benefit from surgical unroofing. However, there is very limited data in the pediatric literature regarding the indication for surgery, the optimal surgical procedure, and the postoperative outcomes. The aim of our study was to evaluate the indications for unroofing and the surgical outcomes in our pediatric patients.

Methods: We retrospectively reviewed all myocardial bridge patients in our institution who underwent surgical relief of myocardial bridges. Baseline clinical characteristics, relevant diagnostic data (stress echocardiography, computed tomography angiography, intravascular ultrasound, and invasive hemodynamic assessment with dobutamine for measurement of diastolic fractional flow reserve), intraoperative findings, and post-operative outcomes were evaluated.

Results: Between September 2012 and September 2016, 12 pediatric patients (7 male, 5 female; average age 15.8 years, range: 11–20 years; body weight; 61.2 ± 11.2 kg) underwent surgical unroofing of LAD myocardial bridges. Eleven of the 12 patients had chest pain refractory to medical therapy. Two of the 11 experienced prior syncope, 1 of which had inducible VF on EP study. One of the 12 patients was asymptomatic until experiencing aborted sudden cardiac arrest during an athletic event. One patient was previously treated for Kawasaki disease, though was without sequela. One patient had previously undergone surgical repair of subaortic membrane and aortic coarctation. Eleven of the 12 patients underwent exercise stress echo, all of which had mid septal dyssynergy on stress images suggestive of a myocardial bridge. Coronary CT confirmed the anatomic presence of myocardial bridges in all patients. IVUS confirmed the length of myocardial bridges:

29.3 ± 16.5 mm, halo thickness: 0.6 ± 0.3 mm, compression at resting heart rate: 30.8 ± 10.8%, and number of jailed septal branches: 2.6 ± 1.7. Invasive hemodynamic assessment with dobutamine confirmed the physiologic significance of the bridges with diastolic fractional flow reserve at peak heart rate: 0.6 ± 0.1. Myocardial bridge unroofing was performed under cardiopulmonary bypass in the initial nine cases and without the use of bypass in the subsequent three cases. All patients were discharged without major complications. The 11 patients with chest pain reported resolution of symptoms on follow up. The patient with inducible VF was no longer inducible on repeat post-operative EP study.

Conclusions: Surgical unroofing of myocardial bridges can be safely performed in pediatric patients, with or without the use of cardiopulmonary bypass. In symptomatic patients in whom physiologic significance of a bridge is established, unroofing can provide relief of chest pain refractory to medical therapy.

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96. Intraoperative Completion Angiogram May Be Superior to Transesophageal Echocardiogram for Detection of Pulmonary Artery Residual Lesions in Congenital Heart Surgery

Luke Lamers, Erick Jimenez, Catherine Allen, Derreck Hoyme, Entela B. Lushaj, Petros V. Anagnostopoulos

University of Wisconsin, Madison, WI

Invited Discussant:

Objective: Intraoperative residual pulmonary artery (PA) stenosis is difficult to diagnose with trans-esophageal echocardiography (TEE). We hypothesized that intraoperative completion angiogram is superior to TEE for detection of residual PA lesions.

Methods: All patients who had surgery involving the PAs in a hybrid suite over a 2-year period had postoperative TEE and completion angiograms that were reviewed retrospectively. Post-operative TEE imaging was interpreted by 2 physicians blinded to surgical and completion angiography results. TEE imaging results were categorized as adequate repair, inadequate requiring revision or unable to assess. TEE data was compared to results of completion angiography obtained immediately post-repair and to operative notes to determine the ability of each modality to reliably detect significant residual lesions.

Results: Nineteen patients, (median age 5 months [range: 0–17] and weight 6 kg [2.7–10.8]), had TEE and completion angiography following PA surgery. Diagnosis included single ventricle variants (n = 13), Tetralogy of Fallot variants (n = 4), corrected transposition (n = 1) and multiple ventricular septal defects (n = 1). Surgeries included: Glenn operation (n = 8), PA reconstructions (n = 4), main PA bands (n = 4) and bilateral PA bands (n = 3). 50% of TEE imaging of the surgical repair was graded as inadequate. Based on TEE results surgical revision was indicated in 2/19 patients. Completion angiography documented residual PA stenosis prompting surgical revision in 5/19 patients (26%). Four patients required left and 2 right PA stenosis revision. An additional main PA band was tightened following hemodynamic and angiographic assessment due to increased PA pressures and excessive pulsatility into a concomitant Glenn anastomosis. No patient with PA abnormali-

ties had hemodynamic instability or excessive desaturations coming off bypass. One Glenn patient with adequate image quality and repair by TEE, was found to have moderate left PA stenosis by angiography (Figure). All other discrepancies occurred in patients with inadequate TEE imaging of the surgical repair. Intraoperative angiography related complications included atrial tachycardia (n = 2) and transient complete heart block (n = 1).

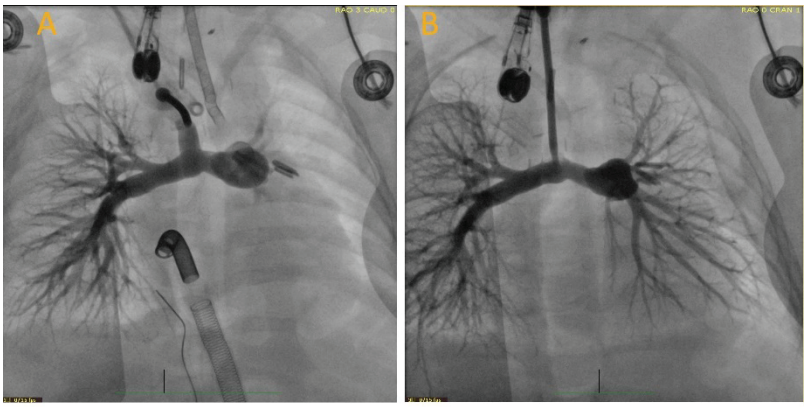


Figure 1: Post Glenn completion angiography before (A) and after (B) left PA revision. TEE imaging documented patent Glenn and proximal branch PAs with no evidence of left PA stenosis.

Conclusions: Completion angiography may be more effective in detecting postoperative PA stenosis compared to TEE even in patients who do not manifest clinical symptoms. Documentation of PA stenosis with completion angiography is low risk and allows immediate surgical revision potentially limiting necessity for future PA interventions.

9:35 am – 9:45 am **Coffee Break**

WEDNESDAY MORNING, MAY 3, 2017

7:30 am – 9:45 am **General Thoracic Surgery** Room 312, Hynes
Simultaneous Scientific Session
5 minute presentation, 6 minute discussion

Moderators: *Wayne Hoffstetter and ◆Katie Nason

97. Induction Therapy for Locally Advanced Distal Esophageal Adenocarcinoma: Is Radiation Always Necessary?

Douglas Z. Liou, Leah Backhus, *Joseph Shrager, *Mark F. Berry
Stanford University, Stanford, CA

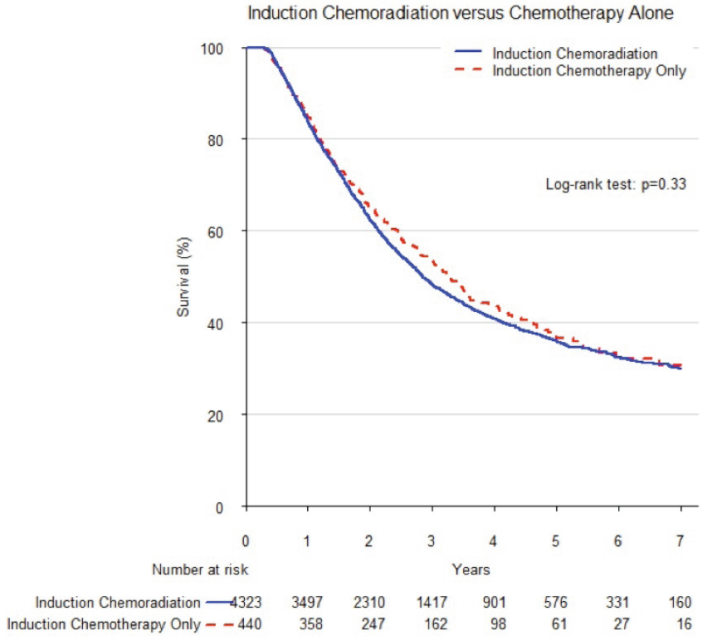
Invited Discussant: *Brendon M. Stiles

Objective: Randomized trials have shown that both induction chemotherapy alone (ICA) and induction chemoradiation (ICR) have survival benefit over primary surgery in patients with locally advanced adenocarcinoma of the distal esophagus or gastroesophageal junction, but direct comparisons of the two induction strategies

are limited. This study tested the hypothesis that survival after ICR is better than ICA for patients with distal esophageal adenocarcinoma who underwent induction therapy followed by surgery.

Methods: Outcomes of patients in the National Cancer Database between 2006 and 2012 treated with ICA or ICR followed by esophagectomy for cT1-3N1M0 or cT3N0M0 adenocarcinoma of the distal esophagus were compared using logistic regression, Kaplan-Meier analysis, and Cox-proportional hazards methods.

Results: A total of 4,763 patients comprised the study group, of which 4,323 (90.8%) received ICR and only 440 (9.2%) received ICA. There were no significant differences in age, gender, race, Charlson comorbidity index, treatment facility type, clinical T status, or clinical N status between the two groups in univariate analysis. Tumor size >5 cm (OR: 1.46, p = 0.006) and living in a census tract with education status above the median (OR: 1.48, p = 0.012) were the only factors that predicted ICR use in multivariable logistic regression. There were no statistically significant differences in post-surgery hospitalization, 30-day readmission, 30-day mortality, or 90-day mortality between the groups. Higher rates of T downstaging (39.7% vs 33.4%, p = 0.012), N downstaging (32.0% vs 23.4%, p < 0.001), and complete pathologic response (13.1% vs 5.9%, p < 0.001) occurred in ICR patients, and positive margins were seen more often in ICA patients (9.6% vs 5.5%, p = 0.001). However, there were no differences in 5-year survival (ICR 35.9% vs ICA 37.2%, p = 0.33; Figure) between the groups in univariate analysis, and ICR was not associated with survival in multivariable analysis (HR: 1.04, p = 0.6).



Conclusions: Using ICR for patients with locally advanced distal esophageal adenocarcinoma is associated with a better local treatment effect but not improved survival compared to ICA. These results suggest that routine use of radiation in addition to chemotherapy is not necessary. Further investigation is needed to identify patient and tumor characteristics where radiation should be selectively utilized.

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98. Use of Drain Amylase Allow for Early and Definitive Intervention of Esophageal Leaks and Aids in Preventing Esophagectomy Mortality

*Philip A. Linden, Yaron Perry, Vanessa Ho, Luis Argote-Greene, Jennifer Ginsberg, Susan Fu, Miri Shlomi, Christopher W. Towe

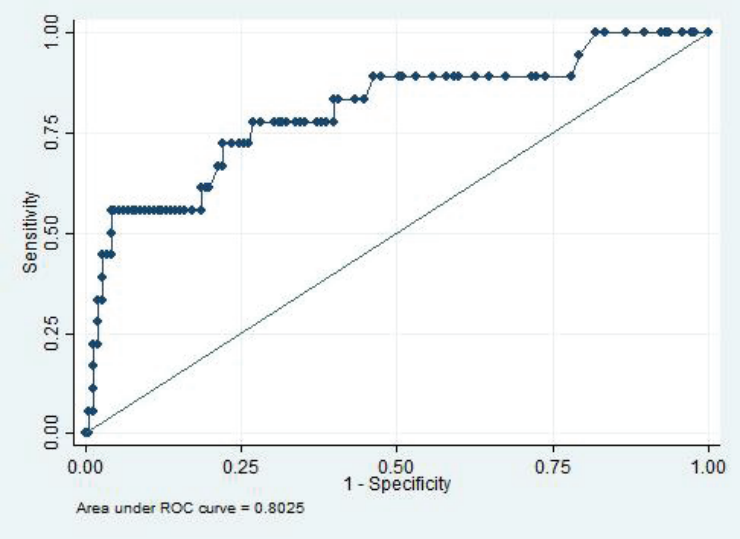
University Hospitals Cleveland Medical Center, Cleveland, OH

Invited Discussant: *Jay M. Lee

Objectives: Despite an expected number of complications, our institution has seen no perioperative deaths following 200 consecutive esophageal resections with gastric conduit reconstruction. We hypothesized that drain amylase obtained early in the postoperative period could predict a leak requiring intervention later in the postoperative course, allowing for rapid and accurate intervention for esophageal leaks and averting perioperative mortality.

Methods: Our previous 200 consecutive esophagectomies with gastric conduit reconstruction were reviewed. The timing and nature of interventions among patients with esophageal leaks were noted. Serial drain amylase and barium swallows, along with time of diagnosis of complication and time to first intervention and other clinical factors were reviewed. Receiver Operating Characteristic (ROC) analysis of daily amylase levels was performed to obtain cutoffs for sensitivity and specificity in detecting leaks early in the postoperative period.

Results: The preoperative comorbidities of this cohort were comparable to the general STS database in regards to age, male gender, preoperative FEV1, and incidence of CAD, CHF, HTN, DM and preoperative chemoradiation. 64.5% (129/200) of esophagectomies were performed minimally invasively. Combined 30 day and in hospital mortality was 0% (0/200). Ninety-day mortality was 1.0% (2/200). One year Kaplan-Meier survival was 87.5% (95% CI [0.819–0.916]). 14.5% (29/200) of patients required intervention for anastomotic leak. ROC analysis of the ability of day 4 amylase levels to predict an esophageal leak yielded an area under the curve of 0.803 (Figure). A drain amylase level greater than 32 was 89% sensitive (but only 54% specific) in predicting a leak requiring intervention. A drain amylase above 124 on POD4 was 90% specific (but only 56% sensitive) for a leak requiring intervention. Interventions (some patients had more than one) included opening of incision in 9.5% (19/200), endoscopy/stent in 3.5% (7/200), and reoperation in 5.0% (10/200). The highest and final level of intervention (antibiotics, opening incision, stent, or operation) occurred within 24 hours of presentation of leak in 86.2% (25/29) and prior to esophagram in 75.8% (22/29). The median stent duration was 28 days (range: 3–55); all but two stents were removed prior to 31 days. Of all patients needing reintubation in the postoperative period, 92% (22/24) were performed in controlled fashion in the OR or ICU—only two suffered unrecognized deterioration requiring emergent intubation on the floor.



Conclusions: The routine use of drain amylase as an early diagnostic tool to predict and detect esophageal leaks as well as lack of reliance on barium swallow allows for early transfer to ICU and definitive management of intrathoracic leaks within 24 hours of presentation and aids in preventing death following esophagectomy.

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99. Endoscopic Mucosal Resection for Submucosal Esophageal Cancer

David B. Nelson[1], Arlene M. Correa[1], Rajeev Dhupar[2], Alexei Goltsov[1], Dipen Maru[1], Boris Sepesi[1], Mara Antonoff[1], *Reza Mehran[1], *David C. Rice[1], *Garrett L. Walsh[1], *Ara Vaporciyan[1], *Stephen Swisher[1], *Jack A. Roth[1], Raquel Davila[1], Sonia Betancourt[1], Heath Skinner[1], Mariela Blum[1], *Wayne L. Hofstetter[1]

[1]MD Anderson Cancer Center, Houston, TX; [2]University of Pittsburgh, Pittsburg, PA

Invited Discussant: *Gail E. Darling

Objective: Endoscopic mucosal resection (EMR) is a diagnostic and potentially therapeutic option for superficial esophageal cancer. However, there are significant concerns regarding the risk of lymph node metastasis once esophageal cancer has reached the submucosa. Despite recommendations, many appropriately fit patients choose to avoid surgery in favor of alternative options. Our aim is to evaluate the outcomes of organ preservation after EMR for submucosal esophageal cancer.

Methods: From a prospectively maintained institutional database we reviewed patients who underwent EMR from 2007 to 2015 and were found to have submucosal invasion. Patients who were medically unfit to receive any further chemoradiation or surgery were excluded. The primary endpoints were local recurrence, regional recurrence, distant recurrence and cancer-related mortality. Time to event was measured using cox regression analysis, and differences between groups were measured with either unpaired t-test or chi-squared test.

Results: We identified 74 consecutive patients who met criteria for analysis. After EMR, 36 patients underwent esophagectomy and 38 patients opted for organ preservation. Median follow-up was 36 months. Patients that underwent esophagectomy were younger, and more likely to have a positive deep margin on endoscopy; however, there were no differences in rate of lymphovascular invasion (LVI), depth, or grade between groups (see table). Organ preservation on univariate analysis was an independent predictor of local recurrence (p = 0.042), whereas multivariate analysis showed that only tumor size was an independent predictor (p = 0.021). Rate of regional recurrence after organ preservation was 5% with no occurrences after surgery. LVI and tumor size were both independent predictors of distant recurrence (p = 0.031, p = 0.021) and cancer-related mortality (p = 0.029 and p = 0.010) with organ preservation showing no association with either (p = 0.613, p = 0.586). Mortality and cancer-related mortality after organ preservation versus esophagectomy were 16 vs 19% and 11 vs 8%. Patients who developed local recurrence after organ preservation underwent surgery (3 of 8), repeat EMR (2 of 8), or had definitive chemoradiation (2 of 8) with one patient developing distant metastases. Among organ preservation patients without LVI whose tumors were 2 cm or less in size, completely resected and moderate-well differentiated with invasion limited to SM1 (n = 8), there was one recurrence which was local only and treated with repeat EMR.

Table: Differences Between Patients Who Underwent Surgery and Those Who Elected for Organ Preservation

	Surgery (n = 36)	Organ Preservation (n = 38)	p-Value
Age	64	69	0.03
Receipt of chemoradiation	10/36 (28%)	14/38 (37%)	0.405
Positive deep margin on EMR	25/36 (69%)	10/38 (26%)	<0.001
T2 or higher invasion on esophagectomy among patients who had a positive deep EMR margin	3/36 (8%)	Unable to measure	
SM1	16/36 44%)	22/38 (58%)	0.247
LVI	16/36 (44%)	23/38 (61%)	0.665
Moderate grade vs poor grade	17/36 (47%)	23/38 (61%)	0.251
Local recurrence	1 (3%)	8 (21%)	0.042
Distant recurrence	3 (8%)	4 (11%)	0.613

Conclusions: Organ preservation after EMR for submucosal esophageal cancer was an independent predictor of local recurrence, although in patients with low risk features there was only one local recurrence and was treated endoscopically. These findings should prompt further investigation to determine the treatment options for patients with submucosal esophageal cancer.

100. Esophagectomy Versus Endoscopic Resection for Patients with Early-Stage Esophageal Cancer: A National Cancer Database Propensity-Matched Study

Katy A. Marino, Jennifer L. Sullivan, ◆Benny Weksler

University of Tennessee, Memphis, TN

Invited Discussant: *Haiquan S. Chen

Objectives: Endoscopic resection has become a popular treatment for stage T1a esophageal cancer. This study was designed to compare outcomes following esophagectomy or endoscopic resection in patients with stage T1a esophageal cancer.

Methods: The National Cancer Database was queried for all patients from 2006 to 2012 with T1a esophageal adenocarcinoma who underwent either esophagectomy or endoscopic resection. Patients who received preoperative therapy or had metastases at diagnosis were excluded. Kaplan-Meier analysis was used to examine survival. A balanced cohort was generated using propensity score matching with common variables including age, sex, race, insurance status, treatment facility type, Charlson-Deyo comorbidity score, and tumor grade.

Results: We identified 2,173 patients eligible for the study; 1,317 (60.6%) underwent esophagectomy and 856 (39.4%) underwent endoscopic resection. Their mean age was 65.4 years, and 1,842 (84.8%) were male. In the unmatched cohort, patients who underwent esophagectomy were younger (63.5 vs 68.3 years, $p < 0.001$), were more often operated on in community settings, were more likely to have a Charlson comorbidity score >0 (30.4% vs 22.5%, $p = 0.002$), and had longer mean hospital stays (14.3 vs 3.2 days, $p < 0.001$) than patients who underwent endoscopic resection. Patients who underwent esophagectomy had significantly better mean survival (84 vs 62 months, $p < 0.001$; Figure A). We were able to select 735 matched pairs. In the matched cohort, the two treatment groups were similar on variables entered into the propensity score, but patients who underwent esophagectomy had longer mean hospital stays (14.0 vs 3.6 days, $p < 0.001$) and were more likely to be readmitted within 30 days (7.0% vs 0.6%, $p < 0.001$). There was no significant difference in mean survival between treatments in the matched cohort (75 months for esophagectomy vs 63 months for endoscopic resection, $p = 0.162$; Figure B).

Figure 1A Unmatched Cohort

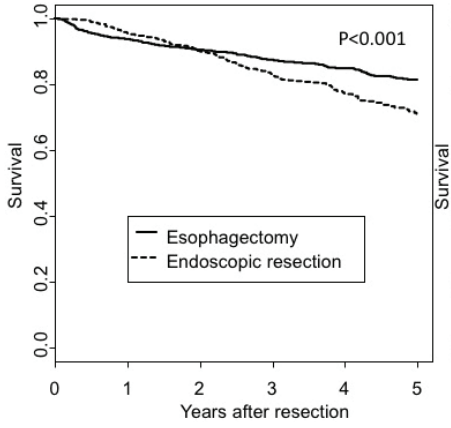
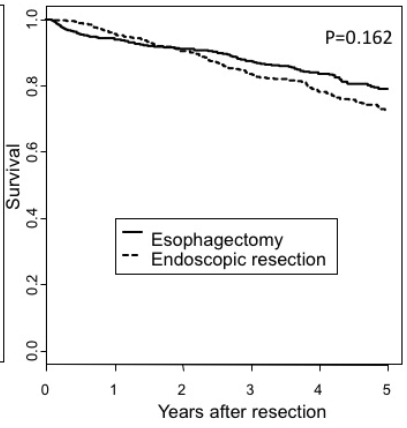


Figure 1B Propensity-Matched Cohort



Conclusion: In patients with early-stage esophageal adenocarcinoma, survival appears equivalent after endoscopic resection or esophagectomy, but endoscopic resection is associated with shorter hospital stays and fewer readmissions. These findings need to be validated in prospective studies.

Impact of Technology on Approach and Outcomes for Barrett Cancer and High Grade Dysplasia

Invited Speaker: *Bryan F. Meyers, *Washington University*

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101. Adjuvant Chemotherapy Improves Survival in Patients with Completely Resected, T3N0 Non-Small Cell Lung Cancer Invading the Chest Wall

Justin Drake, Jennifer L. Sullivan, ◆Benny Weksler

University of Tennessee, Memphis, TN

Invited Discussant: *Abbas E. Abbas

Objective: Adjuvant chemotherapy (AC) is effective in prolonging survival in non–small cell lung cancer (NSCLC) patients with N1 disease or when tumors are larger than 4 cm. Patients with T3N0 disease due to chest wall invasion often receive AC because their disease is classified as Stage II NSCLC (the same as patients with N1 disease). We designed this study to evaluate if AC improves survival after complete resection of T3N0 NSCLC with invasion of the chest wall, in particular, tumors smaller than 4 cm.

Methods: The National Cancer Database (NCDB) was used to identify patients from 2004 to 2013 who underwent complete resection of NSCLC with invasion of the chest wall. Patients who received preoperative therapy, had N1 or N2 disease, or had an incomplete resection (R1 or R2) were excluded. Two cohorts were created: one containing patients with tumors of any size, and one containing patients with tumors ≤4 cm in greatest dimension. Within each cohort, we performed propensity-matching of patients who received AC and patients who did not based on age, sex, race, Charlson comorbidity score, tumor size, and type of institution where the patient received treatment. Survival was examined using Kaplan-Meier analysis. Significance was set at $p \leq 0.05$.

Results: We identified 2,705 eligible patients; 1,548 (57%) received AC, and 1,157 (43%) did not. Patients who received AC were younger (63.1 vs 69.7 years, $p < 0.001$), had larger tumors (5.4 cm vs 5.0 cm, $p < 0.001$), and were more likely to have a comorbidity score of 0 (51.6% vs 46.7%, $p < 0.001$) as compared to patients who did not receive AC. Patients who received AC also had a significantly better median survival (66 months vs 31 months, $p < 0.001$). We matched 896 patient pairs from the 2,705 eligible patients. The two groups (with and without AC) were well matched without differences in tumor size (5.2 cm for surgery with AC vs 5.3 cm for surgery without AC, $p = 0.530$). Patients who received AC after surgery had significantly better median survival than patients who underwent surgery without AC (61 months vs 33 months, $p < 0.001$). We then matched 303 patient pairs with tumors ≤4 cm. The mean tumor size was 2.7 cm in both groups (with and

without AC). Patients who received AC had significantly better survival as compared with patients who underwent surgery alone (76 months vs 46 months, p < 0.001) (Figure 1).

Figure1A Overall survival in the matched cohort, all tumor sizes. p<0.001

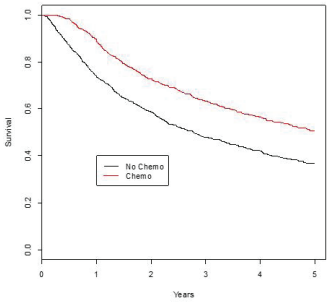
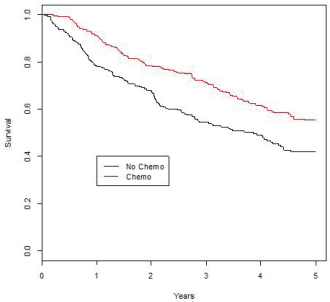


Figure1B Overall survival in the matched cohort with tumor size <40. p<0.001



Conclusion: In this large database study, AC significantly improved survival in patients with T3 (chest wall) N0 NSCLC after complete R0 resection. The benefits of AC were seen in patients with smaller tumors as well as those with a range of tumor sizes. These findings should be confirmed in larger prospective studies, but until then, AC is justified in patients with T3 (chest wall) N0 non–small cell lung tumors of any size that have been completely resected.

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102. Macroscopic Complete Resection Does Not Affect Survival in Patients with Malignant Pleural Mesothelioma: It Is All Histology and Nodal Disease

*Hasan F. Batirel[1], Muzaffer Metintas[2], Hale Basak Ozkok[3], Guntulu Ak[2], Perran Fulden Yumuk[1], Rengin Ahiskali[1], Emine Bozkurtlar[1], Tunc Lacin[1], Bedrettin Yildizeli[1], Mustafa Yuksel[1]

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Invited Discussant: *Isabelle Opitiz

Objective: Macroscopic complete resection (MCR) is the recommended surgical strategy in malignant pleural mesothelioma (MPM). The objective of this study is to analyze whether MCR contributes to survival in patients with MPM.

Methods: Between 2002 and 2016, 154 patients underwent pleurectomy decortication (PD) (n = 90), extrapleural pneumonectomy (EPP) (n = 42) or exploratory/diagnostic procedures (n = 22) for MPM in our clinic. The intent was to perform MCR through a posterolateral thoracotomy. Patient data were recorded in a prospective database. Demographic criteria (age, gender), histology, postoperative mortality (90-day), length of hospital stay, use of neoadjuvant/adjuvant treatment, MCR, pathologic stage, follow-up and survival were recorded. Kaplan-Meier survival and uni- and multivariate analyses were performed.

Results: Average age was 56 ± 10 (62 females). 110 had epithelioid histology. In hospital mortality was seen in 7 (4.5%). Mean length of hospital stay was 7.6 ± 3.9

days. Upfront treatment was applied in 32. 128 underwent adjuvant treatment (48 had chemoradiation). Mean follow-up was 21 ± 19 months. As of September 2016, 33 were alive. Overall median survival was 17.6 months. 2 and 5-year survivals were 35 and 15%, respectively. Epithelioid histology (Epithelioid/Biphasic/Sarcomatoid, Median Survivals 20.2, 14.5, 7.3 months, respectively, $p < 0.001$) and postoperative N0 status (N0/N2/NX, Median survivals 23.4, 10.8, 11.9 months, respectively, $p = 0.039$) were associated with improved survival. Mean number of lymph node stations sampled in N0 patients were 4.7 ± 3.5. In multivariate analysis histology and N0 stayed significant ($p < 0.001$ and 0.012, respectively). MCR did not cause any survival difference in the overall cohort, patients with epithelioid histology and patients with epithelioid and N0 status (Figure A, B, C). There was no difference in survival according to surgical technique (PD 18.2, EPP 19.3 and exploratory/diagnostic procedures 11.1 months, $p = 0.3$; Figure D), as well.

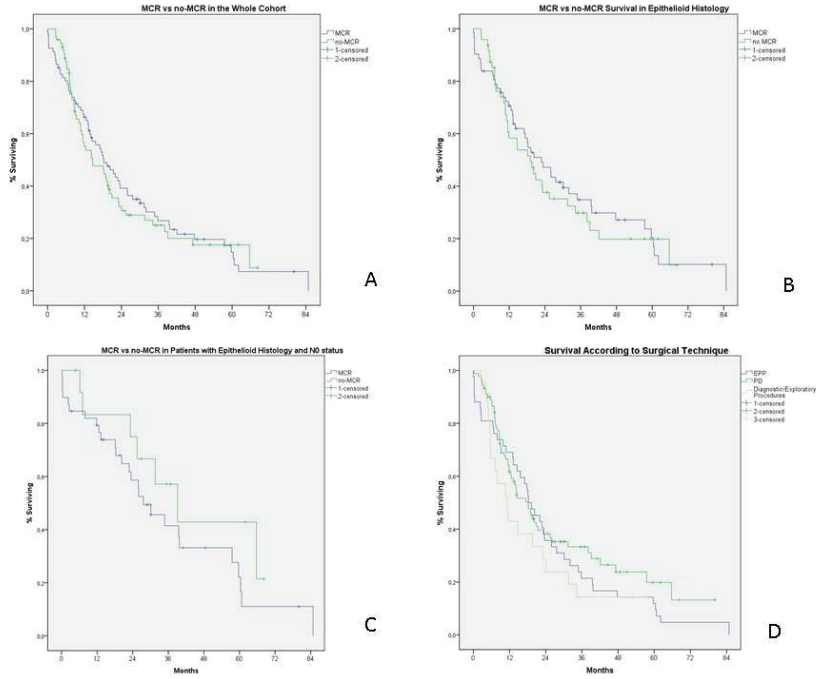

Figure: A. Median survival was 18.3 vs 14.6 months in MCR (n = 81) and no-MCR (n = 73) patients (p = 0.7). B. In patients with epithelioid histology, MCR (n = 62) resulted in a median survival of 22.8 months versus 19.1 months in no-MCR (n = 48) patients (p = 0.65). C. In patients with epithelioid histology and N0 status, MCR resulted in a median survival of 27.6 months versus 39.1 months in no-MCR patients (n = 0.22). D. Surgical technique also did not result in any survival advantage.

Conclusions: MCR does not prolong survival in patients with MPM. Histology and pathologic N0 status are prognostic and should be vigorously evaluated before proceeding with major surgical intervention. A randomized study is needed to determine the least traumatic surgical option that would provide the best quality of life and facilitate completion of multimodality treatments.

103. A Phase I Trial of Extrapleural Pneumonectomy or Pleurectomy/Decortication, Intrathoracic/Intraperitoneal Hyperthermic Cisplatin and Gemcitabine with Intravenous Amifostine and Sodium Thiosulfate Cytoprotection for Patients with Resectable Malignan

*David J. Sugarbaker[1], William Richards[2], *Raphael Bueno[2]

[1]Baylor College of Medicine, Houston, TX; [2]Brigham and Women's Hospital, Boston, MA

Invited Discussant: *Marc DePerrot

Objective: Intracavitary instillation of hyperthermic intra-operative chemotherapy (HIOC) with single agent cisplatin is used to treat surgical margins during resection of malignant pleural mesothelioma (MPM). This single-institution prospective phase I study investigated the maximum tolerated dose (MTD), toxicity and initial efficacy of gemcitabine added to cisplatin HIOC following either extrapleural pneumonectomy (EPP) or pleurectomy/decortication (PD) for MPM.

Methods: Scientific and Institutional Review Board approvals were obtained. Non-random assignment to treatment arms was based on the procedure most appropriate to the patient's fitness and potential for macroscopic complete resection. Gemcitabine dose escalation followed a 3+3 design from 100 mg/m^2 in 100 mg increments. Published intracavitary dosing of cisplatin (175–225 mg/m^2) with systemic cytoprotection were used (JTCVS 2009; 138:405–11). Fisher's exact and Mann-Whitney tests were used for comparison between arms. Overall survival (OS) from date of intent-to-treat registration was analyzed using Kaplan-Meier and Cox methods (Stata 13.1).

Results: From 2007 to 2011, 141 patients with MPM were enrolled: median age 68 (44–88); 25 (18%) females. EPP arm: n = 59, epithelioid histology 31 (53%), median radiographic tumor volume 236 cc (16–4,285); PD arm: n = 41, epithelioid 29 (71%), volume 79 cc (6–1,107). Two patients experienced operative mortality (2%). Morbidity (grades 2–5) was observed in 32 (54%) and 17 (42%) patients on the EPP and PD arms, respectively. DLT (Grade 3 leukopenia) was observed in two patients at 1100 mg/m^2 gemcitabine, establishing the MTD at 1000 mg/m^2, in combination with 175 mg/m^{2}cisplatin. At long-term follow-up (median 51 months for 23 censored patients), median OS was 17 months for all registered patients, 18 months for patients on the EPP arm, and 39 months for the PD arm. The survival comparison between arms is not significant ($p = 0.062$) in multivariable analysis accounting for tumor histology ($p < 0.001$) and volume ($p = 0.006$). OS for patients with epithelioid tumors was 26 and 59 months for EPP and PD arms, respectively, compared to 11 and 21 months for those with non-epithelioid tumors.

Conclusions: 1) Combination cisplatin/gemcitabine HIOC can be safely given in the context of complete surgical resection of MPM by EPP or PD. 2) MTD was established at 175 mg/m^2 cisplatin/1000 mg/m^2 gemcitabine with systemic cytoprotection. 3) Morbidity and mortality of this treatment are comparable to rates reported for surgical resection without HIOC (JTCVS 2004; 128:138–46). 4) In comparison to published experience with single agent cisplatin HIOC, the current protocol suggests that combination cisplatin/gemcitabine HIOC may enhance survival of patients with epithelioid but not non-epithelioid MPM.

104. Lung Adenocarcinoma with Perioperatively Diagnosed Pleural Seeding: Is Main Tumor Resection Beneficial for Prognosis?

Chi Li, Shuenn-Wen Kuo, Hsao-Hsun Hsu, Mong-Wei Lin, Jin-Shing Chen
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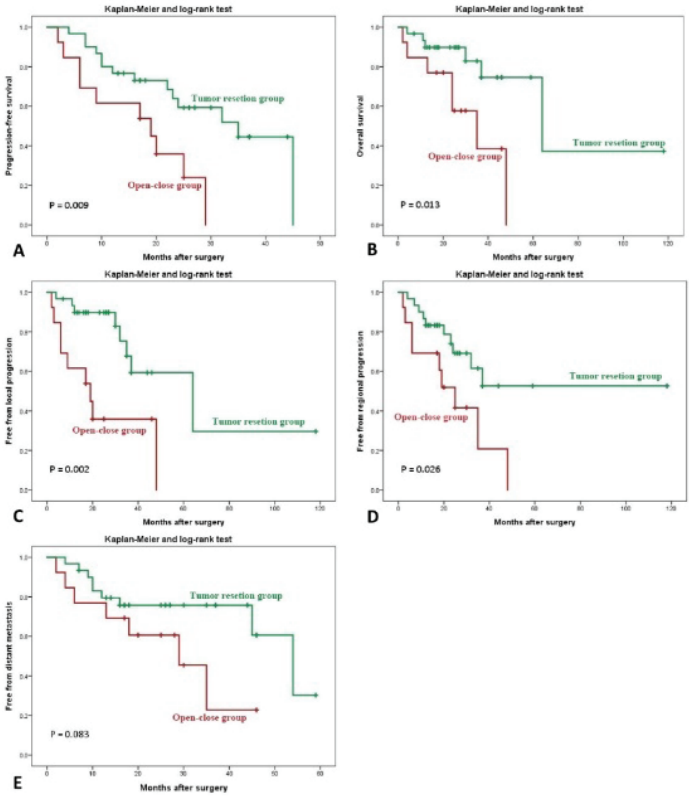
Invited Discussant: ◆Benny Weksler

Objective: To evaluate whether main tumor resection improves survival compared to pleural biopsy only in lung adenocarcinoma patients with perioperatively diagnosed pleural seeding.

Methods: In this retrospective study using a prospectively collected lung cancer database from January 2009 to December 2014, a total of 43 lung adenocarcinoma patients with pleural seeding diagnosed unexpectedly during the operation were included in this study. All these patients underwent preoperative chest computed tomography and positron emission tomography, and neither image-detected pleural seeding nor distant metastasis was noted. The choice of surgical approach of either main tumor resection or pleural biopsy only was at the discretion of each individual surgeon.

Results: Main tumor resection and all grossly visible pleural nodule resection were performed in 30 patients (tumor resection group). The surgical methods of main tumor resection included lobectomy (n = 13; 43%) and sublobar resection (n = 17 [57%]). The other 13 patients received pleural nodule biopsy only (open-close group). There were no significant differences between the two groups in terms of age, gender, comorbidities, preoperative lung function, ECOG performance status, tumor size, clinical T and N stage, EGFR mutation status, neoadjuvant and adjuvant treatment. Patients in tumor resection group had a longer operative time than in open-close group (202 vs 76 minutes, p = 0.03). There was no other statistically significant difference in perioperative outcomes between the two patient groups, including blood loss amount, hospital stay, and surgical morbidity. Surgical method was the only statistically significant prognostic factor. The patients in tumor resection group were superior in both progression-free survival (3-year survival: 44.5% vs 0%, p = 0.009) and overall survival (3-year survival: 71.4% vs 25.0%, p = 0.013), compared to the open-close group (Figure A, B). The median overall survival was 30 months and 24 months in tumor resection group and open-close group, respectively. We applied the pattern of disease progression to clarify the differences of progression-free survival in the two groups. Tumor resection group had significantly better local progression-free survival (p = 0.002) and regional progression-free survival (p = 0.026), compared to open-close group (Figure C, D). There was no significant difference between two groups regarding time from surgery to detection of distant metastasis (p = 0.083), yet patients in the tumor resection group tended to have longer time before metastasis (Figure E).



Conclusions: We recommend main tumor resection and all grossly visible pleural nodule resection as the treatment of choice to improve progression-free and overall survival in lung adenocarcinoma patients with perioperatively diagnosed pleural seeding.

105. Lymph Nodal Metastasis in Thymic Malignancies-Results of the Chinese Alliance for Research in Thymomas Prospective Observational Study

Wentao Fang[1], Zhitao Gu[1], Yun Wang[2], Liewen Pang[3], Weiyu Cheng[4], Yi Shen[4], Peng Zhang[5], Yongyu Liu[6], Chun Chen[7], Xinming Zhou[8], *Keneng Chen[9], Yangchun Liu[10], Jianhua Fu[11], Jianyong Ding[12], Lijie Tan[12], Yongtao Han[13], Yin Li[14], Zhentao Yu[15], Teng Mao[1], Jun Yang[1], Kejian Cao[1]

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Invited Discussant: *Cameron D. Wright

Objective: The real incidence of lymph node metastases in thymic malignancies is unclear. And it is never known whether lymph node dissection is necessary for these tumors. This study was to define the incidence and risk factors of nodal metastases in thymic tumors through a multicenter prospective observational trial by the Chinese Alliance for Research in Thymomas (ChART).

Methods: From June 2014 to August 2015, thymic tumor patients without preoperative therapy, who underwent total thymectomy and intentional nodal sampling or dissection, were prospectively collected. Tumor staging was based on the ITMIG proposal for the UICC staging system. Results from this prospective study were then compared with a previously reported ChART retrospective study.

Results: Two-hundred seventy-five patients were enrolled in the study. A mean number of 3.1 stations and 4.9 lymph nodes were harvested. Metastasis was detected in 41 nodes (3.04%) in 15 patients (5.5%). Nodal involvement in anterior (N1) and deep mediastinum (N2) was 73.3% (11/15) and 60% (9/15). There were 5 (33.3%) simultaneous N1 and N2 diseases, 6 (40%) multistation metastasis (NETT-37.5%, thymic carcinoma-8.3%, thymoma-0.4%, $p < 0.001$), and only 2 (13.3%) bilateral metastasis (both were NETT). No nodal involvement was found in type A or B1 thymomas. N(+) rate in thymomas, thymic carcinoma, NETT were 2.1%, 25% and 50%, respectively ($p < 0.05$), and in T1-4 tumors were 2.7%, 7.7%, 18.4%, and 50%, respectively ($p < 0.001$). Comparing with the results from the retrospective study, N(+) rate was higher in almost all histologic subtypes and in each T category (Table). In univariate analysis, WHO histologic type, T stage, tumor size, bilateral and deep mediastinal sampling were significantly associated with positive nodal disease. In multivariate analysis, histology subtypes B3/thymic cancer/NETT (HR: 9.857, 95% CI [2.522–38.521], $p = 0.001$), stage T3 or above (HR: 2.281, 95% CI [1.229–4.23], $p = 0.009$), and deep mediastinal nodal sampling (HR: 5.96, 95% CI [1.418–25.05], $p = 0.015$) predicted greater likelihood of finding nodal metastases. Based on histology and T stage, patients could be divided into a low-risk group (192/275 [69.8%]) with T1-2 and types A-B2 diseases with a mere 0.5% (1/192) N(+) rate, and a high-risk group (83/275 [30.2%]) of stage above T3 or histology over B3 tumors with 16.9% (14/83) nodal metastasis.

Table: Comparison of Rate of Lymph Node Metastasis Between the ChART Retrospective and Prospective Studies

Variables	Incidences of Nodal Metastasis (%)		Variables	Incidences of Nodal Metastasis (%)	
	ChART Retrospective Study	ChART Prospective Study		ChART Retrospective Study	ChART Prospective Study
WHO histology type			T stage		
A	0	0	T1a	0.3	2.0
AB	0	2.4	T1b	0	8.3
B1	0	0	T2	6.9	7.7
B2	0.4	1.6	T3	8.5	18.4
B3	2.7	5.6	T4	7.4	50
Ca	7.9	25			
NETT	16.6	50			

Conclusions: Lymph nodal involvement in thymic malignancies is more common than previously recognized. Intentional and extensive lymph node retrieval may yield to increased detection of nodal involvement and more accurate staging. Nodal metastasis is more frequent in tumors with aggressive histology and advanced T stage, and often in multiple stations or regions. Systemic dissection of both anterior and deep mediastinal lymph nodes in selected high-risk patients should be recommended.

9:45 am – 9:55 am **Coffee Break**

Masters of Surgery Video Sessions

9:45 am **Advanced Techniques for Complex Cardiac Surgical Challenges – Video Session** Room 302/304, Hynes

See page 81 for description.

9:45 am **Congenital Masters of Surgery Video Session** Room 306, Hynes

See page 81–82 for description.

9:55 am **GENERAL THORACIC MASTERS OF SURGERY VIDEO SESSION** Room 312, Hynes

See page 82 for description.

11:30 am **AATS Centennial Adjourns**