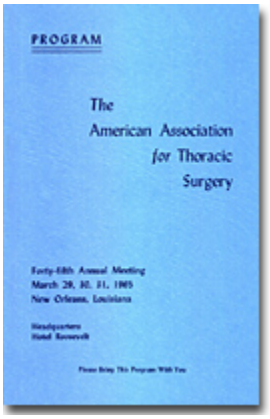
1965 ANNUAL MEETING PROGRAM



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Monday Morning, March 29, 1965

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

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

1. Immediate Surgery for Traumatic Heart Disease

THOMAS F. BOYD, and JOHN W. STRIEDER,
Boston, Mass.

Until recently, civilian production of the majority of penetrating cardiac wounds was localized to a few southern United States cities. With changes in immigration and social violence, northern hospitals have been forced to evolve their own methods of treatment. The last twenty-five patients with penetrating cardiac trauma who arrived alive at Boston City Hospital are reported. Twenty-two were taken to the Operating Room to be treated by close observation, blood replacement, and pericardiocentesis. On this regimen, several patients rapidly worsened and were operated upon with excellent results. Others were observed for hours and then had a rapidly downhill course, necessitating late operation. These patients eventually succumbed. Immediate operation again became routine therapy and all but a single patient became long-term survivors. Three patients who were operated upon in the Emergency Room did not survive. Sixteen of the patients who arrived in the Operating Room alive and were operated upon within two hours of injury became long-term survivors, including two with bullet wounds of the heart. Four who were operated upon after two hours did not survive. The difference between these groups is statistically significant. We believe, therefore, that immediate surgery is indicated in every patient with penetrating cardiac trauma.

2. Chest Trauma with Pneumothorax and Hemothorax

JOHN W. V. CORDICE*, and JOSE CABEZON*
New York, N. Y.
Sponsored by GEORGE H. HUMPHREYS II

Study was made of 507 cases of chest trauma seen at the Harlem Hospital Center during a seven year period, 1957-1963 inclusive, in which there was hemothorax, pneumothorax or both as significant clinical findings The great majority were stab wounds (420), but there were twenty-five cases of bullet wounds and sixty-one cases in which blunt trauma (beatings, falls, automobile injuries, etc.) was the cause. A small number of patients presented penetrating trauma of the neck, shoulder or abdomen with the wound of entrance not on the chest primarily. Evaluation of the cases was made as regards incidence, source and degree of pneumothorax and hemothorax, and this data was correlated with the types and locations of wounds and the effectiveness of needle versus tube drainage of the pleura. Indications for open thoracotomy will be discussed. Further detailed study and commentary is made of certain groups of patients as follows: Bilateral chest injuries (48), bullet wounds (25); blunt trauma (61); thoraco-abdominal wounds (49); and cervical thoracic wounds (22). Follow-up has been made on the patients as regards the residual radiologic findings and any symptoms or disability referable to the chest. The forty-nine deaths are analyzed as to cause, preventability and errors in diagnosis and management.

3. The Patho-Physiology of Pulmonary Embolism: Relationships to Accurate Diagnosis and Choice of Therapy

DAVID C. SABISTON, JR., and HENRY N. WAGNER, JR.*,
Durham, N. C.

Pulmonary embolism continues to represent a serious and often fatal complication. Despite its importance, opinion is divided concerning the magnitude of pulmonary arterial occlusion required to produce serious hemodynamic effects and the method of choice in establishing an accurate diagnosis. To gain more objective information a combined clinical and experimental study was undertaken. More than 150 patients were evaluated by pulmonary scintiscanning employing radioactive macro-aggregated albumin, and 100 dogs with experimental embolism were studied for acute and chronic responses including the ultimate fate of emboli in the lungs. The following conclusions have been drawn: (1) serious hemodynamic effects occur after *more than half* of the pulmonary arterial bed is occluded, (2) the diagnosis can be established rapidly and accurately by scintiscanning, (3) in a small number of patients pulmonary arteriography is required for diagnosis, (4) areas of lung with arterial occlusion may become revascularized with the passage of time as demonstrated by serial scanning, and (5) pre-existing cardiac or pulmonary disease seriously aggravates the response to embolism. Analysis of these factors has led to a useful approach in the choice of a group of patients selected for pulmonary embolectomy.

4. Intramural Arterial Dissection During Cardiopulmonary Bypass

DONALD ELLIOTT*, and BENSON B. ROE,
San Francisco, Calif.

Vascular accidents associated with retrograde perfusion through the femoral artery during extracorporeal circulation are rarely reported. Three published cases and many other unreported cases were apparently due to intimal damage at the time of arterial cannulation and provided evidence of extraluminal dissection early in the perfusion. Two cases of fatal intramural aortic dissection are reported which had an abrupt onset after satisfactory total body perfusion for 40 minutes and 60 minutes, respectively. One dissection developed as the result of an arteriosclerotic plaque in the abdominal aorta which became elevated during retrograde flow. The other dissection occurred in an apparently normal segment of the common iliac artery with total dissection of the major arterial tree which was involved with cystic medial necrosis. In both instances abnormal perfusion was immediately recognized by changes in line pressure, intraarterial pressure, and urinary output. Although both of the patients died, the clinical course in the second case strongly suggests that the dissection, regardless of its source, can be managed successfully by: 1) prompt recognition, 2) immediate cessation of retrograde perfusion, and 3) introduction of the perfusion cannula into the ascending aorta.

5. Treatment of Dissecting Aneurysms of the Aorta Without Surgery

MYRON W. WHEAT, JR., ROGER F. PALMER*, THOMAS D. HARTLEY*,
and ROBERT C. SEELMAN*, Gainesville, Fla.

Acute dissecting aneurysm of the thoracic aorta is a serious therapeutic problem with a surgical mortality of 50 to 100%. Theoretical considerations indicate that depression of the initial ventricular impulse (I.V.I.) should result in a major reduction of forces impinging on the aortic wall. Drugs that reduce the rate of ventricular fiber shortening (□L/□t) in isolated systems should result in reduction of I.V.I, in intact systems and therefore reduce forces furthering dissection. Reserpine, guanethidine, and trimethaphan but not hexamethonium reduce □L/□t in isolated rabbit hearts. During the past six years we have treated 12 patients with acute dissecting aneurysm of the thoracic aorta. The six patients treated surgically all died. Since October 1963, six consecutive patients with acute dissecting aneurysms of the thoracic aorta have been treated for two to five days with I.V. trimethaphan and I.M. reserpine followed by maintenance on oral reserpine and guanethidine. Pain when present was relieved immediately with administration of trimethaphan. All six patients are living, four months to one year later without evidence of further dissection.

6. Metabolic Alterations Noted in Cyanotic and Acyanotic Infants During Surgery Under Hyperbaric Conditions

WILLIAM F. BERNHARD, RICHARD DANIS*, and ROBERT E. GROSS,
Boston, Mass.

Palliative or corrective surgery was carried out in 100 infants under hyper-baric conditions (30-44 p.s.i. gauge). 76 cyanotic babies (pulmonary or tricuspid atresia, tetralogy, transposition great vessels) comprised Group I, and 24 acyanotic patients (aortic or pulmonic stenosis, aortic coarctation) formed Group II. Metabolic changes were apparent in both groups; however, the most profound alterations occurred in 45 patients of Group I, less than 6 months of age. Precompression studies indicated: arterial Po_2 of 18-40 mm.Hg; lactate-pyruvate ratios (25-70), inversely related to Po_2; excess lactate (1.5-3.5 mM/L); arterial Pco_2 (35-50 mm.Hg); pH (6.90-7.25). In addition, pulmonary compliance was markedly reduced in 10 infants. Following compression, hypercarbia (45-70 mm.Hg) developed, and was treated by administration of an amine buffer. Lactate-pyruvate ratios decreased by conclusion of operation and decompression. 61 infants survived (80%). Acute metabolic disturbances also occurred in 1/3 of Group II patients. Congestive failure resulted in reduced pulmonary compliance, low pH (7.15-7.30) and hypercarbia. Lactate-pyruvate ratios were not elevated unless ventricular fibrillation ensued. Group II survival rate was 88%. These results will be compared with a separate series of 200 infants operated upon under standard conditions (1956-1962).

7. A New Disposable Membrane Oxygenator With Integral Heat Exchange

M. L. BRAMSON*, JOHN J. OSBORN*, F. BEACHLEY MAIN*,
San Francisco, Calif., MARK F. O'BRIEN*, Melbourne, Australia,
JOHN S. WRIGHT*, Sydney, Australia, and
FRANK GERBODE, San Francisco, Calif.

The paper reports the development, over a five year period, of a new disposable membrane oxygenator which is believed to eliminate some remaining obstacles to the extensive use of heart-lung machines embodying this type of lung. The design and its rationale are described, and it is shown, inter alia, that: a) a compact 14-cell lung with 5.6 sq.m. of effective membrane area, and flow rates up to 5.0 liters per min., will provide adequate $O_2$and CO_2exchange for total perfusion of adults, b) the priming volume of such a lung is less than one liter, c) the hemodynamic resistance of the lung, even at high flow rates, is so low that only one pump is required for the extracorporeal circuit, d) essential constancy of the extracorporeal blood volume is maintained notwithstanding wide variations in flow rates and pressures, e) effective control of blood temperature is obtained at no cost in priming volume or additional surfaces in contact with blood, and f) greatly simplified automatic equalization of arterial inflow with venous outflow is obtained. The results of one series of laboratory, and one series of clinical perfusions are reported.

*By Invitation

Monday Afternoon, March 29, 1965

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

8. Changing Concepts in the Surgical Treatment of Pulsion Diverticula of the Lower Esophagus

THOMAS H. ALLEN*, Birmingham, Ala., and O. THERON CLAGETT, Rochester, Minn.

A review of twenty years experience at the Mayo Clinic in the surgical treatment of lower esophageal (epiphrenic) pulsion diverticula shows a rather distinct contrast between therapeutic concepts employed and morbidity observed during the first ten years and the clinical experience during the latter period. The importance of associated hiatal and other esophageal abnormalities is discussed and the incidence is recorded. The salient features of surgical management are outlined and illustrated stressing careful pre-operative evaluation and preparation, the use of a left thoracotomy approach, two-layer closure of the esophagus following diverticulectomy, esophagomyotomy, and correction of associated lesions. Two cases illustrating the severe complications resulting from conventional diverticulectomy only in the presence of associated lesions are briefly reviewed.

9. Hiatal Hernia and Reflux Esophagitis in Children

IRVIN L. HEIMBURGER*, Indianapolis, Ind., WILLIAM C. ALFORD, JR.*, GEOFFREY H. WOOLER*, and JOHN A. AYLWIN*, Leeds, England

Sponsored by HARRIS B SHUMACKER, JR.

Hiatal hernia, a significant cause of vomiting during infancy, is frequently complicated by severe peptic esophagitis. Sixty-one infants and children with hernias have been seen at the Leeds infirmary. Three-fourths exhibited peptic esophagitis and over half of these had strictures. Treatment of the strictures by repeated dilatations proved entirely unsatisfactory, most of these children eventually requiring esophageal resection. Thirty children were satisfactorily treated by hernia repair. A thoracoabdominal repair has been developed which has eliminated the recurrences originally encountered with the earlier transthoracic repairs Sixteen resections have been performed during the past eleven years. Ten had jejunal loop reconstruction. These have proven very successful and have not been affected by the child's growth or by peptic erosion. The unique method employed to preserve adequate circulation to this loop is described. The high incidence of stricture following esophagogastrostomy in the other six has made this clearly an undesirable procedure. Several of the fifteen patients not treated surgically died as the result of complications that can occur when this abnormality is not corrected. The definite role of early diagnosis and intensive medical management is also discussed.

10. The Preoperative Detection of Left Atrial Thrombi

DON L. FISHER*, LAWRENCE B. BRENT*, EDWARD M. KENT, and GEORGE J. MAGOVERN, Pittsburgh, Pa.

Left atriography by direct injection is shown to be accurate and safe in the preoperative diagnosis of left atrial thrombosis. Routine preoperative use of the test is advised in mitral stenosis, especially if atrial fibrillation is present, or if embolization has occurred. During transatrial septal left heart catheterization, an 8½ F left atrial catheter is placed. 21 ml sodium iothalamate 80% is injected in 1½ sec. A single 1/30 sec P.A. x-ray film exposure is taken at the end of injection, using a grid cassette. An additional film in the R.A.O. view is usually done. Use of a cassette changer is optional. 35 mm cinecardiographic films were found to be inferior to standard sized films. In 378 patients tested, 99 showed thrombi in left atrium or appendage (26%). 56 of the 99 were explored surgically, and no diagnostic errors were found. Only one embolization occurred during testing, and no other major complications. Massive thrombosis was treated by complete removal during open heart mitral repair. Lesser thrombi were treated by closed mitral stenosis repair, leaving intact the thrombi of the main chamber, but removing those of the appendage. Anticoagulant drugs and electrical defibrillation were given during convalescence.

11. Aortic Valve Replacement Utilizing the Sutureless (Ma-govern) Prosthesis

C. WALTON LILLEHEI, RICHARD C. LILLEHEI, and RANDOLPH M. FERLIC*, Minneapolis, Minn.

Extensive experience with open reconstruction techniques for acquired aortic valve disease disclosed initial good, but poor long term palliation. This led to development of techniques for successful total valve replacement in 1958 utilizing a silastic flap valve (patient still alive). In the period 1961-1964, the Starr-Edwards valve was employed in 59 patients with 17 hospital deaths (28%) and 2 late deaths to date. More recently, we adopted use of the sutureless aortic valve, and in a series of 35 consecutive cases have been impressed by reduction of hospital mortality to 9%. To date there have been no late deaths, embolic complications, nor valve migration. This mortality reduction has been particularly evident in poor risk patients of older ages (7th and 8th decades) and those needing multiple procedures (10 of this series). Total body perfusion was carried out at moderate hypothermia (30°C) with Rheomacrodex-mannitol prime (16 to 20 cc/kg.), and perfusion of both coronaries. No venting of the heart is utilized. The sutureless valve is larger in diameter than the comparative sutured valve, but this has been compensated for by development of a simple technique (to be described) for inserting a larger sutureless valve without cardiac damage.

12. Chronic Hemolysis in Patients with Ball-Valve Prostheses

MURRAY N. ANDERSEN, ELEMER GABRIELI*, and JOSEPH A. ZIZZI*,
Buffalo, N. Y.

The occurrence of anemia in certain patients who had previously undergone mitral or aortic valve replacement with a ball-valve prosthesis has led to a study of the degree of chronic hemolysis occurring in such patients. Studies were performed six months to two years after valve replacement in ten patients with prosthetic mitral valves and six patients with prosthetic aortic valves. Chronic hemolysis was evaluated by three principal methods which provide sensitive indices of intra-vascular hemolysis: serum haptoglobin levels, serum lactic dehydrogenase levels (total and fractionated for specific isozymes) and free plasma hemoglobin. Red cell survival times, measured by Cr_{51} tagging, were determined in most patients. Reticulocyte counts and routine hematocrits were also obtained. All patients studied had evidence of significant chronic hemolysis with total, or near-total, depletion of serum haptoglobin and persistent elevation of lactic dehydrogenase in the fractions associated with red blood cell lysis. Elevation of free plasma hemoglobin was unusual in patients with mitral valve prostheses but frequent in the patients with aortic prostheses, indicating more severe hemolysis following aortic valve replacement. The loss of the protective mechanism provided by haptoglobin against free plasma hemoglobin may be of particular significance and the implications of these findings, particularly in relation to renal damage, will be discussed.

13. The Treatment of Coronary Occlusive Disease by Endar-terectomy

RALPH B. DILLEY*, JACK A. CANNON*, ALBERT A. KATTUS*,
REX N. MACALPIN*, and WILLIAM P. LONGMIRE, JR.,
Los Angeles, Calif.

Of twenty-five patients undergoing coronary endarterectomy for localized occlusive arteriosclerosis between 1957 and 1964 at the University of California Medical Center at Los Angeles, nineteen have survived the operative procedure. There have been five early postoperative deaths from thrombosis of the endarterectomized vessel and four late deaths from five months to six years following operation. In one of these an unusual circumferential scarring of the endarterectomized vessel was demonstrated. In another, death occurred after re-operation for a localized process in the right coronary artery six years following a left anterior descending endarterectomy which had remained patent. Detailed follow-up data is available in six of the ten surviving patients at present. Selective cineangiography has demonstrated re-occlusion of the endarterectomized vessel in three patients, and excellent patency in three patients - two, four and six years postoperatively. Operative techniques have included direct open endarterectomy, closed endarterectomy through the aortic root, release of external constricting bands, and internal mammary bypass. Our current indications for operation as well as a detailed analysis of operative techniques employed will be presented. In addition, the causes of the immediate and late deaths plus details of follow-up information in surviving patients will be discussed.

14. Myocardial Revascularization by Vineberg's Internal Mammary Implant: Evaluation of Postoperative Results

DONALD B. EFFLER, F. MASON SONES, JR.*, L. K. GROVES,
and ERNESTO SUAREZ*, Cleveland, Ohio

Seventy-eight internal mammary implants were performed at the Cleveland Clinic Hospital between April 1962 and December 1963. An objective report of results is based upon: (1) patient survival, and (2) restudy with coronary and internal mammary arteriography (Sones' Technic). (1) Survival: 73 Patients are alive. 3 Immediate and 1 late fatality are recorded, each death attributable to coronary artery disease. A 7 months' survivor died of lymphosarcoma; autopsy revealed a viable implant. (2) Arteriography: 44 Patients have been restudied to date. The best arteriograms are obtained 9 to 12 months after operation. Direct opacification of the implanted vessel shows: (a) 31 patients demonstrate working implants, (b) 6 patients have occluded implants, and (c) 7 patients have inconclusive results because of early or inadequate study. Sones' Technic provides logical selection of candidates, an objective method of assessing results, and a means of determining progress of disease. A film, utilizing stop-frame technic, proves conclusively that myocardial revascularization may occur. The revascularization may be accomplished by: (a) new vessel formation, and (b) direct arteriolar-to-arteriolar anastomoses with preexisting coronary vessels. Arteriograms of the "ideal candidate" are included.

*By Invitation

Tuesday Morning, March 30, 1965

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

15. Motility Disturbances Caused by Esophagitis

ARTHUR M. OLSEN, and JERRY F. SCHLEGEL*,

Rochester, Minn.

Patterns of esophageal motility have been described for the normal esophagus and for disturbances of function such as achalasia, diffuse spasm and scleroderma. Recently the identification of hiatal hernia by pressure determinations has been

described. The esophageal motility records of 60 patients with proven esophagitis as demonstrated at esophagoscopy have been examined. Patients with classical achalasia or diffuse spasm or with clinical evidence of scleroderma were excluded from the group. Patients with moderate to severe esophagitis often had evidence of neuromuscular disturbances similar to those observed in patients with sclerodermal involvement of the esophagus. In these cases, the esophageal responses to swallowing were feeble and simultaneous and the gastroesophageal sphincter relaxed poorly. Most of the patients with mild degrees of esophagitis had normal esophageal motility except for the evidence of hiatal hernia. Some of these, however, did show early motor incoordination. It was apparent from our study that esophagitis may produce significant impairment of esophageal motility, and in the more severe cases this is probably irreversible. The recognition of disturbed function which may accompany esophagitis should be of great importance to the surgeon who is contemplating repair of hiatal hernia.

16. The Experimental Production of Esophageal Achalasia by Destructive Lesions in the Medulla

BRIAN HIGGS*, F. W. L KERR*, and F. H. ELLIS, JR.,

Rochester, Minn.

Electrolytic lesions were placed in the motor nuclei of the vagus nerve of dogs and cats using a stereotaxic technique. Pre- and postoperative records of esophageal function were obtained using established manometric, fluoroscopic and cineradiographic techniques. Necropsy studies performed from one to six weeks after operation have included histologic studies of the medulla, peripheral vagus nerves and esophagus. The findings to date suggest that a condition indistinguishable from esophageal achalasia in man can be produced by focal lesions in the medulla. Postoperative motility studies show absence of esophageal peristalsis, normal sphincteric pressures and failure of the inferior esophageal sphincter to relax after swallowing. There is radiographic evidence of esophageal dilatation and narrowing of the distal esophageal segment with obstruction. These results provide further support for the concept that esophageal achalasia is the result of an extraesophageal vagal lesion.

17. The Use of Intercostal Pedicle Grafts in Esophageal Repair

LESTER BRYANT*, Lexington, Ky.

Sponsored by BEN EISEMAN

Dehiscence of the suture line with fistula formation and stricture occurs with significant frequency after operations on the esophagus. In this study, pedicle grafts of intercostal muscle containing the neurovascular bundle were used to close surgical defects and to reinforce suture lines in the canine thoracic esophagus. Excision of a two centimeter segment of the mid-esophagus was performed in twenty animals with end to end anastomosis using a single layer of sutures spaced at 6 millimeter intervals to produce deliberate defects in the suture line. In 10 of these, an intercostal pedicle graft was utilized for circumferential reinforcement of the anastomosis with 90 per cent survival and no evidence of fistula formation or stricture. Six of the 10 control dogs died of mediastinitis and two of the survivors developed esophageal stenosis. In a second group of 10 animals, a surgical perforation of the thoracic esophagus was repaired after 24 hours delay. Repair was effected by a pedicle graft in half the animals with one death due to infection, and mild stenosis of the esophagus in one of the survivors. Four of the five animals repaired by direct suture only expired with esophago-pleural fistulae. The results indicate that intercostal grafts may be useful for closure of traumatic defects, fistulas and anastomoses of the esophagus.

18. Regional Blood Flow in Bronchogenic Carcinoma Utilizing Radioisotope Scanning

HURST B. HATCH, JR.*, WILLIAM MAXFIELD*, and JOHN OCHSNER,

New Orleans, La.

A new radioisotope scanning procedure was used on 50 patients with primary bronchogenic carcinoma in an attempt to obtain regional pulmonary blood flow. All patients except those with peripheral lesions smaller than 2 cm. in diameter showed abnormality in pulmonary blood flow in the diseased portion of the lung. The material used is I^{131} labeled macro-aggregated albumin. The procedure is non-toxic to the patient, does notrequire elaborate preparations, and can be performed in a relatively short period of time. The role that this procedure plays in determining the operability of the carcinoma, the response to therapy, and the prognosis will be discussed.

19. Selective Bronchial Artery Catheterization for Diagnosis and Chemotherapy of Pulmonary Neoplasms

ROBERT E. PAUL, JR.*, PAUL C. KAHN*,

and HAROLD F. RHEINLANDER, Boston, Mass.

We would like to present a preliminary report on selective bronchial arteriography in the human. The methodology of bronchial arterial catheterization utilizing a retrograde percutaneous femoral arterial approach will be described. Normal bronchial arterial patterns and demonstrations of tumor vessels in patients with carcinoma of the lung will be presented. The

preliminary results of acute and chronic bronchial arterial perfusion with chemotherapeutic agents in patients with advanced carcinoma of the lung will be reported.

20. The Pattern of Lymphatic Flow During Extracorporeal Circulation

ARTHUR E. BAUE*, MOREYE NUSBAUM*, GEORGE L. ANSTADT*,

and WILLIAM S. BLAKEMORE, Philadelphia, Pa.

The response of the lymphatic circulation to cardiopulmonary bypass, which could provide information about physiologic derangements during perfusion, has not been systematically studied. To determine this, the thoracic duct was cannulated in 55 dogs with lymph content and flow measured before, during and after bypass. Perfusion rates from 40-90 cc/kg.min. and priming solutions of blood, dextrose-water, dextrose-saline or dextran were used. Differential flows from various regions and changes in RISA appearance time and concentration were measured. A consistent pattern of lymph flow was observed with increases of 300-600% at the beginning of bypass and then decreasing slowly. At the end of bypass, a further decrease occurred reaching control levels much later. This did not correlate well with arterial or venous pressures, perfusion rates, priming solutions or volume changes and is in contrast to reports that lymph flow decreased or stopped with "non-pulsatile" perfusion. Red cells and hemoglobin increased during perfusion. The exaggerated turnover through the lymphatic circulation indicating capillary membrane exchange and interstitial fluid change may account for some of the changes described with perfusion such as sequestration, the "homologus blood syndrome" and post-perfusion volume deficits. The results and significance of these observations as they relate to the physiology of bypass will be presented.

21. Hemodynamic Studies of the Importance of Blood Viscosity and Osmolarity

ROBERT L. REPLOGLE*, and ROBERT E. GROSS,

Boston, Mass.

Each of 45 closed-chest, splenectomized dogs underwent the following measurements before and after moderate hypotension was induced by hemorrhage using the Lamson-Fine technique: cardiac output, renal and carotid blood flows, left ventricular, pulmonary artery and aortic pressures, serial blood volumes, serum osmolarity and whole blood and plasma viscosity. The effects of infusions of low molecular weight dextran, 20% mannitol, 50% glucose, and packed red cells were observed. Conclusions reached: 1. Hematocrit changes profoundly influence blood flow, even when the hematocrit remains within a relatively "normal" range. Increasing the hematocrit from 30% to 60% results in a 50-100% decrease in cardiac output, carotid and renal blood flow. Hemodilution results in a marked increase in cardiac output and peripheral flow. 2. If low molecular weight dextran is infused while hematocrit is kept constant, no change in cardiac output or peripheral flow is observed, even though a measurable reduction in plasma viscosity occurs. This evidence suggests; a) the principal mechanism by which low molecular weight dextran influences blood flow is by lowering hematocrit; b) the practical importance of plasma viscosity is minimal. 3. Increasing serum osmolarity by infusion of hypertonic solutions results in a marked increase in cardiac output and peripheral blood flow, even when hematocrit remains unchanged.

22. The Distribution of Pulmonary Blood Flow After Subcla-vian-Pulmonary Anastomosis: An Experimental Study

LYNN FORT III*, ANDREW G. MORROW, GEORGE E. PIERCE*,

MASAHIRO SAIGUSA*†, and JOSEPH S. MCLAUGHLIN*,

Bethesda, Md.

When a subclavian-pulmonary anastomosis is made, it is usually necessary to construct it at a relatively distal site on the pulmonary artery, and surgeons have speculated as to whether the shunted blood is directed principally to the lung on the operative side or whether it is equally apportioned to both lungs. Radioactive microspheres, which could not pass the pulmonary capillaries, were injected into the circulation of dogs and their concentration determined in lung homogenates. The distribution of the microspheres was similar to that of tagged red cells. With a left subclavian-pulmonary anastomosis, an average of 74% of the shunted blood was delivered to the left lung and 26% to the right lung. The shunt also changed the normal distribution of blood ejected into the pulmonary artery from the right ventricle, 76% being delivered to the right lung and 24% to the left. Similar effects were noted after rightsided anastomoses, i.e., the shunted blood preferentially perfused the right lung and the right ventricular output the left lung. These experimental findings are compared to the altered hemodynamics which apply in patients with congenital heart disease, and a method for extending the observations to man is suggested.

23. A New Technique for Replacement of the Aortic Arch

CARLOS R. LOMBARDO*, ANTONIO L. S. MACHADO*,

and JAMES R. JUDE, Miami, Fla.

Resection of the ascending aorta for aneurysms and acute dissection has only been accomplished with the use of extra-corporeal circulation. The morbidity and mortality associated with their removal is usually the result of severe postoperative hemorrhage and shock secondary to heparinization. A new technique using a specially designed aortic valve which can be inserted into the apex of the left ventricle or a catheter with a ball-valve at its extra-cardiac end is introduced in the left ventricle via the left atrial appendage and sutured to the decending aorta by a sleeve of woven teflon. The coronary circulation is maintained by occlusion of the aorta above the coronary ostia and cerebral circulation by end-to-side anastomosis to the shunt. Eight animals have had either resection of the ascending aorta and replacement with a graft or have had simple perfusion of the entire aorta except the coronary arteries by this method. Hemodynamic studies have revealed only minimal pressure gradients between the left ventricle and the aorta, no incidence of arrhythmia and no elevation of pressures in the left atrium indicating adequate coronary perfusion. All of the animals have survived and none have shown any evidence of neurological dysfunction.

24. Obstruction of the Coronary Ostia During Systole by the Aortic Valve Leaflets

R. T. PADULA*, R. C. CAMISHION, and W. F. BALLINGER II*,

Philadelphia, Pa.

A series of experiments was designed to demonstrate that obstruction of the coronary ostia by the aortic valve leaflets occurs during systole in the intact dog and accounts in part for the diminished coronary blood flow during this phase of the cardiac cycle. Group I. Coronary blood flow through the circumflex artery was measured before and after bypass of the aortic valve - coronary ostia mechanism using systemic-circumflex artery anastomoses (ten dogs). Group II. The valve leaflets and ostia were operatively marked and their relative movements observed by cinefluorography (two dogs). Group III. The functioning valve leaflets and ostia were directly photographed on motion picture film (five dogs). In group I, the initial sharp decrease in blood flow normally found during systole was not observed after the valve - ostia mechanism was bypassed. Thus, systolic blood flow was increased (12%) but was still less than diastolic flow. Cinefluorograms (group II) and motion pictures (group III) conclusively demonstrated that the valve leaflets cover the ostia during early systole. Occlusion of the coronary ostia by aortic valve leaflets occurs during early systole (as well as increased resistance in the peripheral coronary arterial bed caused by the contracting myocardium) reducing coronary blood flow during systole.

25. The Diagnosis of Pericardial Effusions with Ultrasound: An Experimental and Clinical Study

JOHN A. WALDHAUSEN*, HARVEY FEIGENBAUM*, and LLOYD P. HYDE*,

Indianapolis, Ind.

Sponsored by HARRIS B SHUMACKER, JR.

The differentiation of pericardial effusion from a large failing heart is not always easy, although essential for proper therapy. The use of ultrasound offers a simple yet specific technique for the diagnosis of the effusion. An ultrasonoscope emitting vibrations of above 20,000 cycles/sec, was used. Five dogs had saline introduced through a catheter into the pericardium. A sonar probe was placed over the sternum and the reflected echos from the posterior heart wall and pericardium observed. With pericardial fluid present, 2 widely separated reflected signals were present. Without fluid the signals fused. Two normal patients showed one signal coming from the region of the posterior heart wall. In three patients with subsequently proven pericardial fluid, two signals were recorded from the region of the posterior heart wall. A number of patients with proven absence of fluid but large hearts, in contrast, showed only one echo. Limited excursions of the signal reflected poor myocardial contractility. This method appears accurate and has not shown any false positive or negative tests. It has no ill effects and is no more difficult to do than an electrocardiogram. Further studies are in progress.

26. CO2 Flooding of the Chest in Open Heart Surgery: A Potential Hazard

A. BURBANK*, T. B. FERGUSON, and T. H. BURFORD,

St. Louis, Mo.

CO_2 flooding of the chest during open heart surgery has been reported to decrease the incidence of cerebral air emboli. If the quantity of CO_2 returned to the heart lung machine through the cardiotomy suction line is greater than the capacity of the oxygenator to remove it, then a hypercap-neic acidosis will develop. A model was designed to simulate the behavior of a patient under cardiopulmonary by-pass and the effect of CO_2 flooding investigated. As predicted, a hypercapneic acidosis did develop secondary to the CO_2 flooding and persisted for ten to twenty minutes after the CO_2 was discontinued. Two nearly identical clinical cases were then compared, one with and one without CO_2 flooding. A hypercapneic acidosis developed in the second case confirming the experimental result. When CO_2flooding is used, the operating team should be aware of the potential hazard of hypercapneic acidosis and take steps to counteract this hazard.

27. Use of the American and Russian Vascular Staplers for Coronary Artery Anastomoses in Calves

DONALD R. KAHN*, R. F. MALLINA*, WILLIAM S. WILSON*,

and HERBERT SLOAN, Ann Arbor, Mich.

In twelve calves, 2.2 to 2.6 millimeter end-to-end anastomoses were performed with the American stapler between the circumflex coronary artery and either the internal mammary artery (6 calves) or a vein or artery bypass graft which was sutured proximally to the subclavian artery (6 calves). Five calves had 3.3 to 4.1 millimeter end-to-side anastomoses with the Russian stapler between the circumflex coronary artery and a vein or artery bypass graft either sutured proximally to the subclavian or stapled end-to-side to the aorta. All stapled anastomoses remained patent. Coronary cineangiocardiograms obtained from 2 to 5 months after operation demonstrated patency without narrowing of the anastomoses. The coronary sinus was cannulated at this time and occlusion of the anastomotic vessel caused a 40 to 50% decrease in coronary sinus return. Grossly the stapled anastomoses were covered by a thin, smooth endothelial lining and their diameter had actually increased with the growing vessel (0.15 mm. per month). All hearts were normal microscopically. These studies indicate that stapled anastomoses of the circumflex coronary artery maintain a patency rate far superior to reported suture techniques and can supply 40 to 50% of the blood flow to the left ventricle.

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***By Invitation**

Tuesday Afternoon, March 30, 1965

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

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

Address by the President
John C. Jones, Los Angeles
Address by Honored Guest
Dr. A. Gerard Brom

Professor in Thoracic Surgery
University Hospital, Leiden
"Narrowing of the Aortic Isthmus and Enlargement of the Mind"

28. Tracheal and Tracheobronchial Resections: Technic and Results (20 Cases)

J. MATHEY*, J. P. BINET*, J. J. GALEY*, C. EVRARD*,

G. LEMOINE*, and B. DENIS*, Paris, France

Sponsored by O. THERON CLAGETT

This communication reports on 20 cases of tracheal and tracheobronchial resections. The study period extends from 1951 until 1964. In 16 cases, annular resection was elected and repair completed by end to end tracheal or bronchotracheal anastomosis. Four technical points are emphasized: 1) at the time of resection, ventilation and anesthesia must be provided through the distal airway, 2) annular resection with end to end anastomosis is to be preferred when technically feasible, 3) following resection of the tracheal bifurcation, reconstruction of the bronchial tree is essential, and 4) when dealing with malignant lesions, complete removal of the tumor must always be controlled by quick section. Two additional technical aids, extracorporeal circulation and the Marlex mesh prosthesis are currently fashionable. They are discussed in relation to our results. Lateral as opposed to annular resection is only used when the latter is technically impossible. The choice of incision resides between a lateral and anterior sternum-splitting incision. The latter affords broad exposure of the trachea and its bifurcation. Immediate results are as follows: 10 high and 6 low (including the bifurcation) tracheal annular resections with end to end anastomosis - 3 hospital deaths. 3 high and 1 low lateral resections - 2 hospital deaths. Late results with follow up from 8 months to 5 years will be presented.

29. Non-metastatic Neurological Complications of Bronchogenic Carcinoma: The Carcinomatous Neuromyopathies

DONALD L. MORTON*, HIDEO ITABASHI*, and ORVILLE F. GRIMES,

San Francisco, Calif.

The carcinomatous neuromyopathies are a group of neurological syndromes which occur in association with carcinoma and may involve almost any level of the neuromuscular system, but are unrelated to the presence of metastases. These neurological syndromes are probably the most frequent non-metastatic manifestations of bronchogenic carcinoma, but they have received little attention in the thoracic surgical literature. However, the recognition of these neuromyopathies and their differentiation from metasta-tjc lesions deserves special emphasis when considering the surgical treatment of bronchogenic neoplasms. The experience of the University of California Hospitals (San Francisco) and the Langley Porter Neuropsychiatric Institute with this syndrome will be reviewed. Patients with bronchogenic carcinoma may have a wide variety of non-metastatic neurological lesions, including cortical cerebellar degeneration, peripheral neuropathies, encephalomyelitis, polymyositis and myasthenia-like syndromes. The frequency, clinical picture, differential diagnosis and neuropathological findings of these lesions will be discussed. Sixteen cases of this syndrome which were proved at autopsy will be presented. The severity of the syndrome has no relationship to the size or growth rate of the tumor. A surgical approach to the treatment of carcinoma is indicated in these patients, especially since the carcinomatous neuropathy may undergo remission following removal of the primary neoplasm.

30. Preoperative Irradiation in Patients Undergoing Pneumo-nectomy for Carcinoma of the Lung: Incidence of Postoperative Cardiac Complications

JAMES B. D. MARK, San Jose, Calif.,

EDWARD P. CALL*, and CARL F. VON ESSEN*, New Haven, Conn.

In recent years, preoperative irradiation as part of the treatment plan for patients with carcinoma of the lung has undergone critical appraisal at several institutions. Emphasis has been on long-term cure. No evaluation of postoperative complications in previously irradiated patients has been undertaken. During the past six years, 60 patients have undergone pneumonectomy for carcinoma of the lung at the Yale-New Haven Medical Center. Twenty of these patients received planned preoperative irradiation under a selective protocol. Patients in the irradiated and non-irradiated groups were found to be comparable relative to age, sex, stage of disease (TNM classification) and preoperative cardiac status. Postoperative bronchopleural fistula did not occur in either group. The incidence of postoperative cardiac complications in the irradiated group was found to be more than twice as great as that in the non-irradiated group. Operative mortality in the irradiated group was eight times that in the non-irradiated group (4/20 vs. 1/40). Additional correlations with postoperative morbidity, length of survival and post-mortem findings have been carried out. Based on this data, it appears that preoperative irradiation in patients undergoing pneumonectomy for lung cancer is associated with a higher incidence of postoperative cardiac complications and mortality.

***By Invitation**

Tuesday Evening, March 30, 1965

7:00 P.M. Reception
International Room

8:00 P.M. Banquet and Dancing
International Room
Attendance limited to Members of the Association and their ladies, Invited Speakers and their ladies, Invited Guests and their ladies
Dinner dress preferred

Wednesday Morning, March 31, 1965

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

31. The Immediate and Long-term Physiologic Function of Bilateral Re-implanted Lungs

L. PENFIELD FABER*, ALCEU L. SCAFFA PEDREIRA*,

PAUL H. PEVSNER*, and EDWARD J. BEATTIE, JR.,

Chicago, Ill.

Conclusive evidence that the acutely re-implanted dennervated lung will sustain life is lacking. Bilateral lung re-implantations seemingly without time for nerve regeneration are hereby reported. A series of 10 dogs underwent right lung re-implantation. Seven days later left lung re-implantation was performed. Four dogs surviving bilateral lung re-implantation are alive at 9, 6, 2, and 2 months respectively. A control group of 7 dogs underwent right hilar stripping followed in one week by left hilar stripping. Four dogs survived this procedure and were sacrificed after 3 months. All dogs were studied by cardiac catheterization, bronchospirometry, and measurement of lung compliance at varying post-operative intervals. Cardiac output, pulmonary artery pressure and pulmonary resistance and their response to O%was determined. Ventilatory response to hypercapnia and anoxia was measured. Lung biopsies were obtained from all dogs. The dogs surviving bilateral re-implantation show an early post-operative rise in pulmonary artery pressure and pulmonary vascular resistance. These values tend to return to normal as the post-operative period lengthens. Pulmonary artery pressure remains normal in the hilar stripping group. All dogs in both groups increased tidal volume and minute ventilation in response to hypercapnia and anoxia.

32. Preservation of the Canine Lung in Vitro for 24 Hours Using Hypothermia and Hyperbaric Oxygenation

DAVID A. BLUMENSTOCK, NEIL LEMPERT*, and FERNANDO MORGADO*,

Cooperstown, N. Y.

In this study the left lung was removed from 20 dogs, perfused with serum or dextran and placed at 4°C. for 24 hours in an atmosphere of oxygen at a pressure of 30 pounds per square inch. The lung was then placed in a homologous host treated with methotrexate to delay the rejection reaction. The transplant was evaluated by biopsy 3-10 days later. Nine of the 20 lungs had a normal histologic appearance at biopsy. Of the 11 failures, 10 were due to technical problems with the pressure tank or the vascular anastomosis. One failure was unexplained and may have been due to the method. The preservation failed in two additional lungs cooled to 4°C. but not subjected to hyperbaric oxygen. This method is simple and may be satisfactory to preserve lungs used for clinical transplantation.

33. Canine Pulmonary Allografts with Uncontrolled Cross Circulation

O. GAGO*, R. ZAJTCHUK*, S. L. NIGRO, and W. E. ADAMS,

Chicago, Ill.

Repeated uncontrolled cross circulation as a means of preventing rejection without the aid of drugs or X-ray treatment was used following pulmonary homografts in 60 dogs. Lung biopsy and blood Po_2 studies during repeated thoracotomy following transplantation were used for evidence of pulmonary function. A complete alveolocapillary block occurred by the third day in the control group of left lower lobe and right lung allografts as demonstrated by the oxygen diffusion studies and the histologic pattern of edema and peribronchial lymphocytic infiltration. Uncontrolled cross circulation between the host and the donor, and between the host and different subjects during each cross circulation, have been shown to preserve the function of left lower lobe allografts studied for as long as 24 days after grafting, at which time they were sacrificed for other studies. During this time they exhibited normal Po_2 and histological appearance. The same procedure was used in right lung allografts, obtaining inconstant results. These findings indicate that the amount of antigen plays a significant role in the control of the rejection phenomenon. Physiological and histological data will be presented and the significance of this methodology as a means of preventing graft rejection discussed.

34. Immediate and Delayed Orthotopic Homotransplantation of the Heart

YOSHIO KONDO*, FRANZ GRADEL*, WILLY MEIER*,

and ADRIAN KANTROWITZ*, Brooklyn, N. Y.

Sponsored by KARL E. KARLSON

Among 43 puppies whose hearts were transplanted orthotopically under profound hypothermia without a pump-oxygenator, one is alive 203 days postoperatively. Its well-functioning homograft has grown proportionally and become innervated. No immunosuppressive therapy has been used. Fifteen puppies lived 7-57 days; about half died of acute rejection at 2-3 weeks. The ultimate result sensitively reflected the graft's handling, e.g., 76% of transplants from donors under moderate hypothermia maintained circulation over 24 hours. These findings suggest the technical feasibility of heart transplantation for otherwise uncorrectable congenital heart failure, but procurement of ideal grafts will be a major problem. In 20 experiments to preserve grafts 24 hours, several factors were variously combined and survival data on recipients compared. Best results were obtained with the donor under moderate hypothermia, coronary artery perfusion with Tyrode solution for one minute, cooling in 4°C Tyrode, refrigeration under 3 atm. O_2 pressure, without solution to avoid edema. Eleven of 13 similarly treated grafts functioned adequately for at least four hours. One recipient survived five days. We hope to evolve a reliable storage method by making minor changes in this technique.

35. An Artificial Heart Inside the Chest

YUKIHIKO NOSE*, LAWRENCE L. TRETBAR*, A. SENGUPTA*,

S. R. TOPAZ*, and W. J. KOLFF*, Cleveland, Ohio

Sponsored by DONALD B. EFFLER

Present artificial hearts approximate the human heart in size and shape and fit within the pericardium of the calf. This one-piece Silastic unit can pump 8 liters of blood per minute. Attachment of the artificial heart is by direct end-to-end anastomosis to the great vessels and atria. Reservoir action of the atria is not compromised. The four valves are a newly designed tear-drop shape which gives greater flow with less excursion than a ball valve. Retaining feet are used instead of a cage. The heart is driven by compressed air with a relatively simple solenoid system. Regulation of cardiac output is governed by right and left atrial pressures. Calves have replaced dogs as the experimental animal in order to simulate human conditions. The longest survival is 30 hours. Most failures have been mechanical and should therefore be avoidable. Since stroke volume is monitored from beat to beat the effect of drugs can be studied. Vasopressors (nora-drenalin) caused increased blood pressure with decreased cardiac output. Some vasodilators (dibenzyline) caused a fall in blood pressure with a rise in cardiac output without a change in the driving mechanism.

36. The Permanently Implanted Bypass Heart

NAZIH ZUHDI*, JOHN CAREY*, and ALLEN GREER,

Oklahoma City, Okla.

Implanted bilateral bypass of heart is accomplished by withdrawing blood at a pre-determined rate from right atrium and returning it to pulmonary artery and withdrawing it from left atrium and returning it to aorta. Such a bypass heart decreases work of the heart as measured in kilogram meters per hour. This may not be conspicuously reflected by oxygen consumption measurements. Function of the bypass implanted heart is to decrease work of the heart and increase cardiac output as a reduction-additive device to the beating heart. Flow rates smaller than the cardiac output in the bypass heart mean less basic energy and simpler energy conversions. Prototype and controlling mechanisms will be briefly outlined. A bypass implanted heart is placed in either pleural cavity and requires four anastomotic lines without a body perfusion system. Pulmonary artery pressure, aortic pressure and heart rate were recorded during similar and unequal flow rates in each side of the bypass heart for different lengths of time. Equalization of flow of both sides of the implanted heart is achieved through cardiac and extra-cardiac mechanisms. The impossible problem of having pumps delivering identical amounts of blood may thus be obviated.

37. Assisted Circulation: The Pressure Pulse Generator

PHILLIP B. CALLAGHAN*, and DAVID H. WATKINS,

Denver, Colo.

In recent years attempts to assist the circulation in cases of coronary occlusion or following cardiac surgery have been sought. One of the methods which has been tried to assist the circulation has been counterpulsation. Early attempts to use pneumatically operated systems have failed, and it appears that on a system analysis basis the failures may well have been due to engineering design rather than poor physiological concepts. Consequently, a hydraulically or electrically actuated system has been designed which has the following features: (1) ability to maintain good volume transfer in and out of the arterial system even at high heart rates, (2) ability to maintain synchronization even with cases of auricular fibrillation or auricular flutter with a varying block, (3) ability to discriminate physiologically between true heart beats and physiological noise, (4) very fast response time, leading to the discovery of a *Null timing* point at which the effect on cardiac work of the pressure pulse generator appears to be a maximum for a given volume displacement, and (5) construction of the blood handling apparatus to minimize priming volume. Resultant new physiological concepts and clinical applications of the pressure pulse generator will be illustrated.

38. The Normal Mode of Action of the Mitral Valve and its Alteration Following Replacement by a Prosthetic Ball Valve

STANLEY K. BROCKMAN*, HAROLD A. COLLINS, and

HAROLD E. SNYDER*, Nashville, Tenn.

Left atrial pressure, left ventricular pressure, the gradient across the mitral valve and phonograms were recorded in dogs before and after insertion of a Starr-Edwards mitral ball valve. Individual atrial contractions in dogs with heart block caused a delayed rise in ventricular pressure which remained elevated while atrial pressure fell. The negative difference in A-V pressure resulted in closure of the mitral valve. In dogs with sinus rhythm the mitral valve is closed prior to the rise in ventricular pressure by the same mechanism. Closure of the prosthetic mitral valve is accomplished by a similar mechanism but the negative difference in A-V pressure is less. An increased resistance across the prosthetic valve best explains the altered pressure relationship. Closure of the mitral ball valve can be distinctly felt with each atrial contraction during induced ventricular fibrillation. "Double draw" dye studies revealed no mitral regurgitation. These data suggest that the normal mitral valve and the ball valve are closed by atrial contraction prior to the onset of ventricular contraction. This is contrary to the accepted view that the mitral valve is closed by the rising intraventricular pressure.

39. Open Heart Surgery for Mitral Valve Disease

WILLIAM P. YOUNG, VINCENT L. GOTT*, and GEORGE G. ROWE*,

Madison, Wis.

Closed heart surgery for mitral disease was abandoned at the University of Wisconsin Hospitals in 1961. Since then 120 patients have had open surgery on the mitral valve alone or in conjunction with other valves. The frequency of unexpected clots, subvalvular stenosis, and ability to open posteromedial commissures widely justified the open procedures. In 81 patients mitral stenosis was more significant than mitral insufficiency. There were only 3 deaths in this group. All 3 had multiple valve disease. In 39 patients, mitral insufficiency was the more significant, 14 of these died. Dissatisfaction with the results of annuloplasty led to a more routine use of a caged-ball prosthesis. This was, however, accompanied by an increase in deaths, believed to be due to pressure of the cage into the interventricular septum and/or partial obstruction of the left ventricular outflow tract by the ball. The hinged-leaflet prosthetic valve has recently been adopted for use when annuloplasty does not seem satisfactory. With this valve there has been but one death in 10 cases and it was due to cirrhosis. Cardiac catheterization studies of the hinged-leaflet valve are very favorable and will be presented.

40. Factors Limiting Survival After Circulatory Occlusion Under Hypothermia and Hyperbaric Oxygenation

W. STERLING EDWARDS, WILFRED F. HOLDEFER, JR.*,

and ALAN R. DIMICK*, Birmingham, Ala.

Canine experiments were conducted under hyperbaric conditions at 2 atmospheres, absolute, combined with mild general body hypothermia (30°C) to determine whether the brain or the heart was the major factor limiting the safe time of inflow and aortic occlusion. Experiments were done in a hyperbaric chamber large enough for 2 humans and the experimental animal. After reaching 2 atmospheres pressure the animals were ventilated with 98% O_2 and 2% CO_2 for 15 minutes before caval and aortic occlusion were established for 30 minutes. One half the animals served as controls and the other half had coronary perfusion with hyper-oxygenated blood from a small reservoir, delivered through a needle in the ascending aorta proximal to the aortic clamp. There was a mortality of 83% in the control animals, as compared with a 22% mortality in those with coronary perfusion, and refractory ventricular fibrillation was a much more difficult problem in the control animals. Dogs that survived in both groups had no gross neurological damage. We believe this indicates that myocardial ischemia is a more serious limiting factor than cerebral ischemia under these conditions.

41. The Influence of Hyperbaric Oxygen and of Hypoxia on the Ventricular Fibrillation Threshold

ALAN D. TURNBULL*, ANTHONY R. C. DOBELL,

and LLOYD D. MACLEAN, Montreal, Quebec

The ventricular fibrillation threshold (V.F.T.) was determined before and after coronary occlusion in 14 normothermic dogs ventilated with room air, 100% oxygen at 1 atmosphere and 100% oxygen at 3 atmospheres. Arterial blood pressure, arterial blood pH, Po_2 Pco_2 and body temperature were monitored throughout all experiments. Using each animal as its own control, no significant variation in susceptibility to ventricular fibrillation was produced when arterial Po_2 varied between a minimum of 16 mm Hg and a maximum of 1660 mm. of Hg. The V.F.T. declined from 22.5 ± 0.9 ma. without occlusion to 8 ± 0.52 ma. with coronary occlusion when animals were ventilated with room air at 1 atmosphere. Protection was not afforded by ventilation with 100% oxygen at 3 atmospheres (V.F.T. pre-occlusion 21.2 ± 1.1 ma. post occlusion 8.3 ± 0.8 ma.). Arterial blood pH, Pco_2 and body temperature were maintained within normal range in both groups. The ease of defibrillation was strikingly facilitated during the period of hyperbaric treatment. Defibrillation was impossible in animals breathing room air

or oxygen at 1 atmosphere with coronary occlusion present. On oxygen at 3 atmospheres, defibrillation was regularly accomplished with single shocks of low voltage even in the presence of coronary occlusion.

42. Clinical Experience and Problems Encountered with an Implantable Pacemaker

JOE D. MORRIS, RICHARD D. JUDGE*, BERNARD J. LEININOER*,

and FRIEDRICH K. VONTZ*, Ann Arbor, Mich.

A series of 65 patients with complete heart block treated by means of an implanted pacemaker has been reviewed. A high incidence of pacemaker failure early in the series has been reduced by progressive improvement in lead design and improvement in surgical techniques of implantation which minimize lead stress. A new lead possessing greatly increased stress tolerance will be shown. Exit block phenomenon characterized by lack of ventricular response to adequate artificial pacemaker stimulus has been encountered in 14 patients. Management of this complication will be discussed. Other mechanisms of pacemaker malfunction will be reviewed and means of identifying and correcting these problems will be demonstrated. Clinical experience with a variable two-rate unit will be presented.

43. A New Epicardial Pacemaker for the Control of Complete Heart Block

RAYMOND C. BONNABEAU, JR.*,

RANDOLPH M. FERLIC*, and C. WALTON LILLEHEI,

Minneapolis, Minn.

The conventional treatment of patients with complete heart block utilizes a cardiac pacemaker implanted in the abdominal wall or elsewhere with myocardial stimulation by means of wire electrodes. Good results have been obtained with this type unit, but many failures have occurred related to wire electrode breakage. As a result, we have developed a small transistorized pacemaker unit measuring 4 x 3 x 1 cm. which is sutured directly on the epicardial surface and heals thereon. Small electrodes projecting from the unit insert into the myocardium from the under surface of the pacemaker, thus entirely eliminating electrode wires. This unit is powered by a mercury cell which can be recharged at approximate yearly intervals from an induction coil source through the intact chest wall. The recent development of much more reliable rechargeable energy cells makes this new approach feasible. Acute and chronic experiments on canines have shown the feasibility and practicability of this approach.

***By Invitation**

Wednesday Afternoon, March 31, 1965

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

44. Endocarditis Associated with Intracardiac Prostheses: Diagnosis, Management and Prophylaxis

RAYMOND A. AMOURY*, FREDERICK O. BOWMAN, JR.*,
and JAMES R. MALM, New York, N. Y.

Intracardiac prostheses were utilized in 340 patients in a series of 550 open heart operations, with 12 instances of post-operative endocarditis. There were 220 patients with congenital heart disease in whom correction required an intracardiac patch. Infection occurred in only one of this group, and, was due to a species of aspergillus. Valve replacement was carried out in 122 patients, with insertion of 141 prostheses of various types. Infection occurred in 1 of 73 mitral valve replacements, and developed in 10 cases following 68 aortic valve procedures. The predominant organism encountered was a coagulase negative staphylococcus. The means of establishing the diagnosis of post-operative endocarditis are analyzed. The methods of management are presented. Four patients survived. One required excision of the infected prosthesis, and implantation of a suture-less valve. One has been bacteriologically sterilized. Two are satisfactorily controlled by chronic, suppressive antibiotic therapy. A modification of the pre- and post-operative antibiotic program has eliminated endocarditis during the past 12 months.

45. The Place of Surgery in Hypertrophic Obstructive Cardio-myopathy (Idiopathic Hypertrophic Subaortic Stenosis)

HUGH H. BENTALL*, London, England
Sponsored by A. G. MORROW

Since the original description by Brock of functional obstruction of the left ventricle, many reports of the surgical treatment of hypertrophic obstructive cardiomyopathy, variously called also hypertrophic or muscular subaortic stenosis, have appeared. The present paper reports experience at Hammersmith Hospital, London, with fifteen patients treated surgically between the years 1958 and 1964 and amplifies our original reports by means of postoperative haemodynamic studies. A brief description is given of the methods of operation used and of the dangers inherent in operating in this condition. The symptomatic, haemodynamic and electrocardiographic results are given and the results correlated where possible. The mechanisms revealed by this study taken in conjunction with the histo-chemical and electron microscopy studies of Pearse, make it clear that this is a disorder in which there is widespread disorganization of the heart muscle and that surgical treatment is more unlikely to effect any radical cure, but that surgery should be regarded as a method of limited but important value in the treatment of patients with severe obstruction who are in danger of sudden death or who are severely and distressingly incapacitated.

46. Right Ventricular Outflow Obstruction Due to Anomalous Muscle Bundles

HERBERT E. WARDEN*, Morgantown, W. Va.,
RUSSELL V. LUCAS, JR.*, and RICHARD L. VARCO,
Minneapolis, Minn.

Significant right ventricular outflow obstruction may be caused by large anomalous muscle bundles traversing the right ventricular cavity. This type of obstruction is distinguishable from the more common types of infundibular stenosis and may occur with an intact septum and without associated intracardiac pathology. This report concerns 11 patients with intact septa in whom the diagnosis of anomalous muscle bundle obstruction to right ventricular outflow was established by catheterization and angiocardiography. In 6 patients, the anomalous muscle bundles represented the only cardiac abnormality and was the sole cause of obstruction to blood flow through the right ventricle, while in the remaining 5 patients, there was an associated pulmonary valvular stenosis. To date, 8 patients have undergone operation and all are now asymptomatic with essentially normal hemodynamics. Experience with the above group of patients has suggested certain features of anomalous muscle bundle obstruction of the right ventricle which this presentation will attempt to emphasize: 1) this type of obstruction is a distinct entity which may occur independently and may produce significant right ventricular hypertension, 2) there are associated diagnostic characteristics which make its pre-operative recognition possible, and 3) normal hemodynamics may be restored by corrective surgery.

47. Surgical Treatment of Lutembacher's Syndrome

WILLIAM H. MULLER, JR., JAMES B. LITTLEFIELD, and
JULIAN R. BECKWITH*, Charlottesville, Va.

Lutembacher's syndrome (mitral stenosis and atrial septal defect) is a rare surgical lesion. The correction of the mitral valve deformity associated with this syndrome may prove difficult. The authors present their experience with 2 patients successfully treated for Lutembacher's syndrome who are now well 10 months following operation. Cardiac catheterization data and the technique used to correct the congenital deformity of the mitral valve are presented. The experience of others with the surgical correction of this syndrome will be summarized.

48. Incomplete Persistent Atrioventricular Canal: Operative Methods and the Results of Pre- and Postoperative Hemo-dynamic Assessments

NINA S. BRAUNWALD, and ANDREW G. MORROW,
Bethesda, Md.

Thirty patients are described in whom operative treatment of incomplete persistent atrioventricular canal was undertaken. In 11 patients an additional anomaly was present: common atrium 5, pulmonic stenosis 2, sub-aortic stenosis 1, and small ventricular septal defect 3. In all, the cleft mitral valve was repaired, the interatrial septum reconstituted with a prosthesis, and any associated malformation corrected. Four operative deaths occurred, from air embolism, aplastic anemia (chloramphemcol), recurrent shunt, or residual mitral regurgitation. Two patients died late, one from heart block and one from mitral regurgitation. Intraoperative dye curves were recorded in all patients and 17 have had detailed postoperative hemodynamic assessment. Pulmonary hypertension was abolished in 6 of the 7 patients in whom it was present preoperatively. Pulmonary capillary and right atrial pressures were normal postoperatively in all patients studied, indicating satisfactory mitral and tricuspid valve function. No circulatory shunt was evident in 22 patients and trivial ones, not necessitating reoperation, are present in the other 2. The operative methods utilized, and certain correlations between pre- and postoperative hemodynamic findings and the results of operation, will be presented.

49. Congestive Heart Failure in Children with Atrial Septal Defect

M. WEINBERG, JR., R. A. MILLER*, A. R. HASTREITER*,
J. G. RAFFENSPERGER*, E. H. FELL, and H. G. BUCHELERES*,
Chicago, Ill.

Atrial septal defects in infants and children, exclusive of endocardial cushion defects, generally are associated with few or no symptoms. Operation is recommended as an elective procedure to prevent complications in adult life. A distinct group is encountered, however, in which congestive heart failure and severe retardation of growth and development appear in infancy, and operation is mandatory at an early age. Although physical examination, cardiac catheterization, and angiocardiography demonstrate findings of only the isolated interatrial communication, associated anomalies should be suspected and may be encountered at operation. These include mitral stenosis and insufficiency, incomplete forms of triatrial heart, anomalous drainage of pulmonary veins, and fibroelastosis or hypoplasia of the left ventricle. At times no clear additional deformity is recognized. All of these variations have been encountered by the authors, and will be discussed. The presence of severe symptoms in a child with an atrial septal defect should constitute a special indication for careful inspection of the left atrium and ventricle, the pulmonary veins, and the mitral valve. Of overwhelming importance is the

recognition that control of blood volume is unusually critical in these children. Pulmonary complications are frequent and demand exceptional attention.

50. Total Anomalous Pulmonary Venous Drainage: Surgical Treatment in 61 Patients

DENTON A. COOLEY, and GRADY L. HALLMAN*,
Houston, Texas

Drainage of the entire pulmonary circulation into the right side of the heart may occur in numerous anatomic forms. Darling's classification which is based upon the site of entry for the pulmonary blood into the systemic venous blood describes four types: supracardiac, paracardiac, infracardiac, and mixed. Prognosis and age of onset of symptoms in this complex anomaly depend upon several factors including size of the foramen ovale, presence of obstruction in the venous trunk, patency of the ductus arteriosus, and others. This report is based upon a consecutive series of 61 patients operated upon between 1957 and 1964. Supracardiac drainage was demonstrated in 35 patients, and other types accounted for the remainder. Age of the patient influenced risk of operation, since among 33 infants less than one year of age there were 15 survivors and in the remaining 28 patients 26 survived complete surgical correction. This presentation will be concerned with technical considerations in repair of total anomalous pulmonary venous drainage. Methods will be proposed for reducing the mortality in small desperately ill infants including use of staged operations.
By Invitation

The American Association for Thoracic Surgery, 1964-65

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