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THE AMERICAN ASSOCIATION FOR THORACIC SURGERY

1961-1962

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MONDAY MORNING, APRIL 16, 1962

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Monday Morning, April 16, 1962

8:30 A.M. Business Session (Limited to Members)
Khorassan Room

8:45 A.M. Scientific Session: REGULAR PROGRAM
Khorassan Room

1. Combined Preoperative Irradiation and Resection for Bronchogenic Carcinoma

DONALD L. PAULSON, ROBERT R. SHAW, JOHN L. KEE, RICHARD E. COLLIER *(by invitation),* and JOHN T. MALLAMS *(by invitation),* Dallas, Tex.

The natural history of bronchogenic carcinoma is such that surgery alone, however radical, is limited in its application to about one-third of the cases when first seen. Biologic factors of location, cell type and the response of the host predetermine operability. In spite of its limitations, surgery has been the only curative treatment heretofore adyocated for bronchogenic carcinoma in a localized phase. Results following resection may be improved mainly through a better selection of patients for surgery without a corresponding improvement in the cure rate for all patients with this disease. Irradiation therapy, although used mainly for inoperable lesions and postoperatively, has been proven to be of value in producing palliative results as well as prolonging life in individual cases. Preoperative irradiation in combination with resection has been utilized by the authors since 1956 for bronchogenic carcinomas located in the superior sulcus involving the chest wall and more recently for both operable and inoperable hilar lesions. A preliminary report of the results in over 40 cases of bronchogenic carcinoma treated by means of combined pre-operative irradiation and resection will be made.

2. Veterans Administration Surgical Adjuvant Lung Cancer Chemotherapy Study: Present Status.

FELIX A. HUGHES, and GEORGE HIGGINS *(by invitation),* Memphis, Tenn.
(Spokesmen for the VA Adjuvant Cooperative Group)

Since 1957 the cooperative group in 22 VA Hospitals has placed in the lung study 1,007 patients following pulmonary resection for bronchogenic carcinoma. Four hundred and fifty four of these patients are being followed at the present time. Information will be presented regarding the effect of nitrogen mustard administered as an adjunct to pulmonary resection on postoperative mortality and on subsequent survival of patients. The 30 day postoperative mortality in pre-study cases, in a group of cases given only saline, in the control groups of the concurrently randomized cases for the 0.4 mg/kg nitrogen mustard treated, and for the present 0.3 mg/kg series of cases has approximated 10%. The 30 day mortality of the cases treated with 0 4 mg/kg nitrogen mustard was 21.5% (20/92); for the present series treated with 0.3 mg/kg it is 15.5% (47/303). The complications and causes of death will be analyzed. Fifty percent three year survival has followed "curative" resection, while "palliative" resection has resulted in about 20% three year survival. New drugs available for adjuvant group trial will be discussed, as will the optimum time for adjuvant drug administration following pulmonary resection. Protocols for a treatment program using resection, radiotherapy, and chemotherapy are being formulated.

3. Larynx and Lung Cancer in the Same Patient: A Report of 40 Cases

WILLIAM G. CAHAN, and POMPEYO MONTEMAYOR *(by invitation),* New York, N. Y.

In a patient with cancer of the larynx, the possibility of a cancer of the lung existing either synchronously or metachronously should be considered. At Memorial Center there have been at least 40 instances in which primary carcinomas of larynx and lung have occurred in the same patient, 9 synchronously and 31 at a later date. When the cancers occur synchronously, the question of priority of management arises, and it has been our experience that the more malignant of the two, namely, the cancer of the lung, should be removed first. In the post-laryngectomy patient there is a particular problem in that the tracheotomy is often associated with tracheobronchial inflammation. These inflammatory processes, such as tracheitis sicca, often result in cough and sputum which may be bloody. Not infrequently symptoms are attributed entirely to the chronic irritation, but can be, manifestations of a separate lung cancer. In the follow-up of laryngectomized patients, it is suggested that chest x-rays be taken at 6-month intervals in order to be alert to the possibility of early lung cancer formation. In addition, any longstanding cough, with or without production of sputum through the tracheotomy, should be suspected of indicating lung cancer. In this series there have been 4 patients who have lived five years after their last surgical procedure Most of those who died of disease did so from lung rancer and its extension There is little question that increased numbers of survivors can be expected if the lung cancers were brought earlier to surgical management.

4. Intrathoracic Tumors Associated with Hypoglycemia

HERBERT C. MAIER, and DAVID BARR
(by invitation), New York, N. Y

Various metabolic abnormalities are being recognized more frequently with a variety of intrathoracic tumors. When hypoglycemia is present, the patient is frequently considered to have mental difficulty and the correct diagnosis may be long delayed This paper gives a summary and analysis of the various types of tumors found within the thorax which may be associated with severe hypoglycemic states. The recognition of this clinical entity is not difficult if the possibility of various nonpan-creatic tumors causing a low blood sugar is borne in mind The intrathoracic tumors causing hypoglycemia are chiefly large extrapulmonary growths of certain mesodermal types The tumor may be present for some years before the metabolic disturbances become manifest. If treatment is unduly delayed, chronic hypoglycemia may result in brain damage. With surgical excision of these tumors a return of the blood sugar to normal levels can usually be anticipated. Knowledge concerning the malignant potential of such tumors is still meager but in some instances a recurrence of hypoglycemia signals the appearance of metastases.

5. Clinical Evaluation of a New, Effective Mucolytic Agent

WATTS R. WEBB, Jackson, Miss.

Approximately one-fourth of all postoperative deaths are due to pulmonary complications and most of these are secondary to airway obstruction from retained secretions. This study has evaluated the effectiveness of N-acetyl cysteine in liquefying secretions during the operative and postoperative periods, and during the care of suppurative lung disease. The volume and character of the sputum and clinical results have been followed in over 200 patients. This agent has proved extremely effective in reducing the viscosity of mucoid and purulent secretions to aid their removal. In vitro, it produces liquefaction within one minute of contact. It has been safely administered by nebulization, direct instillation into a tracheotomy or through an indwelling percutaneous intratracheal catheter. The incidence of postoperative endotracheal suctioning, bronchoscopies, atelectasis and pneumonia has been markedly reduced. In particular, the postoperative respiratory care of small children has been greatly simplified. During operation, it is effective as a spray down the endotracheal tube for clearing tenacious secretions. Tracheostomy care is improved as crusting with secretions is prevented. Use prior to bronchograms has improved the filling in cases with heavy secretions. Mucosal biopsies and resected specimens have shown no mucosal changes The only adverse effect noted has been a rare incidence of bronchospasm in susceptible individuals.

6. The Premature or Critically-Ill Infant with Esophageal Atresia: Increased Success with a Staged Approach

THOMAS M. HOLDER, VICTOR G. MCDONALD, JR.,
Kansas City, and MORTON M. WOOLLEY, Los Angeles, Calif.
(all by invitation)

Sponsored by ROBERT E. GROSS, Boston, Mass

Today the fullterm infant with esophageal atresia has a good chance for survival with primary repair (80-90%). Most deaths occur in the premature infants or in patients who have already developed serious pneumonia (25 to 50% survival). The usual cause of death in these small patients is pulmonary complications. The present approach is one which (A) directs therapy toward clearing of pulmonary complications, and (B) allows for growth and maturation of the baby prior to the definitive procedure. This is accomplished by (A) a Stamm gastrostomy under local anesthesia as soon as the diagnosis of tracheo-esophageal fistula is made, (B) a retropleural division of the tracheo-esophageal fistula under local anesthesia 24 to 48 hours later, and (C) the definitive repair of the esophagus when the patient's condition and size (5 to 6 pounds) permits. Using this approach, 13 patients ranging in size from 2 pounds 13 ounces to 5 pounds 8 ounces, have been treated with 9 successes - a mortality of 31% in a group in which one would anticipate a 65 to 75% mortality with primary repair. Two of the 4 deaths occurred in infants with other major anomalies.

MONDAY AFTERNOON, APRIL 16, 1962

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Monday Afternoon, April 16, 1962

2:00 P.M. Scientific Session: REGULAR PROGRAM
Khorassan Room

7. Surgical Treatment and Follow-up of 140 Cases with Correction of Tetralogy of Fallot

HENRY T. BAHNSON, Baltimore, Md., FRANK C. SPENCER,
Lexington, Ky., CATHERINE A. NEILL *(by invitation),* and
HELEN B. TAUSSIG *(by invitation),* Baltimore, Md.

Since 1956 correction of the tetralogy of Fallot has been performed during cardiopulmonary bypass on 140 patients. In most cases this has been done with normal flow, normothermia, and with patching of the ventricular defect. The right ventricular outflow tract or pulmonary artery has also been patched when necessary to relieve the obstruction. Seventy-three per cent of the patients survived operation and have been followed. Important determinants of operative risk have included: coronary arteries which arise anomalously and cross the outflow tract or which have a major septal branch passing through the area of infundibular resection; pulmonary hypertension in association with a previous shunt; young age. A shunt operation had been done previously in most cases, but this added little to the risk of operation unless the anastomosis had been end-to-end or of aortic-pulmonary type. Selection of patients for operation, points in operative technique and postoperative care, and follow-up will be discussed.

8. Pulmonary Valvotomy and Infundibulotomy in Infants

M. WEINBERO, JR., J. P. BICOFF *(by invitation),*
H. G. BUCHELERES *(by invitation),* M. H. AGUSTSSON *(by invitation),*
M. BEHRAVESH *(by invitation),* J. D. ANDERSON *(by invitation),*
E H. FELL, and B M. GASUL *(by invitation),*
Chicago, Ill.

The results of closed transventricular pulmonary valvotomy and in-fundibulotomy (Brock operation) performed upon severely ill infants from three days to one year of age are presented. The defects in this group include pulmonary valve stenosis, pulmonary valve atresia, tetralogy of Fallot, transposition of the great vessels with pulmonary stenosis, tri-cuspid atresia, and tricuspid stenosis. In all instances operation upon these infants was considered urgent because of congestive heart failure or severe symptoms of hypoxia. The anatomic variations in the entities listed are discussed and demonstrated in relation to operative treatment Of particular importance in the use of this procedure is the fact that it does not interfere with the later performance of a corrective operation or a shunt for palliation after the child has been enabled to attain the age and size to make these procedures more easily performed with a low mortality. In the case of tetralogy of Fallot, the results obtained here are such that the Brock operation is considered by us to be the procedure of choice in small infants with severe symptoms, even though in some cases a second palliative operation may become necessary before a corrective operation is undertaken.

9. Corrected Transposition: The Surgical Features and Associated Anomalies

H. SAYED, W. P. CLELAND, H. H. BENTALL, D. G. MELROSE,
M. B. BISHOP, and J. MORGAN *(all by invitation),*
London, England
Sponsored by JOHN H. GIBBON, JR., Philadelphia, Pa.

The experience with sixteen cases of corrected transposition is presented, seven of whom were operated on under bypass. The condition is defined and the anatomy is briefly described. The associated cardiac anomalies are discussed correlating the incidence of conduction defects with the abnormal course of the conducting tissue. The clinical, cardiographic, radiographic and haemodynamic aspects of these cases are mentioned underlining the diagnostic points. Brief description of the pathological material will include three cases that died following surgery, and one case that died during investigation. The operative details of seven cases are presented with special emphasis on the surgical difficulties. Complete heart block which is the most important hazard following surgery is underlined and the significance of mitral valve lesion is discussed. Criteria for choosing cases with corrected transposition for surgery are suggested and a technique to minimize the surgical hazards is described.

10. Open Heart Surgery in Infants

HERBERT SLOAN, JOE D. MORRIS, JAMES MACKENZIE *(by invitation),* and
AARON STERN *(by invitation),* Ann Arbor, Mich.

Correction of intracardiac defects in infants has been accompanied by a high mortality rate which has been the result in part of difficulties in the use of extracorporeal circulation. Most present day equipment is too large and the volume of the extracorporeal circuit is too great to permit accurately balanced perfusions in infants weighing less than ten kilograms. An entire extracorporeal circuit and accessories designed for perfusions in infants has been developed. The priming volume has been reduced and all parts have been miniaturized. The equipment has been employed with a standard pumping unit. Experience in the use of extracorporeal circulation to repair intracardiac defects in more than 50 infants two years of age or less will be reported. The trials and tribulations of their care will be stressed. The improvement which results from increased experience and proper perfusion equipment will be cited.

11. A Two Stage Operation for Total Anomalous Pulmonary Venous Drainage in Childhood

W. T. MUSTARD, and J. D. KEITH *(by invitation),* Toronto, Canada

Thirty-five children with total anomalous pulmonary venous drainage have been operated upon at the Hospital for Sick Children, Toronto, in the past ten years. Twenty-one were of the supracardiac type with 1 into the right superior vena cava and the remainder into the left superior vena cava. In 6 children the drainage was into the coronary sinus, in 4 into the right atrium, and in 4 the drainage was mixed cardiac and supracardiac drainage. Seventeen of the children operated upon were in the first year of life and the majority of these under 6 months of age The presence of an atrial septal defect is mandatory for sustaining life. When the atrial septal defect or patent foramen ovale is small, death may occur in the first few weeks or months of life. If the atrial defect is large the child may survive a number of years. The larger the right to left shunt the greater the development of the left side of the heart. The infant who gets into trouble early in life has an inadequate right to left shunt, and, therefore, an underdeveloped left heart unable to meet the strain of total correction and the new load placed on the left ventricle. Our experience with total anomalous pulmonary vein drainage leading into the left superior vena cava following surgical anastomosis of the common vein to the left atrium, suggests it is better to leave the left superior vena cava patent and ligate it several months or a year or two later, after the left ventricle has developed sufficiently to accept the new load. In the adult such a two stage procedure may not be as necessary.

12. Renal Toxicity of Polybrene in Open Heart Operations

J. ALEX HALLER, JR. *(by invitation),* HERBERT T. RANSDELL, JR., and
W. FIELDING RUBEL *(by invitation),* Louisville, Ky.

Oliguria and occasionally acute renal shutdown are included in the complications of most series of open heart procedures In most instances this renal dysfunction is vaguely attributed to inadequate perfusion or blood reactions. In our experience at the Louisville Children's Hospital, there has been a striking correlation between this oliguria, rising BUN, and renal shutdown and the relative amount of undiluted Polybrene used in the operating room and subsequently in the recovery room. In the four patients who died of renal shutdown, distinctive renal lesions were noted at autopsy and all received greater than average doses of Polybrene To test this hypothesis 10 dogs were given graded doses of undiluted Polybrene to counteract comparable clinical Heparin doses. Varying degrees of uremia were produced and were again directly related to the increasing Polybrene dosages. This apparent Polybrene toxicity to the renal parenchyma will be discussed in relationship to the experimental and clinical findings.

13. Respiratory Insufficiency as a Factor in Postoperative Gastrointestinal Bleeding

WILLIAM S. BLAKEMORE, and SIDNEY K. WOLFSON, JR.
(by invitation), Philadelphia, Pa

Among 3,000 patients who had a craniotomy or thoracotomy between 1951-1959, 14 patients (4 after craniotomy, 10 after thoracotomy) without prior history of peptic ulcer had massive upper gastrointestinal bleeding. When blood CO_2 measurements were recorded, the venous contents and/or arterial tensions were elevated (59-80 mmHg). Nineteen patients without gastric, thoracic or intracranial lesions were studied. Free and total gastric acid was measured in aliquots obtained by continuous suction at 15' intervals during control periods of breathing air followed by breathing 5% CO_2 and 20% oxygen in nitrogen for one hour via an open circuit mask. A second one hour period of breathing air followed. Gastric acid (meq/min) increased in all subjects during the period of breathing the CO_2 gas mixture. Arterial pCO_2 and pH, and volume of the collected gastric sample were measured. From these data there appears to be a correlation between elevation of arterial pCO_2 and gastric acidity and postoperative upper gastrointestinal hemorrhage Respiratory insufficiency commonly associated with thoracotomy or craniotomy may be a common etiological factor and emphasizes the need for the measurement of arterial pCO_2 in these patients. Therapy to prevent or reverse these changes will be discussed.

TUESDAY MORNING, APRIL 17, 1962

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Tuesday Morning, April 17, 1962

8:30 A.M. Scientific Session: THORACIC SURGERY FORUM

Khorassan Room

14. An Objective Comparative Evaluation of Vascular Clamps

JD MORTENSEN, and GRANT A. HICKMAN

(by invitation), Salt Lake City, Utah

A comparative evaluation of the performance of various currently popular vascular clamps has been carried out in which three parameters of the clamps have been carefully assessed: 1) A method was devised for testing the*occlusive ability* of the clamps to determine how much intraatrial fluid pressure they could withstand without leaking. 2) The *holding ability* of the clamps was investigated to quantitate their reliability or resistance to slipping. 3) Finally, the *trauma* produced when the clamps were applied with measured force to arteries in living anesthetized animals was assessed by both gross and microscopic pathologic study. Fourteen different vascular clamps have been objectively evaluated as described above. The results are presented in tabular, comparative form. There is surprising difference in performance from clamp to clamp in all three parameters investigated. Certain of the clamps should be excluded from clinical use because of poor performance in the occlusive tests, others do not perform satisfactorily on the holding tests, hence are unreliable Several clamps cause significant trauma, and cannot be recommended for clinical use on this basis. Clamps that perform acceptably on all tests include the Senning, Muller-Markham, and Potts fine-toothed clamps, the atraugrip Bailey, Glover, and DeBakey clamps, and the Kapp-Beck serrated clamps. Most clamps will perform unsatisfactorily if not properly

used. Suggestions and precautions to assure proper use of vascular clamps are made.

15. Neutron Activation Analysis in the Study of Pulmonary Disease: The Use of an Atomic Reactor as a Laboratory Instrument

JOHN H. KENNEDY *(by invitation),* and

W. F. BETHARD *(by invitation),* San Diego, Calif.

Sponsored by CIFFORD F. STOREY, San Diego, Calif.

The identification of specific elements by the analytic technique of neutron activation analysis was described by Hevesy in 1936. It is accomplished by bombarding samples and standards with neutrons in order to convert the elements to unstable radioactive forms so that identification and quantitation can be carried out by appropriate counting procedures. The significant advantages to this method are extreme sensitivity (e.g. arsenic (As 76) can be detected in concentrations of 0.005 micro-grams), freedom from reagent contamination, and in many cases nondestructive analysis of the sample. This method has been used during the past three years in the petroleum industry and in the quantitation of trace elements (e.g. manganese) in body fluids. The authors describe the use of an inherently safe nuclear reactor (TRIGA) for the analysis of normal and diseased pulmonary tissues obtained at surgery. At present analyses may be carried out in biologic tissues for many elements, including arsenic, iodine, aluminum, copper, silicon, vanadium, zinc, manganese and beryllium. Examples of gamma ray energy spectra obtained by neutron activation analysis from pulmonary biopsies are presented as well as a short color film illustrating the experimental method. The authors are at present using this method to study the arsenic content in normal and cancerous lung in smokers and nonsmokers. Arsenic, known to be carcinogenic, occurs in varying concentrations in tobacco leaf.

16. Left Heart Bypass: Experimental and Clinical Observations on its Regulation with Particular Reference to Maintenance of Maximal Renal Blood Flow

JOHN E. CONNOLLY, SAMUEL L. KOUNTZ *(by invitation),* and

ROBERT J. BOYD *(by invitation),* Palo Alto, Calif.

Left heart bypass is now a well recognized technique to permit prolonged cross-clamping of the thoracic aorta. Also there are indications that it may prove to be advantageous in the mechanical support of acute heart failure. Various problems in the determination and regulation of proper proximal and distal pressures to assure left heart decompression and at the same time maximal renal blood flow have been encountered in clinical cases to be presented.

Left heart bypass during aortic cross-clamping has been performed on dogs and measurements made of left atrial, aortic root and femoral artery pressures, as well as renal artery flow using a square-wave electromagnetic flowmeter. It was found that if the aortic root pressure is maintained at the pre-bypass level, the femoral pressure and renal blood flow remain near normal. However, if a rise as little as 10mm. Hg mean pressure is allowed in the aortic root, the distal aortic pressure drops significantly and the renal blood flow falls dramatically, even greater than can be explained by the decreased distal aortic pressure. Experiments were then performed to investigate the relationship of renal blood flow to left atrial pressure and confirmed that slight increases in left atrial pressure produced a striking diminution in renal blood flow suggesting a reflex regulation of renal blood flow mediated via stretch receptors in the left atrium. In the light of these findings, a simplified technique of bypass will be presented with recommendations as to its precise regulation and the length of time it can be safely carried out

17. A Study of the Peripheral (IVC and SVC) and Central (Splanchnic) Venous Flow Rates During Extracorporeal Bypass

JAY L. ANKENEY, S. K. MURTHY *(by invitation),* and

FREDERICK LAROCHELLE *(by invitation),* Cleveland, Ohio

A technique has been developed with appropriate catheterization of the venae cavae plus external pumping in which it is possible to measure continuously the central (splanchnic) and peripheral (IVC and SVC) venous flow rates Utilizing this method, central and peripheral venous flow rates have been measured before, during and following a 45 minute period of total cardiopulmonary bypass at a rate of 75 cc/kilo./min utilizing a rotating disc oxygenator with gravity drainage. With a constant arterial inflow, flow rates in these two areas remain relatively constant throughout perfusion. Progressively increasing the arterial perfusion rate results in a relatively greater increase in peripheral than splanchnic flow, without a proportional increase in arterial pressure. Therefore, total peripheral vascular resistance decreases and a straight line relationship between systemic pressure and flow rates does not exist during perfusion. Vasopressors result in a decrease in peripheral flow with a concomitant increase in the splanchnic blood flow and elevation of portal vein pressure. This report will also include a study of the effects of lowering body temperature (hypothermia) upon the relative flow rates in these two vascular beds during perfusion.

18. A Study of Prepulmonary Bypass in the Development of an Artificial Placenta for Prematurity and Respiratory Distress Syndrome of the Newborn

JOHN C. CALLAGHAN, Edmonton, Alberta, Canada

In the early portion of this study, 14 lambs taken by cesarian section were subjected to extracorporeal circulation and submerged in amniotic fluid in an artificial placenta. Ten of these animals were maintained for periods of ten to nineteen hours under conditions of artificial foetal circulation. Six mongrel dogs were subjected to periods of controlled suffocation during which time they were perfused with oxygenated blood into the right alriurn from a membrane oxygenator. Lower caval blood and peripheral arterial blood were returned to the oxygenator. Four newborn puppies weighing 500 to 700 grams were maintained with satisfactory cardiac output with approximately one-third of their cardiac output infused as oxygenated blood into the right atrium resulting in peripheral saturations of 75-85%. The pulmonary artery and its capillary bed acted as a conduit for the oxygenated blood It is felt that this means of circulation is feasible in the premature child and newborn baby with respiratory distress syndrome. Here venous cannulation alone with the infusion of oxygenated blood into the right atrium is used in a manner not too dissimilar to that of placental circulation.

19. Physiologic Principles of Coronary Perfusion

ROBERT F. SHAW *(by invitation),* New York, N.Y

Sponsored by GEORGE H. HUMPHREYS II, New York, N.Y

The perfusion characteristics of the myocardium have been investigated with a view toward determining optimal coronary perfusion techniques The response of the myocardial vascular bed to perfusion by pressure-determined and flow-determined systems has been studied in open-chest anesthetized dogs at different levels of steady cardiac effort and during cardiopulmonary bypass. Coronary perfusion pressure and coronary flow were varied independent of aortic pressure. During pressure-determined perfusion, a characteristic vasomotor response to alterations in perfusion pressure was observed in each of over 700 observations in 22 dogs. Abrupt changes of perfusion pressure caused abrupt changes of flow; within 0.5 seconds, active coronary vasomotion intervened to return flow toward its original level in both the working and bypassed hearts. This mechanism is capable of regulating coronary flow *independent* of perfusion pressure over the range, 70-145 mm Hg. The level at which flow is regulated correlates with the level of cardiac effort. These studies demonstrate an intrinsic mechanism by which the heart regulates coronary flow in accordance with its needs, operative normally and in pressure-determined systems, but not in flow-determined systems. The effects of under-perfusion and over-perfusion on cardiac contractility will be presented. A pneumatic pressure-regulating reservoir which can convert any positive displacement pump from a flow-

determined to a pressure-determined system will be described.

20. A New Method for Coronary Arteriography by Means of Acetylcholine Asystole with Controlled Return of Heart Rate Using a Cardiac Pacemaker

AYDIN BILGUTAY *(by invitation),* and

C. WALTON LILLEHEI, Minneapolis, Minn.

Coronary arteriography with acetylcholine induced asystole has gained some acceptance within the last few years. Its wider clinical application has awaited further developments to make it safer and more reliable Analysis of the response of hearts to acetylcholine in 70 canine electrocardiograms and our experimental and clinical work with the development of pacemaking equipment for control of heart block suggested the combination of acetylcholine for asystole and pacemaker restoration of the heartbeat for obtaining coronary arteriograms more safely. A method has been developed where asystole is induced by acetylcholine, a coronary arteriogram is taken, and the controlled return of the heartbeat is assured by means of cardiac pacemaker stimulation via an internal electrode introduced to the right ventricle through the saphenous vein. With the cardiac rate maintained by the pacemaker after acetylcholine induced asystole, the blood pressure is immediately restored and the dangers of serious or fatal arrhythmias due to myocardial anoxia are obviated. The phase of recovery with its associated arrhythmias when acetylcholine arrest alone is utilized is replaced by a regular beat of the pacemaker and the time for return of the previously present heart rate is greatly shortened. This method was tested extensively before its first clinical application in a patient who had had a preoperative coronary angiogram and a myocardial revascularization procedure nine months before. The coronary arteriograms obtained with this new technique have provided visualization significantly superior to other methods previously utilized.

21. Cerebrospinal Fluid Pressure Changes Following Experimental Superior Vena Cava to Right Pulmonary Artery Shunt

PANAGIOTIS SYMBAS, LEON WOODS, and HAROLD A. COLLINS

(all by invitation), Nashville, Tenn

Sponsored by H. WILLIAM SCOTT, JR., Nashville, Tenn.

Occasional patients manifest evidence of transient cerebral disturbance following complete diversion of superior vena caval blood into the distal end of the right pulmonary artery. The transitory nature of the disturbance suggested cerebral edema as a possible cause. In order to clarify the changes in Cerebrospinal fluid pressure following superior vena cava to right pulmonary artery shunts, the following experimental study was undertaken. In a series of 21

adult mongrel dogs the superior vena cava was anastomosed to the right pulmonary artery in the manner described by Glenn. Gerebrospinal fluid pressures were determined by direct cisternal puncture preoperatively and at periodic intervals postoperatively. Autopsy examination was performed to determine the cause of death and patency of the anastomosis in those animals failing to survive the operative procedure. All animals demonstrated a fairly striking increase in the cerebrospinal fluid pressure following operation The increase in the cerebrospinal fluid pressure correlated reasonably well with the increase in external jugular venous pressure. In those animals failing to survive operation the manifestations were suggestive of cerebral impairment, and cerebral edema could be demonstrated at autopsy despite the presence of a patent anastomosis. The results of this study suggest that an increased cerebrospinal fluid pressure following superior vena cava to right pulmonary artery anastomosis can produce cerebral edema as an undesirable complication. Current studies are concerned with the most efficacious method for prevention of cerebral edema following this operation

22. Catechol Amine and Serotonin Response to Cardiopulmonary Bypass

ROBERT L. REPLOGLE, MORRIS LEVY, and

RICHARD C. LILLEHEI *(all by invitation),* Minneapolis, Minn.

Sponsored by ROBERT E. GROSS, Boston, Mass

Demonstration of a similarity in the changes of epinephrine, norepinephrine, and serotonin during both prolonged cardiopulmonary bypass and hemorrhagic shock might be useful as evidence for consideration of a common denominator predisposing to their visceral complications. For this reason circulating plasma epinephrine, norepinephrine and serum serotonin were measured in 14 patients before, during and after extra-corporeal circulation of periods varying from 30 minutes to 35/a hours. There were 9 normothermic, moderate flow (60-75 ml/kg) and 5 hypothermic, low flow (25-30 ml/kg at 28-30°C) perfusions. While a marked increase in plasma epinephrine concentration occurred during moderate flow, normothermic perfusion, no change or only a slight increase in plasma epinephrine was seen during low flow, hypothermic perfusion. A decrease in serum serotonin was regularly observed during both types of perfusion, indicating release of platelet-bound serotonin. Renal function was depressed to varying degrees in all patients undergoing bypass; but in two patients who had a prolonged bypass (2 and 3½ hours) with moderate flow and normothermia, striking elevations in plasma epinephrine were associated with profound depressions in renal function, tubular necrosis and death. These studies show a catecholamine and serotonin response during

normothermic, moderate flow perfusion similar to that previously described during hemorrhagic shock. The deleterious effects of increased catechol amine concentrations appear directly correlated with the length of the cardiopulmonary bypass. Hypothermia, however, blunts this stress response even when the perfusion flow is less than half that usually used in moderate flow perfusions. The clinical significance of these findings as well as the significance of the serotonin changes will be discussed.

23. Myocardial Metabolism in the Hypothermia Bypassed Heart

MAURICE G. FUQUAY *(by invitation),* CHARLES A. BUCKNAM *(by invitation),*

and HOWARD D. SIRAK, Columbus, Ohio

In 58 dogs, an investigation was undertaken to compare the effects on the bypassed heart of potassium and cold-induced cardiac arrest. An arrest_ interval of 30 minutes was induced at 37°, 30°, 20° and 10°C. The indices for evaluating myocardial metabolism at each temperature were the pH, CO_2 content, O_2 saturation, glucose, lactic acid and pyruvic acid levels, and a number of enzymes in postarrest samples of coronary sinus blood. Results showed less metabolic acidosis and better oxygenation at 20°C than in any of the other groups. Moderate levels of cooling (not below 20°C) reduced myocardial acidosis by decreasing the oxygen requirements of the tissues. However, with hypothermia at 10°C myocardial acidosis still developed even when the rest of the body was being perfused at high levels with well-oxygenated blood. Metabolic acidosis of the coronary arterial blood was most severe in the 37°C potassium-arrest and in the 10°C cold-arrest groups. From the standpoint of those enzymes which are highly concentrated in cardiac muscle, there was less production of enzymes at the lower temperatures. A close correlation was found between the enzyme concentration in coronary sinus blood and the level of hypothermia, the lowest values being obtained in the colder groups while the higher values consistently accompanied potassium arrest at 37°C or 30°C cold arrest. Serum glutamic-oxaloacetic transaminase and serum pyruvic-oxaloacetic transaminase were the most sensitive indices.

24. Tissue Oxygen Tension During Total Body Perfusion and Hypothermia

EARLE B. MAHONEY., JAMES A. DEWEESE *(by invitation),*

PAUL D. HARRIS *(by invitation),* CLAY E. PHILLIPS, JR. *(by invitation),*

and SEYMOUR I. SCHWARTZ *(by invitation),*

Rochester, N. Y.

The efficacy of total body perfusion, as determined by the oxygen tension of vital organs, has been examined in the dog. Changes in tissue oxygen tension have been measured by means of a modified technique of stationary platinum electrode polarography. The studies have been performed during perfusion with varying flow rates and at various levels of body hypothermia. 1) Normothermia with Varying Flow Rates: The oxygen tension of brain, liver and kidney remain remarkably constant until perfusion rates are decreased to 40cc/Kg/min. but muscle oxygen tension is reduced with perfusion below 80cc/Kg/min. 2) Myocardial and Muscle Oxygen Tension with Low FJow Rates and Hypothermia- Flow rates of below 40cc/Kg/min. at normothermia resulted in a profound decrease in oxygen tension but at 15°-20°C oxygen tension was maintained with low flow rates. 3) Hypothermic Cardiac Arrest: Coronary artery perfusion with cold blood (5°C) was used to lower the myocardial temperature to lower than 10°C and this low temperature was maintained with saline ice with no further perfusion. The myocardial oxygen tension was maintained at essentially normal levels for periods of 30 minutes of arrest. 4) The relation of blood flow and oxygen tension of various organs at varying levels of hypothermia will be discussed.

25. Cardiac and Peripheral Vascular Responses to Hyperther-mia Induced by Blood Stream Heating

T. COOPER *(by invitation),* V. L. WILLMAN *(by invitation),*

and G. R. HANLON, St. Louis, Mo.

The re-establishment of thermal equilibrium following total body per-fusion is usually initiated by direct blood stream heating through a heat exchanger and is often accompanied by frank pyrexia in the early post-perfusion period. The ability of the circulatory system to foster heat loss under these circumstances is limited by the effects of the heat on the heart and regulatory mechanisms. These studies were designed to permit description of the cardiac effects of hyperthermia apart from the effects on peripheral resistance and blood volume. In 5 dogs in which cardiac rate was electronically controlled, myocardial contractility, as measured by ventricular function curves and by myocardial strain gauge arches, was unchanged or improved until the temperature exceeded 41°C after which it gradually deteriorated. In 6 other animals, cardiopulmonary effects were eliminated by extracorporeal perfusion. Systemic flow was held constant so that changes in mean arterial pressure reflected changes in total peripheral resistance and changes in the extracorporeal venous reservoir reflected changes in intracorporeal blood volume. As intravascular temperature was elevated to 40°C, arterial pressure rose an average of 26%. Intracorporeal blood volume decreased 50-250 ml. Heating after ganglionic blockade resulted in a

decrease in arterial pressure and negligible changes in the proportion of blood in the intracorporeal and extracorporeal circuits. The data emphasize the importance of regulation of blood volume while rewarming on cardiopulmonary bypass and during the febrile phase in the early post-operative period and emphasize the importance of avoiding hyperpyrexia because of its deleterious effects on myocardial function.

26. Viscosity Studies of Blood, Plasma and Plasma Substitutes in Extracorporeal Circulation

KEITH REEMTSMA *(by invitation),* and

OSCAR CREECH, JR., New Orleans, La.

Various physiologic responses in extracorporeal circulation have been studied extensively, but scant attention has been directed toward physical changes in perfusing media. The measurement of viscosity has assumed increasing importance with the widespread use of hypothermia and, more recently, the introduction of diluents to extracorporeal circuits. Viscosity studies were performed with a recently developed ultrasonic viscosimeter Approximately 800 determinations were made, at temperatures form 0° to 50°G, on blood with different hematocnts and on plasma, dextran and dextrose solutions. Results were as follows: 1) At 37°C hematocrits up to 40% showed slight effect on viscosity; above 40% hematocnt, viscosity increased progressively with increasing hematocrit. 2) As temperature was lowered, vicosity increased much more steeply in blood with high hematocrits than in blood with low hematocrits. 3) At 37°C low-molecular-weight dextran (6% solution) was approximately twice as viscous as plasma, and high-molecular-weight dextran (6% solution) was four times as viscous as plasma. 4) With hypothermia, greater increases in viscosity were observed with dextran solutions than with whole blood, plasma or dextrose solutions These studies suggest that viscosity is especially important in the presence of high hematocrits and/or low temperatures. Low-molecular-weight dextran showed a two-fold effect on viscosity; it increased the viscosity of plasma but decreased the apparent viscosity of whole blood by lowering the hematocrit. The final effect on viscosity depended upon the diluent, hematocrit and temperature.

27. Pedicle Grafting of the Sino-Auricular Node to the Right Ventricle for the Treatment of Complete Atrio-Ventricular Block

RICHARD W. ERNST *(by invitation),* Dallas, Tex.

Sponsored by DONALD L. PAULSON, Dallas, Tex.

Sino-auricular pacing of the ventricles should be superior to electrical pacemaker stimulation in complete A-V block. An attempt to achieve this is presented. The area of the S-A node between the appendage and superior vena cava is identified with its nutrient artery. A horizontal mattress suture is started at the tip of the S-A node and continued along the path of the nutrient artery, thus excluding the S-A node with the artery from the right atrial wall. The excluded

area is then resected leaving it attached near the A-V groove. A subepicardial tunnel over the right ventricle nearest to the graft from the A-V groove for a distance of 2 cm. is made through which the graft is passed. The free tip of the graft is anchored to the right ventricle with a loose suture. Two months later through a right atriotomy conduction through the atrio-ventricular bundle is blocked with sutures. Following this the pedicle graft in its new location is completely removed. Typical complete A-V block is noted only after the transplanted S-A node is removed. This indicates that the transplanted S-A node has taken the place of a new pacemaker with supraventricular qualities.

28. Hypoxia as the Cause of Hemorrhage Into The Cardiac Conduction System, Arrhythmia and Sudden Death

W. M. THOMPSON, JR. *(by invitation),* NALDA THUNG *(by invitation),*

J. F.DAMMANN, JR., RODRIQUEZ PEREZ *(by invitation),*

MIQUEL SANMARCO *(by invitation),* and

CHARLES MEHEOAN *(by invitation),* Charlottesville, Va.

A histologic study of the hearts of 60 newborn infants who died with symptoms of respiratory distress revealed a 30% incidence of hemorrhage isolated to the cardiac conduction system. A review of routine pathologic specimens did not show a single instance of isolated hemorrhage in this area Seventy-five hearts obtained from cardiac patients with or without surgery, revealed a better than 50% incidence of hemorrhage in the conduction system and this hemorrhage could be correlated with an episode of hypoxia. The findings in the newborn infants and in the latter group of patients signify that hypoxia plays an important role in the production of hemorrhage and subsequent death. On this basis, it was decided to subject animals to an atmosphere of normal carbon dioxide and reduced oxygen tension. A large series of rats, when subjected to an atmosphere of 6% oxygen, with a few exceptions, developed electrocardiographic evidence of arrhythmia and hemorrhage throughout the myocardium predominately in the area of the conduction system. Except for small areas of hemorrhage and congestion in the lungs, there was no further hemorrhage. These findings indicate that adequate oxygenation is of great importance in preventing arrhythmia and sudden death.

TUESDAY AFTERNOON, APRIL 17, 1962

Back to Annual Meeting Program

Tuesday Afternoon, April 17, 1962

2:00 P.M. Executive Session (Limited to Active and Senior Members)
Khorassan Room

3:00 P.M. Scientific Session: REGULAR PROGRAM
Khorassan Room

Address by the President
O.Theron Clagett, Rochester, Minnesota

Address by Honored Guest
Norman R. Barrett, M. Chir., F.R.C.S.
Senior Surgeon, St. Thomas' Hospital
London, England
"Publish or Perish"

Richard H. Sweet (1901-1962) Edward D. Churchill
Experience With 500 Cases of Hiatus Hernia
Richard H. Sweet
(Presented by Earle W. Wilkins, Jr.)

Tuesday Evening, April 17, 1962

7:00 P.M. Banquet and Dancing
Starlight Roof

Speaker
Leslie R. Blasius
Communications Consultant
New York Telephone Company
"SAGE - The Electronic Paul Revere"

Attendance limited to Members of the Association and their ladies, Invited Authors and Co-authors and their ladies
Dinner dress preferred

WEDNESDAY MORNING, APRIL 18, 1962

Back to Annual Meeting Program

Wednesday Morning, April 18, 1962

8:30 A.M. Scientific Session: REGULAR PROGRAM Khorassan Room

29. Clinical and Pathological Characteristics of Carcinosarcoma of the Esophagus

JAMES L. TALBERT *(by invitation),* Baltimore, Md., and

JAMES R. CANTRELL *(by invitation),* Seattle, Wash.

Sponsored by ALFRED BLALOCK, Baltimore, Md.

The distinctive clinical and pathological characteristics of carcinosarcoma of the esophagus are of sufficient therapeutic import to warrant special emphasis despite the relative rarity of the lesion In contradistinction to the more common epidermoid

carcinoma, carcinosarcoma is typically a polypoid lesion and exhibits a strong tendency to remain localized within the limits of the esophageal wall Direct invasion of adjacent structures, lymphatic spread and distant metastasis occur only late in the disease. The therapeutic approach to this neoplasm must be based upon these specific characteristics. Curative resection should be feasible in a high proportion of cases. The evidence pertinent to these considerations will be reviewed. A series of four cases will be presented to illustrate the characteristic diagnostic and pathological features of this tumor.

30. Columnar Epithelium Lining the Lower Esophagus: Association with Hiatal Hernia, Esophagitis, Ulcer, Stricture and Tumor

RICHARD H. ADLER, Buffalo, N. Y.

The lower portion of the esophagus has been found to be lined by columnar epithelium in five patients followed for periods up to three years. In each instance there was an associated hiatal hernia. All had a short stricture well above the hiatal hernia at the level of the aortic arch, initially diagnosed as carcinoma in most instances. Another individual had a typical punched-out "gastric" ulcer in the mid-esophagus in columnar epithelium well above a hiatal hernia. An additional person had an adenocarcinoma in the distal esophagus above a hiatal hernia In four other patients with hiatal hernias, progressive strictures observed over periods up to five years were found to have associated columnar epithelium in the strictured area. Esophagoscopy for dilatation of strictures and for multiple serial mucosal biopsies formed an integral part of diagnosis and treatment Although the lower esophagus lined by columnar epithelium is generally held to be a congenital anomaly, the author will present a concept that this represents an adaptive replacement of squa-mous epithelium related to reflux digestive esophagitis; also, that the most distal esophagus may have a variable amount of columnar epithelium under normal conditions Evidence gathered from a study of over 250 postmortem esophagi suggests that the esophageal glands may play a significant part in this epithelial replacement Discussion will include practical considerations of the associated ulcers, strictures and tumors.

31. Combined Prosthetic Replacement of the Aortic and Mitral Valves Using a Left Atrial Approach

ROBERT S. CARTWRIGHT *(by invitation),* JAMES W. GIACOBINE

(by invitation), WILLIAM B. FORD, and WILLIAM E. PALICH *(by invitation),*

Pittsburgh, Pa.

The aortic valve and the ventricular septum may be exposed through the left atrium by incising the aortic leaflet of the mitral valve either perpendicular or parallel to the annulus. Initial experiments in dogs showed that repair following these incisions can result in functional healing of the valve. In subsequent experiments in twenty-one dogs, replacement of the aortic valve with a prosthesis or combined replacement of the aortic and mitral valves was proven technically feasible. This approach permits (1) successful ball valve replacement of the pliable aortic valve in an intact aorta, (2) combined prosthetic replacement of the aortic and mitral valves during an acceptable period of cardiopulmonary bypass, and (3) sufficient exposure of the ventricular septum to permit repair of high ventricular septal defects and (4) direct vision operative treatment of hypertrophic stenosis of the left ventricular outflow tract. Clinical trial has thus far been limited to combined prosthetic replacement of the aortic and mitral valves. Although the time interval since our first application of the method has been too short for final conclusions, survival with dramatic hemodynamic improvement has been obtained. Details of the exacting surgical technic will be presented along with the results of postoperative studies of valve function with phonocardiography, kymography, and cine technics

32. Analysis of Results from Open Operation for Acquired Aortic Valve Disease

DWIGHT C MCGOON, H. T. MANKIN *(by invitation),* and

JOHN W. KIRKLIN, Rochester, Minn.

In 194 open operations performed for acquired aortic valve disease the technic for calcine types was decalcification (60%), single or double leaflet replacement (25%) or total replacement (15%). Noncalcific incompetence (from rheumatic fever, bacterial endocarditis, or aneurysm of ascending aorta) was treated by plastic revision or by total valve prosthesis. Among 112 cases with isolated calcific lesions, hospital mortality rate was 16% when coronary artery perfusion was used, 36% when external cardiac cooling was used. It was 38% in 42 cases with isolated noncalcific valve incompetence. Mortality was 47% in 40 patients in whom mitral valve lesions demanded concomitant repair. Other factors implicated in deaths included failure to relieve valve pathology, calcific emboli, associated coronary artery atherosclerosis, and complications of prolonged whole body perfusion. Identification of these has allowed some specific measures for minimizing their occurrence. Palliation after surgery is with some exceptions excellent. Attempts to decalcify rather than partially replace extensively diseased calcareous valves sometimes proved inadequate. Among patients with non-calcific incompetence, those treated with total prosthetic reconstruction have shown the best results. Patients with advanced symptoms from cardiac failure have

demonstrated the ability to improve markedly with correction of their mechanical valve defect.

33. Internal Mammary Implantation for Coronary Heart Disease: A Clinical Follow-Up Study One to Eight Years After Operation

W. G. BIGELOW, H. BASIAN *(by invitation),* and

G. A. TRUSLER *(by invitation),* Toronto, Canada

Nineteen patients disabled from angina, which was not responsive to medical therapy, have been operated upon one and one-half to eight years ago. The final results of this study are considered surprisingly good. There were 11 patients in the favorable group without angina decubitus. In this group there were no operative deaths, and there were 3 late deaths during the period of follow-up. This small series indicates that survival may be somewhat better than natural life history expectancy. Clinical assessment one and one-half to eight years after operation in the 8 favorable cases are: 2 excellent, 4 good, 1 fair, and 1 no change. Good and excellent cases were back to work. All but one of those tested showed an improvement in exercise ability and symptoms of angina over the preoperative state, and 60% showed improvement in the electrocardiographic changes with exercise. The test that has stimulated this report has been the visual evidence on cineangiography of patency and flow in the implanted internal mammary artery following injection of dye into the subclavian artery at the mouth of the left internal mammary artery. One patient demonstrates this seven and one-half years after surgery. (Movie) Further evidence of patency is found in *a.*post-mortem study. Injection of the internal mammary artery in this case that died four years after operation showed patency and communication with the coronary arterial tree by vessels of large caliber. It is hoped that this report may stimulate further study and development of this principle.

34. The Postoperative Management of the Severely Ill Patient After Open-Heart Surgery on Cardiopulmonary Bypass

J. F. DAMMANN, JR., NALDA THUNO *(by invitation),*

IONACIO CHRISTLIEB *(by invitation),* W. H. MULLER, JR.,

and JAMES B. LITTLEFIELD, Charlottesville, Va.

During the past two years, we have evolved a method of postoperative management which has definitely improved our mortality and morbidity figures in patients with severe aortic disease and chronic left heart failure. Such patients are prone to develop arrythmia, progressive pulmonary insufficiency and have very little cardiac reserve to rely upon during the early period of recovery. The patient is returned to the Recovery Room while under anesthesia and placed on the Engstrom Respirator. Central aortic and central venous pressures are monitored continuously, and arterial and venous blood gas determinations are

followed closely. The patient is kept on the respirator under anesthesia or sedatives until the electrocardiogram is stable, cardiac output is reasonably normal, arterial oxygen tension is sufficient, acid base balance has been corrected, blood volume and peripheral vascular tone have returned to normal. Only when these parameters are normal is the patient allowed to waken. The use of the Engstrom Respirator is continued until an adequate level of arterial oxygen tension can be maintained while breathing room air. It is our belief that this method of management after prolonged cardio-pulmonary bypass removes the workload of breathing and the possibility of significant hypoxia during a critical period of readjustment of all organ systems, and thereby materially decreases the risk of sudden death and of major postoperative complications.

35. Bilateral Surgery for Pulmonary Tuberculosis

THOMAS W. SHIELDS, ROBERT T. Fox, and

WILLIAM M. LEES, Chicago, Ill.

The patient with bilateral tuberculosis continues to be a challenging therapeutic problem. Though a majority of these patients can be successfully managed by the antimicrobial drugs alone, a not small segment of this group requires bilateral surgical intervention for ultimate control of the disease At the Chicago Municipal Tuberculosis Sanitarium approximately 10% of all patients admitted annually undergo a major thoracic surgical procedure; of these 8.5% require bilateral procedures. Since April 1950 to March 1961, 176 patients have completed a bilateral surgical program. Of these 176 patients, there were 97 bilateral resections, 61 bilateral plombage procedures and 18 patients who had resection on one side and a plombage on the other. The bilateral surgical resections were 48 bilateral segmentectomies, 39 lobectomy-segmentectomies, 7 bilateral lobectomies, 2 pneumonectomy-segmentectomies, and one pneumonectomy-lobectomy. The 60 day operative mortality following the completion of the program for the entire group was 2.2% and a total non-fatal complication rate of approximately 25%. The results in the operative survivors were successful in 79% of the patients' a failure (continued active disease) in 7.6% of the patients and 7%of the patients were lost to follow-up. The indications, the timing of, and postoperative problems in these bilateral surgical procedures will be discussed.

36. Surgical Treatment of Cavitary Pulmonary Histoplasmosis

WALTER DIVELEY, ROBERT MCCRACKEN *(by invitation),*

WILLIAM STONEY *(by invitation),* and VERNON MCCONNELL *(by invitation),*

Nashville, Tenn.

Excision of granulomatous lesions believed to be caused by pulmonary histoplasmosis have been frequently reported. However, there has been no large recorded experience with the excision of cavitary lesions in this disease. This report is concerned with fifteen patients with cavitary disease due to histoplasmosis who were treated by pulmonary resection. One patient was subjected to bilateral resection. The diagnosis was established by demonstrating the organism by culture in thirteen patients. In two patients the diagnosis was based on a positive skin test, histoplasmin complement fixation studies, and the microscopic appearance of the excised tissue. The organism was cultured from the sputum before operation in nine patients None of the patients received Amphotericin The selection of patients for operation, extent of resections performed, postoperative complications and results of treatment are discussed in detail

37. Resection for Localized Air Trapping Pulmonary Disease: Preoperative and Postoperative Function Studies

JOSEPH L. LUCIDO, PAUL MURPHY *(by invitation),* and

HERBERT C. SWEET *(by invitation),* St. Louis, Mo.

Resection of pulmonary tissue for emphysematous blebs, bulla and related processes is a well established method of treatment, with satisfactory clinical results. The laboratory documentation of benefit in such cases is less well established. This paper presents a series of twenty-four patients in whom preoperative and postoperative studies in the pulmonary function laboratory permits objective appraisal of the value of pulmonary resection in air trapping pulmonary diseases. Under air trapping pulmonary disease we include lobar emphysema, pressurized blebs, bulla and cysts, or combination of these entities. The patients manifested various degrees of dyspnea and respiratory inadequacy, including cyanosis and lethargy. The pulmonary function studies comprised vital capacity, maximum breathing capacity, total lung volume, nitrogen retention, residual air and relation of residual air to total lung volume. There has been striking improvement in these values after pulmonary excision consisting of individual bleb removal, wedge resection, segmental resection or lobectomy. We have not included individuals with a spontaneous pneumothorax secondary to the above lesions. The value of precise function studies and management of these clinical problems is well documented by this correlation of clinical and laboratory data.

WEDNESDAY AFTERNOON, APRIL 18, 1962

Back to Annual Meeting Program

Wednesday Afternoon, April 18, 1962

2:00 P.M. Scientific Session: THORACIC SURGERY FORUM

Khorassan Room

38. The Surgical Significance of the Fibrous Skeleton of the Heart

JACOB ZIMMERMAN *(by invitation),* and

CHARLES P. BAILEY, New York, N. Y.

The majority of surgical heart lesions, congenital as well as acquired, are related anatomically to the fibrous structures at the base of the heart which have, in a vaguely denned sense, been referred to as its "fibrous skeleton." Standard descriptions of these structures make no attempt at defining them either in relation to function or with respect to their substantiality as anchorage for surgical sutures. The fibrous skeleton of the heart, which is here defined as those structures at its base which are densely collagenous and comparatively stationary relative to the myocardium and valve leaflets, was carefully identified anatomically in this study by: (a) Gross dissection of fresh human hearts, (b) Continuous serial histological sections through the base of the heart with histological identification of the structures and three-dimensional model reconstruction. (A specially adapted technique for mounting the sections in plastic will be published separately.) A detailed description of these collagenous structures will be presented with special stress on their anatomical relationship to valve leaflets and the conduction system. The profound influence of this more accurate appreciation of cardiac anatomy on the concepts underlying the surgical treatment of mitral and aortic valve diseases will also be discussed

39. Replacement of the Canine Pulmonary Valve and Pulmonary Artery with a Graphite Coated Valve Prosthesis

VINCENT L. GOTT, RONALD L. DAGGETT,

WILLIAM P. YOUNG, DONALD E. KOEPKE *(all by invitation),* and

ANTHONY R. CURRERL, Madison, Wis.

At the present time there appears to be a significant need for a pulmonary artery-pulmonary valve prosthesis for clinical application. Such a prosthetic unit would permit a more satisfactory surgical repair in patients with tetralogy of Fallot, transposition of the great vessels, isolated pulmonary valve insufficiency and truncus arteriosus We therefore have been experimenting with a complete pulmonary artery-pulmonary valve prosthetic unit in the canine heart. The artificial valve is a flap valve constructed of a rigid plastic housing and a flexible butterfly wing leaflet. This valve unit is placed inside a teflon fabric graft which serves as the pulmonary artery replacement. The complete artery-valve unit except for the flexible leaflet is coated with colloidal graphite, for previous work from this laboratory has shown that this type of coating significantly reduces clotting on a plastic prosthesis. It was felt that the experimental placement of this artificial valve in the low-velocity pulmonary arterial circuit would also serve as a severe clotting test for this type of valve unit. To date the pulmonary artery and pulmonary valve have been replaced in 20 dogs. Eleven dogs died between the 5th and 12th day after surgery, usually as a result of postoperative hemorrhage or pneumonia. Clotting was not a significant problem in these early deaths. Six of the dogs now survive one to five months after surgery and in most of these animals the valve is known to be functioning as determined by auscultation, cardiac catheterization and exploratory thoracotomy. It is hoped that with continued modification and improvement of this prosthetic unit, clinical application may be possible.

40. Dynamics of Pulmonary Outflow Patches

JOHN R. DERRICK, THOMAS MILLER, and TAYLOR SMITH

(all by invitation), Galveston, Tex.

Sponsored by ALBERT W. HARRISON, Galveston, Tex.

Purpose: Several series of experiments were performed to investigate the limitations and cardiodynamics of patches placed in the pulmonary outflow tract and over the pulmonary valve in dogs. Methods: Series 1. Teflon patches of varying size were placed over different sized defects in the pulmonary outflow tract. The patch and defect surface area were correlated with the dog weight and cardiac size and with the cardiac function pre and post-operatively by employing pressure and flow determinations. Series 2. Similar investigation was carried out with patches over the pulmonary valve. Series 3. Gineradiography of radiopaque patches in place in the right ventricle and over the pulmonary valve was carried out, and the findings correlated with the cardiac function studies. Series 4. Radiopaque sutures were placed in the pulmonary outflow tract and across the pulmonary valve and cineradiography was performed to demonstrate lines of stress and direction of myocardial contraction Results-From Series 1 and 2, we were able to establish the correlation between the onset of failure and the size patch and amount of myocardium that can be removed from the pulmonary outflow tract. From Series 3 and 4, we were able to demonstrate by cineradiography the mechanical stresses placed on a

patch in the pulmonary outflow tract. Discussion: The authors will discuss the application of their findings to the use of patches in the correction of pulmonary stenosis. A movie will be shown to demonstrate the cineradiographic findings.

41. Experimental Production and Study of Left Ventricular Aneurysm

K. TYSON *(by invitation),* I. MANDELBAUM *(by invitation),*

and H. B. SHUMACKER, JR., Indianapolis, Ind.

Left ventricular aneurysms have been produced acutely and chronically in dogs by suturing to the ventricular wall pouches of teflon or homologous aorta and removing the intervening ventricular wall Paradoxical filling of aortic homograft aneurysms is evident from gross observation and cineangiographic study. The adverse effect of chronic aneurysms has been demonstrated by cardiac enlargement, elevation of left atrial pressure and by decreased left ventricular function curves. Left ventricular function studies carried out after producing acutely homograft aneurysms show depression as compared with measurements made with the aneurysm clamped off. The same is true of the less expansile teflon aneurysms when ventricular cavity-aneurysm exchange is assisted by gentle manual compression during diastole. Left ventricular function does not seem to be depressed when the ventricular size is acutely enlarged by inserting a patch graft in a vertical incision, the measurements being the same with the patch in place as with the incision closed. The studies carried out show that aneurysms have an adverse effect upon left ventricular function .and that this is due in part at least to paradoxical filling. As yet they offer no demonstrable support for decreased function as the result of increased ventricular diameter (LaPlace's law).

42. Post-Stenotic Dilatation: Confirmation of an Old Hypothesis by a New Method

JOHN L. KLINE, JOSE L. GIMENEZ, and ROGER MALONEY

(all by invitation), Philadelphia, Pa.

Sponsored by GEORGE P. ROSEMOND, Philadelphia, Pa.

The exact hemodynamics which produce the phenomenon of post-stenotic dilatation remain obscure despite considerable work by a few investigators over the past half-century. We propose to show by a totally new method and employing growing pigs rather than static glassware or tubing, that the theory of post-stenotic blood stream turbulence is in all likelihood correct. The weanling pig is an extraordinarily hardy animal which can survive multiple pre- and post-operative studies, and also which can increase tenfold in weight within 5 months. In addition we have thus produced considerable post-stenotic delatation of the aorta and of the right and left outflow tracts of the heart in a brief time. Utilizing high-speed cineangiography and by a new technique of droplet injection of radiopaque dye, we have demonstrated that there is indeed a whirlpool of turbulence within the post-stenotic segment. By means of a Vanguard Motion Analyzer the kinetic energy expended in a lateral direction of such droplets can be computed in terms of the velocity index If a constant bombardment of the vascular wall persists - in the growing animal, the kinetic energy expended will alone produce post-stenotic dilatation.

43. Experimental Cardiac Surgery Under High Atmospheric Pressure

N. G. MEYNE (EVARTS A. GRAHAM Memorial Traveling Fellow

1958-59), M. E. SLUIJTER, and I. BOEREMA *(all by invitation),*

Amsterdam, Netherlands.

In 1956 Boerema introduced the idea of the use of oxygen under high atmospheric pressure as an aid to cardiac surgery. By cooling the metabolism of the tissues is diminished and at the same time the amount of physically dissolved oxygen can be increased by ventilation with oxygen at 3 atm in a high pressure chamber. 35 Dogs were cooled by surface cooling to 19-23°C; inflow occlusion and atriotomy were performed for 30-20 minutes; during a part of the procedure the animals were ventilated with oxygen at 3 atm in a high pressure chamber. In 20 control animals similar experiments were carried out at normal pressure. In the last part of the series all high pressure animals survived the experiment and 86% were long term survivors, without abnormalities on subsequent histological examination. Advantages of the high atmospheric pressure were found in less potassium shift, less rise in hemoglobin concentration and hematocrit, compared to the normal pressure group, immediately after release of the flow. During the rewarming phase the drop in CO2-combining power was very slight and less than in the control series. When ventricular fibrillation occurs under high atmospheric pressure, defibrillation is extremely easy and frequently spontaneous defibrillation occurs during manual massage; ventricular fibrillation did not occur in the cooling period.

44. Hyperbaric Oxygenation in Vascular Collapse

SAFUK ATTAR *(by invitation),* WILLIAM G. ESMOND

(by invitation), and R. ADAMS COWLEY, Baltimore, Md.

A standard preparation of vascular collapse was developed by bleeding dogs to a mean arterial pressure of 30 mm.Hg and maintaining this pressure for 2 ½hours. At the end of this period the shed blood was reinfused intravenously. Mortality in a series of 30 dogs treated in this manner was 83%. In a second series, 11 dogs were bled in an identical manner and their pressure stabilized at 30 mm Hg for 30 minutes, after which they were introduced individually into a pressure chamber where pure oxygen was introduced until a pressure of three atmospheres absolute was realized. The dogs were maintained at this level for two hours after which the pressure was reduced slowly to one atmosphere and their shed blood was reinfused. Mortality in this group was reduced to 36%. The significant reduction in mortality observed in the second series is believed due to improved tissue oxygenation due to greatly increased oxygen transport in simple physical solution in the blood in addition to oxygen transport by hemoglobin.

45. Preservation of the Canine Lung

DAVID A. BLUMENSTOCK, JOHN A. COLLINS, and

HERBERT B. HECHTMAN *(all by invitation),* Cooperstown, N.Y.

Sponsored by ROBERT H. WYLIE, New York, N.Y.

Preyious studies in the laboratory have shown that homografts of the lung in dogs can survive extended periods of time if Methotrexate is given to the recipient animal. Most homografts survive more than a month and several have survived over six months. This provides a homo-graft system, which has been used to test various methods of preserving the lung outside of the body. A series of ten unrelated animal pairs have been subjected to orthotopic homotransplantation of the left lung. In each case the donor lung was stored in vitro 18 to 24 hours before placement in the recipient animal. The lung was stored at 4°C and was ventilated with room air after the blood in the pulmonary vessels had been replaced by saline, dextran, or serum. When saline or dextran was used death of the transplant occurred during the first two weeks or the transplant survived but showed nearly complete fibrosis. In one lung treated with serum some granulomas were seen at biopsy 56 days after transplantation, but the alveoli and vessels were normal. The present series indicates that the lung can be successfully stored outside of the body for 18 hours. Further elaboration of technique and pulmonary function studies will be reported.

46. An Approach to Extracorporeal Surgery of the Heart

EDWARD J. HURLEY, EUGENE DONG, JR., RICHARD R. LOWER

(all by invitation), and NORMAN E. SHUMWAY, Palo Alto, Calif.

There are many cardiac diseases which theoretically could be best treated by homotransplantation or by total removal of the heart and replacement after corrective surgery. While homograft rejection has no immediate solution, it is feasible to consider that such complex problems as transposition of the great vessels might be treated by removing the heart, performing corrective surgery leisurely in a bloodless field, and then replacing the heart. Experiments were performed in dogs to develop a method for successful isotopic replacement of the totally excised heart and to study the physiological effects of complete cardiac denervation. *Method:* With peripheral venous cannulation and cardiopulmonary bypass, the heart is excised and immediately placed in normal saline at 0° to 5°C. Replantation of the heart is accomplished by simple suture. A movie will be shown depicting the surgical method.*Results:* Six dogs are alive and well one to six months postoperatively. The longest period of extracorporeal displacement of the heart was two hours, although seven hours was attained in homograft experiments. The safe period of cardiopulmonary bypass appears more restrictive of what may be done in the way of extracorporeal cardiac surgery than the duration of cardiac anoxia. Physiological studies reveal no important untoward effects either from total cardiac denervation or from the prolonged period of myocardial anoxia.

47. Absorption of Hemopericardium

JOHN L. WILSON, Beirut, Lebanon

The mechanism and rate of absorption of whole blood from the pericardium in dogs is investigated by use of red cells tagged with Cr^{51} Observations are made on (1) absorption of a small (physiologically insignificant) volume of blood and (2) absorption of a large hemopericardium. About 20 ml. of tagged blood is injected intrapericardially in splenectomized dogs. Approximately 30% of the tagged cells appear in the circulation within 4 days. Pericardiotomy on

the 5th day invariably shows complete absorption of the blood Features of absorption of hemo-pericardium sufficiently large to produce mild tamponade will be described for comparison. Absorption of hemothorax has been shown to be rapid and complete in dogs with 60-70% of red cells migrating from pleural space into general circulation (Wilson, J L., et al. The absorption of blood from pleural space. Surgery 48:766,1960). Reasons for differences in absorption of red cells from pleura and pericardium will be discussed briefly. Although hemopericardium is a frequent sequel to trauma or surgery, the capacity of the pericardial sac to absorb blood has not been studied previously. Hemopericardium will be better understood and management may possibly be improved when the dynamics of blood absorption from pericardium are elucidated.

48. Carbon Dioxide Pneumomediastinography as an Aid in Evaluation of the Resectability of Bronchogenic Carcinoma

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CLIFFORD J. STRAEHLEY, JR. *(all by invitation),* and

WALTER F. BUGDEN, Syracuse, N.Y.

Our primary interest has been in the development of a technique for the delineation of structures of the mediastinum by introducing carbon dioxide via a cannula placed in a paratracheal or subcarinal position at the time of scalene node exploration. It adds no more than an additional twenty minutes to scalene lymph node exploration. (5). Probably its greatest value lies in the fact that it does not involve another procedure. It is merely an extension of a well known and accepted technique. The failure of other methods of pneumomediastinography is due to the fact that they always involved the addition of another procedure and/or the gas was not introduced directly into the site of primary concern. Thus far, we have had experience with 30 pneumomediastinograms, performed at the time of scalene lymph node exploration and their subsequent anatomic evaluation at the time of thoracotomy. In addition to indicating criteria of absolute contraindication to resection, the dissection of carbon dioxide has, on three occasions, indicated resectability in cases that would have otherwise appeared radiologically inoperable. We have interesting photographic reproductions of Xrays which clearly define the dissection pattern of carbon dioxide in the mediastinum. The reason for the scant illustrative material in the literature of pneumomediastinography, in the past, is the poor definition of structures afforded by these other techniques.

49. Upper Hemi-Body Infusion with Alkylating Agents for Advanced Lung Cancer

H. F. RHEINLANDER, H. H. MILLER, ROSS B. MOQUIN

(all by invitation), and R. A. DETERLINO, JR.,

Boston, Mass.

In evaluating a technique for safely increasing the dosage of alkylating agent delivered to tumors in the upper half of the body, dogs were subjected to thoractomy, the lower thoracic aorta, and internal mammary vessels were temporarily occluded and otherwise lethal doses of nitrogen mustard (1.2 mgm./Kg.) were rapidly injected into a neck vein. Bone marrow and peripheral blood studies were carried out. Encouraged by the successful animal studies, a group of patients with lung cancer found unresectable at thoracotomy were subjected to upper body perfusion using this technique. Another group of patients with obviously inoperable lung cancer have been similarly treated with 1.2 mgm/Kg. of chlorimine mustard but had their aortas occluded by an intraluminal balloon and superficial vessels occluded by an abdominal tourniquet. Results of therapy include shrinkage of tumor, prompt alleviation of bone pain, disappearance of effusion, loss of cough, cessation of hemoptysis and improvement of central nervous system symptoms. Upper body bone marrow is severely damaged by this dosage of alkylating agent but lower body bone marrow is protected and provides adequate production of peripheral blood elements. The neurotoxicity encountered with nitrogen mustard appears to have been overcome by the substitution of chlorimine mustard.

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June 7, 1917

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ANNUAL MEETING DATES

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Meetings of the American Association for Thoracic Surgery

1918-Chicago President, Samuel J. Meltzer
1919-Atlantic City President, Willy Meyer
1920-New Orleans President, Willy Meyer
1921-Boston President, Rudolph Matas
1922-Washington President, Samuel Robinson
1923-Chicago President, Howard Lilienthal
1924-Rochester, Minn. President, Carl A. Hedblom
1925-Washington President, Nathan W. Green
1926-Montreal President, Edward W. Archibald
1927-New York President, Franz Torek
1928-Washington President, Evarts A. Graham
1929-St. Louis President, John L. Yates
1930-Philadelphia President, Wyman Whittemore
1931-San Francisco President, Ethan Flagg Butler
1932-Ann Arbor President, Frederick T. Lord
1933-Washington President, George P. Muller
1934-Boston President, George J. Heuer
1935-New York President, John Alexander
1936-Rochester, Minn. President, Carl Eggers
1937-Saranac Lake President, Leo Eloesser
1938-Atlanta President, Stuart W. Harrington
1939-Los Angeles President, Harold Brunn
1940-Cleveland President, Adrian V. S. Lambert
1941-Toronto President, Fraser B. Gurd
1944-Chicago President, Frank S. Dolley
1946-Detroit President, Claude S. Beck
1947-St. Louis President, I. A. Bigger
1948-Quebec President, Alton Ochsner
1949-New Orleans President, Edward D. Churchill
1950-Denver President, Edward J. O'Brien
1951-Atlantic City President, Alfred Blalock
1952-Dallas President, Frank B. Berry
1953-San Francisco President, Robert M. Janes
1954-Montreal President, Emile Holman
1955-Atlantic City President, Edward S. Welles
1956-Miami Beach President, Richard H. Meade
1957-Chicago President, Cameron Haight
1958-Boston President, Brian Blades
1959-Los Angeles President, Michael E. De Bakey
1960-Miami Beach President, William E. Adams
1961-Philadelphia President, John H. Gibbon, Jr.