

1967 ANNUAL MEETING PROGRAM



The American Association for Thoracic Surgery 1966-1967

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MONDAY MORNING, APRIL 17, 1967

8:30 A.M. Business Session (Limited to Members)
Imperial Ballroom

8:45 A.M. Scientific Session: REGULAR PROGRAM
Imperial Ballroom

1. Abnormalities of the Sinus of Valsalva: Diagnosis and Treatment

MICHAEL E. DEBAKEY, EDWARD B. DIETRICH,* JOHN E. LIDDICOAT,*
SAMUEL A. KINARD,* H. EDWARD GARRETT, and JAMES F. HOWELL,*
Houston, Texas.

Twenty-six patients with abnormalities of the sinuses of valsalva have been treated at the Methodist Hospital within the last three years. These abnormalities were classified as aneurysms (22 cases), fistulae (2 cases), and aneurysms associated with fistulae (2 cases). In the group of 22 patients with aneurysms, 20 had 3 sinus involvement and 2 had single sinus involvement. In the group of patients with fistulae, two were from the left coronary sinus to the left atrium, and one each from the right coronary sinus to the right atrium and the right ventricular outflow tract. The history, physical examination, electrocardiogram and plain chest films were nonspecific. Positive diagnosis was established in each case preoperatively by retrograde aortic catheterization and aortic root injection. All the aneurysms were associated with aortic incompetence requiring aortic valve replacement in conjunction with resection of the aneurysm and graft replacement. The aortic valve was normal in three patients with fistulae and the treatment consisted of fistula ligation. The diagnostic features, operative techniques and results in this group of interesting patients with sinus of valsalva abnormalities will be discussed.

2. Mitral Replacement: A Review of Six Years Experience

ALBERT STARR, RODNEY H. HERR,* and JAMES A. WOOD*
Portland, Ore.

This report reviews our total experience with 263 patients undergoing mitral valve replacement with a ball valve prosthesis from September, 1960 to September, 1966. 145 patients had isolated mitral valve replacement, 75 had mitral and aortic valve replacement, 14 had mitral and tricuspid replacement, and 29 had triple valve replacement. The overall operative and late mortality of 15% and 10% respectively were roughly comparable in each of the groups without regard to the number of valves involved. Advances in our thinking with regard to the selection of patients for surgery, improvements in operative approach and technique, management of associated valvular heart disease, modifications of valve design, and certain features of postoperative care have greatly decreased operative morbidity and mortality. Attention is directed to the various causes of late morbidity and mortality such as thromboembolism, myocardial fibrosis, and recurrent regurgitation. The encouragement of encapsulation of the attached portion of the mitral prosthesis, first introduced in March, 1965 with the extended cloth design, has resulted in a decrease in embolic complications from 38% to 4% in the isolated mitral series. Further experiences with totally encapsulated prostheses and other recent innovations in valve design will be discussed.

3. Myocardial Revascularization by Internal Mammary Implant Procedures: Clinical Experience

RENE G. FAVALORO,* DONALD B. EFFLER, LAURENCE K. GROVES, and
F. MASON SONES, JR.,* Cleveland, Ohio.

7,300 selective coronary arteriograms (Sones' technique) have been made in the Cleveland Clinic. 786 patients, so studied, received surgical treatment for coronary artery disease or its sequelae (January, 1961 to October 31, 1966). Internal mammary implantation has the broadest application of all revascularization operations and may supplement coronary perfusion in any part, or all, of left ventricle. 587 patients underwent some form of mammary implantation between April, 1961, and October 31, 1966. The Vineberg procedure, used initially, was followed by the Sewell pedicle implant. Overall hospital mortality is 4.7%; the last 178 operations carried a 2.2% mortality. One year follow-up in 78 patients reveals 90.4% implant patency. Comparative statistics between the Vineberg series and the Sewell series will be presented. Results of implantation are improved by long tunnels beneath major branches of the anterior descending and the circumflex arteries. Current technique (Vineberg-Sewell AP implant) places a trimmed pedicle through two connecting tunnels which traverse the anterolateral and the diaphragmatic aspects of the left ventricle. For patients with severe diffuse disease a double implant is used - the right artery is placed in the anterior left ventricle and the left artery is placed posteriorly. Operative techniques of both procedures will be described - arteriographic evidence of revascularization will be shown.

4. Experience with the Cytologic Detection, Localization and Treatment of Radiographically Undemonstrable Bronchial Carcinoma

F. G. PEARSON,* D. W. THOMPSON,* and N. C. DELARUE,
Toronto, Ontario.

Sputum cytology can detect bronchial carcinoma in stages before the tumor becomes demonstrable in a chest radiograph. In 40 such patients seen at the Toronto General Hospital since 1960, the lesion has been located and histologically verified in 20. Follow-up observations indicate a greatly enhanced prognosis if the lesion is located and adequately treated in these early stages. In a recent sputum cytology screening program of an asymptomatic high risk group of 1,586 patients, with an average of only 1.4 sputum samples per patient, 13 had positive sputum cytology. To date the lesion has been located in 3. 22 patients with symptoms suggestive of bronchial carcinoma but with no tumor demonstrable

in chest radiographs had positive sputum cytology. Localization has been effected in 12. 5 patients presented with radiographic lesion which were found to be benign and unrelated to co-existent, radiographically invisible bronchial carcinoma. Of the 20 patients in whom the lesion was located, 13 were treated by resection and 5 by irradiation. 2 lesions were found at autopsy. Techniques and problems in localization, and follow-up data are presented. The follow-up search for an obscure lesion in a patient with positive sputum cytology is described.

5. Long Term Survival After Surgical Resection for Bronchogenic Carcinoma

JOHN C. JONES, WILLIAM H. KERN,* NILES D. CHAPMAN,*
BERT W. MEYER, and GEORGE G. LINDESMITH,* Los Angeles, Calif.

The authors review a series of 359 consecutive resections of bronchogenic carcinoma with 94 patients surviving five to twenty-two years. The results of the histological review of slides of every specimen in the series is presented in detail with some startling conclusions, particularly as regards survival time of some patients whose specimens were considered to be highly malignant. The location of the tumor in survivors is compared to that of the non-survivors. The various locations of the tumors in long term survivors is considered along with the cell type and size of these tumors. Of interest is the finding of long term survival in some patients with lymph node metastasis, extension of tumor to the margin of bronchial resection, invasion of pleura, and blood vessel invasion. To be considered is the fact that in review of the slides by five pathologists there is a variation in criteria which sometimes makes it difficult to compare results in various series, both in the survivors and non-survivors. These results of long term survival, and the knowledge that many of those who did not survive an initial five years died of unrelated causes, makes it more than ever imperative that these patients be found and submitted to surgery as early as possible.

6. Bronchogenic Carcinoma Involving the Thoracic Wall: Surgical Treatment and Prognostic Significance

ALEXANDER S. GEHA,* PHILIP E. BERNATZ, and LEWIS B. WOOLNER,*
Rochester, Minn.

Of 2,113 patients undergoing surgical exploration for lung cancer, 174 (8.2%) had extension into the thoracic wall with or without concomitant invasion of the mediastinum, pericardium, or major vessels. Of 158 with primary bronchogenic carcinoma in the latter group, 41 (26%) underwent en bloc resection, considered curative by the surgeon, with 1 operative death. Twelve of the 41 (32%) survived more than 5 years; the 5-year survival rate was 35% in squamous cell carcinoma, 60% in adenocarcinoma, and 10% in large cell undifferentiated carcinoma. With proper planning of treatment, the outlook for patients with bronchogenic carcinoma and associated invasion of the chest wall may be among the more favorable outlooks for patients with lung cancer.

7. Treatment of Multiple Lung Metastases in Children with Combined Therapy: Surgery and Chemotherapy and/or Irradiation

EUGENE E. CLIFFTON,* and JOHN L. POOL, New York, N. Y.

The results of surgical treatment of pulmonary metastases in children from 1946 to 1966 is to be reported. There were 20 children who had multiple pulmonary metastases treated with chemotherapy and/or x-ray therapy prior to surgery. Long term survival (5 years or more) was obtained in 5 of these patients. One patient had an osteogenic sarcoma, two had adenocarcinomas of the testicle, one a rhabdomyosarcoma and one a Wilm's tumor. Two others are living and well at 26 and 39 months after surgery for the metastases. These both had Wilm's tumors. In 4 patients, bilateral resections were performed and of these, one patient is alive and well 8 years following surgery and a second is living without evidence of recurrence 26 months following surgery. This last patient had 7 tumor nodules removed. Two others are living and well less than one year. The total experience of recognized metastatic cancer in the lungs of children will be reported in the completed paper. This five year survival of 20% is surprising and would suggest a much more aggressive approach to the treatment of metastatic lung cancer in children, with chemotherapy and x-ray therapy followed by resectional treatment of those lesions which persist.

*By Invitation

MONDAY AFTERNOON, APRIL 17, 1967

2:00 P.M. Scientific Session: REGULAR PROGRAM Imperial Ballroom

8. Fascia Lata Replacement of Aortic Valves

AKE SENNINO,* Zurich, Switzerland.

Sponsored by JOHN W. KIRKLIN

Since 1962 diseased aortic valves have been replaced with autologous fascia lata. The technical aspects of this operative method will be discussed. The clinical experience with this technique in the first ninety cases of aortic stenosis or incompetence will be presented. Hemodynamic improvement was assessed by pre-and postoperative catheter studies.

Special attention will be paid to the occurrence of late complications (endocarditis and insufficiency) during a follow-up period of 4 ½ years.

9. An Evaluation of Aortic Valve Homografts Sterilized by Electron Beam Energy

JAMES R. MALM, FREDERICK O. BOWMAN, JR.,* PAUL D. HARRIS,* and

A. T. W. KOWALIK,* New York, N. Y.

Aortic valve replacement has been reported utilizing human grafts sterilized by immersion in 1% beta-propiolactone. Subsequent storage by freeze-drying or nutrient medium has modified valve consistency and limited the safe preservation time prior to implantation. A technique of freezing (-70 degrees centigrade) for preservation and high energy radiation (2 megarads) for sterilization has provided a soft pliable graft with a prolonged utilization time. Comparative tensile strengths of identical specimens of aortic grafts show 1) no change in untreated grafts (control) 6-24 hours after death; 2) a decrease up to 40% with 1% beta-propiolactone; 3) no change by freeze irradiation technique; and 4) strength varies with age and sex of donor, i.e. for comparable age, grafts from females are stronger than males. Techniques for valve harvesting, sterilization and implantation will be presented. Among eleven patients with homograft implantations, there has been 1) no operative mortality; 2) maintenance of normal blood pressure; 3) no post-operative anticoagulation used; and 4) no post-operative emboli. Only one patient has an aortic diastolic murmur noted immediately postoperatively. The relationship of late aortic insufficiency, previously reported in 44% of transplanted aortic valves, to methods of graft preservation and technique of implantation will be discussed.

10. The Problem of Insufficiency Following Homograft Replacement of the Aortic Valve

W. G. BIGELOW, A. S. TRIMBLE,* H. E. ALDRIDGE,* and

P. BEDARD,* Toronto, Ontario.

The development of a technique to insert homograft aortic valves in the subcoronary position has given cardiac surgeons an alternative to the plastic ball valve. There are perhaps three reasons why the homograft technique has not been generally accepted: (1) the technical difficulty of the procedure, (2) the problem of acquiring and storing valves, and (3) the presence of a post-operative aortic diastolic murmur in a large percentage of cases in all the reported series. The first two problems can be solved. This report is an attempt to assess the problem of post-operative insufficiency. Twenty-three patients have undergone homograft replacement of the aortic valve. There were five hospital deaths. The clinical results have been good, with no post-operative thrombosis, embolism, or infection, and no anticoagulant therapy with its attendant complications. Seventy percent have an aortic diastolic murmur, some of which have appeared after leaving hospital. Thus far eleven patients have had hemodynamic and angiographic assessment four to 18 months after surgery. A second assessment is planned for some, to assess any change. An attempt will be made to correlate the degree of insufficiency with: (1) the murmur, (2) the original aortic valve pathology, (3) the selection and storage of valves, and (4) the experience of the team.

11. Valve Replacement in Active Aortic Insufficiency Due to Endocarditis

G. C. KAISER, V. L. WILLMAN, M. THURMANN,* and C. R. HANLON,

St. Louis, Mo.

Infection superimposed upon an artificial valve is attended by such high mortality that some have considered it futile to attempt correction of these defects. Bacterial endocarditis of the normal aortic valve, usually acute, may result in sudden medically unmanageable aortic insufficiency. This hemodynamic crisis may preclude survival long enough for definitive bacterial treatment. We have recently observed five male patients with acute aortic insufficiency secondary to bacterial endocarditis. Ages ranged from 17 to 68 years. The organisms involved were staphylococcus (2), pneumococcus (1), alpha streptococcus (1), enterococcus (1). Two patients died of uncontrolled heart failure without operative intervention. In three patients, aortic valve replacement was accomplished (2 Starr-Edwards, 1 McGovern-Cromie). Two patients died; a 65 year old man succumbed to staphylococcal pneumonia on the fifth post-operative day, the other, age 37, died of pseudomonas and aerobacter pneumonia on the eighteenth post-operative day. A 17 year old boy is alive fourteen months after an initial operation, having required two additional operations at three weeks and eight months to close leaks around the aortic annulus. This experience prompts us to advise early aortic valve replacement in acute aortic insufficiency due to endocarditis when hemodynamic impact of the lesion precludes survival for the period necessary to complete antibacterial treatment and medical management.

12. Treatment of Massive Hemorrhage in Pulmonary Tuberculosis

CHIN B. YEOH,* RAFIK T. HUBAYTAR,* JOSEPH M. FORD, and

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

Hemoptysis caused by pulmonary tuberculosis transmits the disease to other portions of the lung, and in massive volumes can prove fatal. From 1959-1966, studies were made on 56 patients who bled more than 200 cc. per day during their stay in the hospital. Evaluation is based on age, sex, race, single or multiple episodes of hemoptysis, bacteriological studies, and new or retreated cases. Of the 43 patients who received conservative treatment, 10 died. Conservative therapy is outlined. The 10 who died are discussed in terms of their clinical courses and the probability of surgical intervention. Criteria governing selection of potential surgical candidates are given. Thirteen patients underwent emergency surgical resections; 11 had lobectomies and 2 had pneumonectomies. Complications following surgery include: (1) spread of disease, (2) respiratory insufficiency, and (3) reactivation and recurrent bleeding from a quiescent site. The 2 operative deaths are reviewed with regard to cause, prevention, and error in management.

13. Pleural Tuberculosis

HIRAM T. LANGSTON, WALTER L. BARKER,* and ALLAN L. GRAHAM,*

Chicago, Ill.

Familiarity with empyema is today an uncommon gift and pleural disease of tuberculosis etiology is conspicuously absent from most current surgical practices. Our experience in this field seems to justify review. In twelve and one-half years 190 patients with significant pleural disease were admitted to the Chicago State Tuberculosis Sanitarium. These were classified as being of tuberculous etiology on the basis of usual criteria. Initial management has consisted of chemotherapy, appropriate antibiotics, and thoracenteses as required. Failure of adequate response as manifested by radiographically persistent pleural or parenchymal disease necessitated surgical intervention 115 times. This was accomplished with an overall morbidity rate of 23% and a mortality rate of 10%. Morbidity and mortality rates are proportional to the complexity of the surgical problem and will be analyzed. There were 35 decortications, and 39 decortications combined with partial pulmonary resection. In 41 cases a pleuropneumonectomy was required. Of particular interest will be the management of those cases wherein a bronchopleural fistula was present preoperatively with respect to establishment of preliminary drainage. The criteria for selection of surgical candidates including the methods of preoperative assessment will be discussed in relation to the timing and modality of surgical maneuver.

14. Radioactive Lung Scanning in the Diagnosis and Management of Pulmonary and Cardiac Disorders

DAVID C. SABISTON, JR., and ROBERT H. JONES,* Durham, N. C.

Pulmonary scanning with radioactive macro-aggregated human serum albumin was first reported in 1964 and is now available for general use. Although originally employed in the diagnosis of pulmonary embolism, recent experience has emphasized its usefulness in a variety of additional disorders. Analysis of the scan data provides important evidence of regional pulmonary *function* as well as demonstrating defects in perfusion. Recent experimental data has shown that *count densities* of lung scans provide an accurate quantitation of regional pulmonary flow. The present study evaluates the use of lung scanning in more than 200 patients with localized pulmonary disease and certain cardiac disorders. The magnitude of the pulmonary perfusion deficit has been determined in patients with carcinoma of the lung, congenital lobar emphysema, pulmonary tuberculosis, cystic lung disease, sequestration and agenesis of the lung, systemic-pulmonary shunts for congenital heart disease, and other cardiac disorders. These data correlate with the perfusion of the area observed at operation and with the pathologic anatomy of the pulmonary vasculature in excised tissue. In summary, lung scanning *quantitates* regional pulmonary blood flow in a variety of pulmonary and cardiac disorders. It has been shown to be of considerable importance in the preoperative evaluation, surgical management and ultimate prognosis of patients with such conditions.

*By invitation

TUESDAY MORNING, APRIL 18, 1967

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

15. Fixation of the Homograft Aortic Valve by Interposed Metal Rings

ALEXANDER S. GEHA,* JACK L. TITUS,* and DWIGHT C. MCGOON

Rochester, Minn.

The homograft aortic valve is excellent in many ways as a replacement for the diseased aortic valve, but has three chief limitations: 1) greater technical difficulty of insertion, 2) a high incidence of postoperative incompetence, and 3) the late result remains in doubt. This study is an evaluation of a method designed to overcome the first two of these limitations and to provide data relative to the third. The homograft aortic valve is attached preoperatively to a fine ring of metal shaped to the exact configuration of its basal rim. The ring is clothed in a closely fitting sleeve of porous Teflon cloth. This unit is attached to the basal rim of the excised cusp with a single row of interrupted sutures which are placed prior to lowering the valve into position. The aortic root is thus obligated to conform to the dimensions of the homograft. No metal is exposed to the blood stream. Homograft aortic valves of this type have been inserted in a series of calves allowing functional, gross and microscopic examinations of the valves at regular intervals up to five months postoperatively. Clinical application of this method appears to be warranted.

16. Heterotransplantation of the Aortic Valve in Calves

PETER E. BLUNDELL,* and J. K. MACFARLANE,* Montreal, Quebec

Sponsored by HENRY J. SCOT

Widespread acceptance of the aortic valve homograft has revived an interest in the use of biologic materials for replacement of the diseased aortic valve. Recently, preliminary studies of both experimental and clinical aortic valve heterografts have been reported. This paper presents the fate of 27 human aortic valves inserted in the subcoronary position of calves. Three methods of valve preparation and storage were used; a) fresh and sterile, b) treated with betapropiolactone and c) treated with betapropiolactone and freeze-dried. When death occurred all valves were examined, photographed and submitted for microscopic study. Twenty-two calves survived more than two weeks and one animal still lives 52 weeks postoperatively. The typical lesion noted was early fibrin deposition on the ventricular aspect of the valve. This progressed until leaflet mobility was impaired and the valvular apparatus became stenotic and calcified. No difference was noted between different methods of valve preparation and storage. Two animals surviving 3 weeks and 3 months had almost normal appearing valves. No infection was noted on any valve. The results of the gross and microscopic findings will be interpreted and compared with a similar series of 10 aortic valve homografts.

17. Biological Study of the Homologous Aortic Valve in Dogs

HITOSHI MOHRI,* DENNIS D. REICHENBACH,* ROBERT W. BARNES,*

and K. ALVIN MERENDINO, Seattle, Wash.

Clinical experience with homologous aortic valves has demonstrated prolonged function of transplants. We have demonstrated low antigenicity of the aortic valve. However, the ultimate fate of transplants is not well understood. Fate of orthotopically transplanted single homologous aortic leaflets has been studied in 35 dogs. Valves obtained from females were prepared as 1) fresh, 2) betapropiolactone-sterilized or 3) frozen leaflets, and transplanted into male recipients. Histology and viability of transplants were studied utilizing tissue culture methods and sex chromatin body analysis. No rejection of any transplanted leaflets has been demonstrated up to 11 weeks postoperatively. Fresh leaflets survived and even proliferated 8 weeks after transplantation. By contrast, no cell growth was shown in tissue culture of betapropiolactone-sterilized or frozen leaflets up to 11 weeks, suggesting such leaflets maintain function as dead tissue. However, possible early host substitution was implied by endothelialization at the base of one of the betapropiolactone-sterilized leaflets at 11 weeks postoperatively. Fate of the transplanted living tissue or substitutional process by host cells over longer periods following transplantation will be discussed.

18. Prevention of Thrombus on Rigid Prosthetic Cardiac Valves by an Autogenous Tissue Covering

NINA BRAUNWALD, and LAWRENCE I. BONCHEK,* Bethesda, Md.

Thromboembolism seldom occurs after the insertion of intracardiac fabric prostheses that permit tissue ingrowth. This experience suggested the evaluation of rigid prosthetic heart valves covered by host tissue. Specially modified ball or lens valves were inserted in 31 calves; all metal parts of the valves were covered with porous synthetic fabric. No anticoagulants were administered. In 16 animals, sacrificed one to 9/2 months postoperatively, no thrombus was found; the fabric-coated valve cages and orifices were symmetrically covered with thin, transparent layers of vascularized fibrous tissue. The movement of the ball or lens within the cage was unrestricted. Twelve animals are well, two to 10 months postoperatively, and two died with thrombosed valves two and four weeks postoperatively, before tissue ingrowth occurred. Of 20 control calves with standard prostheses, four died with thrombosed valves; 12 others had thrombus on the valve cages at the time of death or sacrifice. These findings demonstrate that thrombus formation on prosthetic heart valves of conventional design

can be prevented by encouraging tissue encapsulation of all stationary foreign material. This can be accomplished by covering all metal parts of the valves with porous fabric that promotes autogenous tissue ingrowth.

19. The Production of Muscular Subaortic Stenosis in Dogs

THOMAS H. BURFORD, ALEX F. HARTMANN, JR.,* THOMAS B. FERGUSON,
and RAYMOND W. FERRIER,* St. Louis, Mo.

To gain etiologic and pathophysiologic information about this condition, the ascending aortas of 31 six-week-old puppies (5-7 pounds) were snugly banded with Dacron tape. When the animals reached adult size serial left heart catheterizations and angiocardiograms were performed. Satisfactory data were obtained on 8 animals 17 to 22 months after banding. The resting systolic gradient across the banded area averaged 34 mm Hg. There was no resting gradient across the left ventricular outflow tract in any of the animals. After 5 mg/kg of Isuprel intravenously the gradient across the banded area increased to 74 mm Hg., and 7 of the 8 dogs had an average LV outflow tract gradient of 20 mm Hg. The 8th dog developed a LV gradient of over 200 mm Hg. with Isuprel. Angiograms and later autopsy studies showed that the animals with the low LV gradient had chamber dilatation and moderate hypertrophy of the ventricular wall (6 mm), while the animal with the high LV gradient had no dilatation, but had marked hypertrophy of both the septum (15 mm) and free wall (10 mm). This study supports the view that the development of muscular subaortic stenosis may depend more on anatomic variations in the left ventricle than on pure functional stress.

20. Diaphragmatic Pacing in the Treatment of Hypoventilation Syndromes

EDWARD A. STEMMER,* DONALD W. CRAWFORD,* JAMES P. CAREY,*
and JOHN E. CONNOLLY, Los Angeles, Calif.

Although the availability of transistorized circuits has made prolonged cardiac pacing practical, this technic has not been widely applied to other organs. Our attempts to treat a patient with hypoventilation due to primary carbon dioxide insensitivity led us to investigate the possibility of using electrical stimuli to pace diaphragmatic contractions. The problem is more complex than cardiac pacing since constant stimulation of the diaphragm will interfere with swallowing and speaking. Moreover, the contour of the wave form, frequency of impulse and duration of impulse are also important if smooth, non-painful diaphragmatic motion is to be produced. The basic problems involved in diaphragmatic pacing were studied in ten dogs using a nerve stimulator. Transvenous placement of the electrodes was utilized to avoid the risks of thoracotomy. Respiratory rate and volume were measured with a pneumotachygraph. The effectiveness of ventilation was evaluated by means of serial blood gas analyses while diaphragmatic activity was monitored by cineradiography. After determining the electrical characteristics necessary to stimulate normal diaphragmatic contractions, a transistorized device was developed that was small enough to be implantable. The design of the instrument and the application of this technic in patients will be presented.

21. The Role of Functional Demand on Development of Pulmonary Lesion During Hemorrhagic Shock

BEN M. WILLWERTH,* FRED A. CRAWFORD, JR.,* WILL C. SEALY, and
W. GLENN YOUNG, JR., Durham, N. G.

During hemorrhagic shock in the dog significant morphologic changes in the lung may develop. This could be the result of a circulating toxin liberated during shock, or from local changes that follow increased functional demand in a lung supplied with inadequate blood flow. To study this, one lung of 10 dogs was completely isolated from all of its vascular connections during a 2 hour period of severe hemorrhagic shock. The lung was reconnected after shock period. In a group of 10 dogs not in shock, one lung was occluded for 2 hours as in the experimental group. Nine of 10 lungs perfused during shock revealed severe morphologic changes but little immediate functional change, whereas none of the isolated lungs in the experimental or control group revealed either functional or morphologic alterations. The results of this study show that the lung forced to function during shock may show severe morphologic changes, whereas the lung in the same dog isolated from the circulation during shock will be spared. Local changes in the lung resulting from functional demand in face of low blood flow rather than a circulating toxin may be the cause of the morphologic changes in the lung in hemorrhagic shock.

22. A Study of the Acute and Chronic Respiratory Pathophysiology of Hemorrhagic Shock

J. N. HENRY,* A. H. MCARDLE,* H. J. SCOTT, and F. N. GURD,*
Montreal, Quebec

Cardiac outputs, right and left atrial pressures, and pulmonary artery pressures were monitored by means of chronically implanted catheters in dogs subjected to 4 hours of hemorrhagic shock. The animals were resuscitated and a chronic shock preparation was obtained which allowed continued study for 18-72 hours. The expected sustained rise in pulmonary arterial

pressure was accompanied by a fall in cardiac output to 23% of control value during the period of hypovolemia, and to 70-93% of control value during resuscitation. The left atrial pressure remained low during the time that the right atrial and pulmonary arterial pressures were elevated. This suggested a pulmonary etiology for the increased pulmonary arterial and right atrial pressures. The lungs showed a significant increase in water content when wet and dry weights were compared, while microscopic examination revealed congestive atelectasis, pulmonary edema, and intra-alveolar hemorrhage. Previous studies have demonstrated a significant decrease in the surface activity of the alveolar lining, and a defect in phospholipid metabolism during the period of resuscitation. These findings support the thesis that the elevated central venous pressure and the pulmonary lesions accompanying hemorrhagic shock can be due to intrinsic pulmonary pathology causing increased pulmonary resistance without left ventricular failure.

23. Pathogenesis of the Post-Cardiotomy Syndrome

DONALD R. KAHN,* PAUL Y. ERTEL,* WILLIAM H. MURPHY,*

MARVIN M. KIRSH,* SATHAPORN VATHAYANON,* AARON M. STERN,*

and HERBERT SLOAN, Ann Arbor, Mich.

During the fall of 1965, 23 of 70 patients undergoing cardiac surgery developed the "post-cardiotomy syndrome." Symptoms, appearing in a few days after operation, were prolonged fever, pleuritic chest pain, tachycardia, extreme fatigue, hepatomegaly, and pericardial and pleural friction-rubs. Most patients showed characteristic mucosal lesions of the mouth or lip, which were small, white, painful areas of induration raised above the mucosal surface, and not ulcerated. Microscopic examination of the oral lesions disclosed patchy areas of edematous, degenerating epithelial cells containing deeply basophilic inclusion bodies. Symptoms subsided in two weeks only to reappear three to six weeks later. Some patients had no early symptoms. Laboratory studies showed the appearance of or a rising cold-agglutinin titer, atypical lymphocytes, and EKG findings. Specimens taken from the oral lesions and blood yielded agents with properties of viruses by tissue culture techniques. The agents isolated appear to be members of the para-influenza family. One patient had a similar agent found in the bone marrow taken at the time of operation. These studies suggest that pre-existing virus of the para-influenza family is activated by cardiac surgery to produce a clinical picture described as the "post-cardiotomy syndrome."

24. Hematologic Limitations of Prolonged Cardiopulmonary Bypass

ROBERT L. REPLOOLE,* and SHERWIN V. KEVY,* Boston, Mass.

Sponsored by ROBERT E. GROSS

One hundred and ninety open heart operations have been performed with a rotating disc oxygenator, utilizing the blood remaining in the unit after one case as a priming volume for a second or third case. The total pumping time of the blood ranged from 4 to 7 hours. Thromboelastograms, euglobulin lysis time, and fibrinogen concentration were measured to assess the coagulation system, and erythrocyte osmotic fragility, plasma hemoglobin and platelet levels were serially determined to evaluate the effect of prolonged pumping. Hematologic and coagulatory quality of the perfusate *improved* with repeated perfusion. Erythrocyte osmotic fragility after repeated perfusion diminished, demonstrating selective removal of damaged red cells by the reticuloendothelial system. Platelets diminished, but at no time fell below a level necessary for adequate hemostasis. It appears that a normally functioning reticuloendothelial system and bone marrow compensates for hematologic damage inflicted by prolonged blood pumping. The hematologic complications reported to follow long perfusions may result in part from hematologic and reticuloendothelial depression existing in the severely ill patient prior to bypass. This study suggests that the hematologic limitations of prolonged pumping are dependent upon the adequacy and reserve of the patient's own compensatory mechanisms as well as on the trauma inflicted by the pumping system. Prolonged pumping by repeated perfusion of relatively normal patients does not produce coagulatory or hematologic abnormalities.

25. Pulmonary Lymphatic Drainage

NORMAN H. BAKER,* and LARRY HILL,* Columbus, Ohio.

Sponsored by SAMUEL A. MARABLE

Lymphatic pathways that determine the sites of neoplastic spread have been studied by many scientists. One of the classical descriptions of pulmonary drainage is that of Rouvier's. The results of his study were unusual in that the lymphatics of the right lung were found to drain to the right lateral tracheal nodes and nodes of the tracheal bifurcation and thence to the right jugulosubclavian venous confluence (scalene nodes). By contrast, the lymphatics of the left lower lobe and inferior portion of the lingula were found to drain to the right scalene lymph nodes and the left upper lobe and superior portion of the lingula drained to the left scalene nodes. The practical clinical application of this study lies in the site of scalene lymph node dissection that is to be chosen for lesions in the left lower lobe and lingula. Male volunteers were carefully selected for this study. Injections of a 10% suspension of "powder tempera" were made through a bronchoscope into peribronchial tissues of the left lower lobe of nine volunteers. Four to six days later bilateral scalene lymph node dissections were done. The lymph nodes were examined microscopically for presence of the pigment. The predominantly ipsilateral results of the study will be described and the practical clinical application discussed.

26. Clot Formation Inside the Artificial Heart Device

Y. NOSE,* C. S. KWAN-GETT,* K. HINO,* and W. J. KOLFF,*

Cleveland, Ohio.

Sponsored by DONALD B. EFFLER

The clotting problem must be overcome before long term permanent implantation of the prosthetic heart for total and assisted circulation. We evaluated the clotting phenomenon within the artificial heart implanted in calves. Fifteen left heart bypass pumps were implanted extra- or paracorporeally, using the teardrop, Gott leaflet, and ball valves with Silastic housing. Since low flow induces clotting, flow was maintained at 2 L/min. without heparinization. Clotting was observed within 24 hours in all cases. After sacrificing the heparinized animal, the mechanical heart was removed, rinsed with saline, and the site where clotting formed examined. Clotting was evident around the Gott and teardrop valves; nine of the ball valves showed no clotting. The anastomosis site was usually clot-free. When two different materials or two Silastic parts are used, the junction point is the probable site of initial clotting, especially the junction between the rough and smooth edges. Therefore, it is preferable that only one seamless material be used on the internal surface of the artificial heart. Our results show that Silastic 372 with a very clean, well-vulcanized smooth surface is the best material. DeBakey's group had success with their left heart bypass pump using velour felt. However, we found the velour surface a problem even in acute experiments.

27. Pulsed Laser Energy in the Management of Multiple Pulmonary Metastases

JOHN PETER MINTON,* NEIL C. ANDREWS, and JOHN E. JESSEPH,*

Columbus, Ohio.

The presence of multiple pulmonary metastases generally precludes any concerted effort to "cure" a patient of his malignant disease. To explore a therapeutic tool which might improve the management of this problem a newly designed surgical instrument (a pulsed 1000 joule neodymium laser unit) has been evaluated. Metastatic Brown Fearce carcinoma implants in the lungs of 25 male Dutch rabbits were rapidly, precisely and safely destroyed by direct application of the laser beam to each tumor implant. Tumor destruction was associated with minimal air leak and bleeding. Lung tissue adjacent to the destroyed tumor remained functional. Biopsies of the treated areas were done in long-term survivors. An analysis of the tumor destruction data permits a prediction of the amount of laser energy required to destroy tumor implants 1.5 cm. in diameter or less. The effect of pulsed laser energy on primate lung was studied in five male Macaca monkeys. With few exceptions tissue destruction patterns were similar to those observed in rabbits. Biopsies of the healed lung tissue showed localized areas of destruction surrounded by normal lung. The technical application of the laser beam for tissue destruction will be discussed and illustrated.

*By Invitation

TUESDAY AFTERNOON, APRIL 18, 1967

**2:00 P.M. Executive Session (Limited to Active and Senior Members)
Imperial Ballroom**

**3:00 P.M. Scientific Session: REGULAR PROGRAM
Imperial Ballroom**

Address by the President
Frederick G. Kergin, Toronto, Ontario
"Retrospect and Prospect"

Address by Honored Guest
Viking Olov Bjork
Professor of Thoracic and Cardiovascular Surgery
Karolinska Institute Stockholm, Sweden

"Methods in Open Heart Surgery"

28. American and British Thoracic Surgery

GEORGE A. MASON, Wooler, Northumberland, England.

The Atlantic has been no barrier to the influence by workers on either side of the ocean on the other. Modern communications have made this intimacy closer. A common language and a somewhat similar outlook have been significant factors. Differences and contrasts may make our relatively feeble efforts seem poor shadows of the achievements of our American "cousins," but nevertheless we may have made useful contributions to that common pool of thought and experience upon which progress largely depends. The American Association for Thoracic Surgery has brought together your workers for now more than fifty years. The Journal has enabled us to keep *au fait* with your work. Our members have long appreciated the privilege of being associated with your Advisory Editorial Board. The Society of Thoracic Surgeons of Great Britain & Ireland was founded in 1933 and from the outset received every encouragement from you. Indeed probably every one of our meetings has had its American participants. The founders of both our organizations were men whose names are indicative of milestones in Thoracic Surgery. Those who followed have contributed most of its principal advances and it augurs well for the future that during the formative stages of their careers men from the British Isles are working in North American clinics - and vice versa.

29. The Surgical Treatment of Dextrocardia with Inversion of the Ventricles and Double Outlet Right Ventricle

JOSEPH C. RISER,* PATRICIA M. CLARKSON,* Rochester, Minn.,

JOHN W. KIRKUN, Birmingham, Ala., and DWIGHT C. MCGOON,

Rochester, Minn.

The surgical treatment of the commoner congenital cardiac malformations has become established. Few unusual or complex deformities remain to be explored. One of these is the interesting condition known as dextrocardia with inversion of the ventricles with both great vessels originating from the morphologic right ventricle, and with pulmonary stenosis. Six patients seen at the Mayo Clinic have been diagnosed during life to have this complex anomaly. Three of these patients were sufficiently disabled to warrant surgical repair. A complex intracardiac repair was successful in two of the three patients. Repair was accomplished in the first by ligation of the main pulmonary artery, closure of the ventricular septal defect and construction of an extracardiac shunt between the morphologic left ventricle and the pulmonary artery. In the second case the repair was accomplished entirely from within the heart, using an angioplastic procedure to shift the origin of the pulmonary artery toward the morphologic left ventricle. In the last case the additional associated defect of situs inversus of the atria required a re-direction of pulmonary venous return within the atria (Mustard procedure), as well as closure of the ventricular septal defect so as to direct blood appropriately into the great arteries.

30. Management of War Wounds of the Chest

LEWIS T. PATTERSON,* HENRY J. SCHMITT, JR.,* and

RAYMOND G. ARMSTRONG,* APO San Francisco, Calif.

Sponsored by ROBERT H. WYLIE

From July 1st, 1965 to June 30, 1966, 427 patients with intrathoracic wounds were received at USAF Hospital Clark. They arrived from 6 hours to 61 days after injury. Eighteen percent of these patients were admitted with pneumothoraces. The treatment of hemopneumothorax has primarily been intercostal tubes (93.2%). Only 2.1% were treated by thoracentesis alone while 4.7% had no treatment. The incidence of emergency thoracotomies was 9.3%, all performed in the Republic of Viet Nam. The indications are discussed. The incidence of early elective thoracotomy was 11.4%. The indications for these operations are, (1) evacuation of significant blood and clot from pleural space and, (2) removal of foreign bodies. Eleven patients were received who had survived missile wounds of the heart, 3 of whom had emergency thoracotomies with suture of myocardial defects. The incidence of thoracoabdominal incisions was 8.0% of 75 patients with combined thoracic and abdominal wounds. The mortality rate for the series was 2.8%. However, only one death occurred in those patients with just thoracic trauma.

*By Invitation

TUESDAY EVENING, APRIL 18, 1967
Imperial Ballroom

7:00 P.M. Reception-Given by the New York Society for Thoracic Surgery

8:00 P.M. Dinner and Dancing

Attendance limited to Members of the American Association for Thoracic Surgery and their ladies, the New York Society for Thoracic Surgery and their ladies, Invited Speakers and their ladies, Invited Guests and their ladies. Dinner dress preferred.

WEDNESDAY MORNING, APRIL 19, 1967

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

31. Fetal Cardiovascular Surgery: Experimental Pulmonary Artery Atresia and Its Repair in the Fetal Lamb

S. Z. TURKEY,* and J. H. KENNEDY, Cleveland, Ohio.

Pulmonary artery atresia with intact ventricular septum was produced in a series of controlled chronic experiments in fetal lambs. Techniques of fetal surgery were modified for application to the intrathoracic and intra-pericardial regions. Following laparotomy, hysterotomies were made in anesthetized ewes and fetuses delivered, preserving the placental circulation. Chronic survivals were achieved routinely utilizing microsurgical techniques, precise replacement of fetal blood loss by transfusion, and preservation of the integrity of the amniotic cavity postoperatively. A median sternotomy and pericardiectomy were made in the 60 day fetal lamb (normal gestation is 143 days). The intrapericardial, preductile portion of the main pulmonary artery was dissected and ligated. During surgery ventricular and pulmonary artery pressures as well as fetal and maternal blood pH, pO₂, pW₂ and hematocrit were monitored. The incompatibility of the same lesion in humans with long survival and the high mortality of bypass procedures in early infancy lead to investigation of repair of this experimental lesion during fetal life, with the benefit of the "extra corporeal" placental "lung". Gross and microscopic histologic study were made of the effects of this lesion on development of the right heart and pulmonary vasculature.

32. Acute and Chronic Hemodynamic Effects of Ligation of the Fetal Ductus Arteriosus

J. ALEX HALLER, JR., BRADLEY M. RODOERS,* and

WILLIAM W. MORGAN,* Baltimore, Md.

Acute and chronic hemodynamic effects of ligation of the fetal ductus arteriosus have not been investigated. Occlusion of the ductus arteriosus was performed upon 17 dog fetuses; 7 were maintained as chronic intra-uterine experiments. Pulmonary artery pressure, left atrial pressure, and electrocardiographic changes were recorded before, during and after occlusion. The ductus was then permanently ligated in 7 fetuses, and their transuterine electrocardiograms were monitored for the following 5 days. Two of the 7 fetuses survived 3 and 5 days respectively. In each fetus there was an immediate rise in diastolic, systolic, and mean pulmonary artery and left atrial pressures during ductal occlusion and rapid return to normal pressures with release of the ductus. Significant alterations in the electrocardiograms did not occur. Preliminary studies on changes in pulmonary blood flow before and after fetal ligation will be presented as well as cinefluoroscopic studies of the alterations which occurred in blood flow through the heart and lungs. No histological evidence of pulmonary congestion or of pulmonary vascular abnormality was noted. The technique of intra-uterine fetal ductus ligation will be presented.

33. Evaluation of Left Heart Bypass in a Standardized Experimental Situation of Acute Heart Failure

MICHAEL L. SMALL,* London, England.

Sponsored by FRANK GERBODD

Despite great interest in the development, and now the clinical use, of mechanical support of circulation (either extracorporeal or with an implanted "artificial heart") after acute myocardial infarction, the value of the procedure remains in question. Poor survival after severe myocardial infarction occurs despite treatment with left heart bypass (LHBP) and may be due to two factors of previously unreported significance. These are: (1) site of perfusion, and (2) potassium requirement in LHBP after myocardial infarction. Thirty-four dogs were subjected to standardized circumflex coronary artery occlusion. Thirty-three percent of untreated animals survived. No dogs survived when treated with LHBP if perfusion was via the femoral artery. Eighty-three percent of dogs survived when treated with LHBP if perfused via the carotid artery and given supplementary potassium during the procedure. In addition to perfusion site and potassium requirement, several other factors, considered to be of critical importance in the performance of LHBP after myocardial infarction, are examined. These are: (1) type and volume of fluid requirement, (2) optimal percentage of bypass, (3) level to which left atrial pressure may safely be allowed to fall, and (4) optimal timing and duration of the procedure.

34. Acute Circulatory Support by Mechanical Ventricular Assistance Following Myocardial Infarction

DAVID B. SKINNER,* GEORGE L. ANSTADT,* and THOMAS F. CAMP, JR.,*

Brooks Air Force Base, Texas.

Sponsored by RICHARD H. HOOD, JR.

Since many deaths from myocardial infarction occur within hours, acute mechanical support of circulation might permit increased survival following infarction and more satisfactory initiation of long-term therapy. A pump has been developed to provide direct mechanical assistance to the ventricles without requiring circulation of blood outside the intact cardiovascular system. This simple, reliable device can be applied to the heart as quickly as open cardiac massage can be instituted. No cannulations are necessary. During induced ventricular fibrillation in dogs, cardiac output, blood pressure, regional blood flow to vital organs, coronary artery flow, and arterial pH were well maintained by this method. Experimentally in dogs, the mortality of left circumflex coronary artery division was reduced from 75% when standard supportive treatment was given to 35% by electively inducing ventricular fibrillation after coronary interruption, and supporting the circulation by mechanical ventricular assistance for six hours. Ventricular fibrillation was reversed without difficulty. The comparative extent of myocardial infarction and collateral coronary circulation was evaluated by coronary angiography, serum enzyme measurements, electrocardiograms, and autopsy studies. Problems encountered and clinical applications of this method will also be presented.

35. An Implantable Left Ventricular-Aortic Assist Device

R. M. FILLER,* W. F. BERNHARD, T. ROBINSON,* M. BANKOLE,*

and C. G. LAFAROE,* Boston, Mass.

A new method of assisted circulation is under investigation employing an implantable, double valved pump directly interposed between the left ventricular apex and descending aorta. The device accepts blood from the biologic ventricle during systole, and ejects it into the aorta in diastole. Outflow from the left ventricle to the pump is provided by a short, thin-walled, silastic covered tube (1.0 centimeters in diameter) inserted through a stab wound in the apical myocardium. Placement of the tube is such that it passes through the endocardium, but does not project into the body of the ventricle. Chronic experiments, performed in dogs and miniature swine, indicate firm myocardial fixation of the outflow tube without any interference in left ventricular function. The distal pump connection consists of a segment of dacron graft sutured to the side of the descending aorta. Hemodynamic and metabolic studies demonstrate an 85% average reduction in left ventricular peak pressure along with maintenance of normal systemic pressure and blood flow. Myocardial energy requirements were also markedly reduced. The left ventricular-aortic assist device utilized in this investigation proved to be superior to other implantable, in-series and parallel flow pumps studied.

36. Experimental Allograft Transplantation of the Lung

DAVID A. BLUHENSTOGK, OSCAR V. GROSJEAN,* and

HENRI P. OTTE,* Cooperstown, New York.

Prolonged survival and function of allografts of the lung have been obtained in 8 dogs using a variety of treatment programs. Rejection occurred in 2 to 4 years in 5 animals. Three animals are living with a functioning lung transplant as tested by differential bronchspirometry 2, 3 and 5 years after transplantation. They retain one autologous lung. No drug or other therapy has been given for the past year. The methods used to suppress rejection and the implication of the prolonged presence of a living allograft upon the donor-recipient relationship will be discussed.

37. Regression of Intrinsic Nerves and Other Sequellae with Lung Reimplantation

S. L. NIORO, E. HAMOUDA,* J. RAMS,* E. F. HIRSCH,* and

W. E. ADAMS, Chicago, Ill.

Dogs maintained on replanted lung tissues have been reported to have markedly reduced oxygen uptake, reduced pulmonary ventilation, pulmonary hypertension and normal respiratory cycles. The nervous tissues at that time were not examined. Recently our detailed studies have confirmed an extensive autonomic innervation of the lungs, apparently with preponderance of the vagal component, and largely afferent. Sensory end-organs are distributed extensively in the respiratory passages as thick terminal fibers and their branches; rounded encapsulated or free glomerular structures; and curved segments composed of thick sinuous argyrophilic fibers. Reimplantation of a lung or a lobe divides the nerves at the hilum. Regression of the intrinsic afferent and efferent axons and their terminals occurs. These changes are progressive and are associated with an indurative pneumonia and other sequellae. The hilar nerves 5 ½ years after reimplantation had some evidence of remyelination, but without restoration of the peripheral structures. The results observed in twenty dogs with these and other nerve ablations will be presented and discussed.

38. Esophageal Motility Dysfunction After Ischemia of Ganglion Cells of Lower Esophagus and Cardia of the Dog

RICHARD J. EARLAM,* and F. HENRY ELLIS, JR., Rochester, Minn.

Although the cause of esophageal achalasia is unknown, decreased number or absence of ganglion cells in Auerbach's plexus is a common finding in the disease. In an effort to reproduce this disease experimentally, selective destruction of these nerve cells by a 4-hour period of ischemia was attempted in 14 dogs by perfusing an intact but isolated segment of the lower esophagus and cardia with Tyrode's solution. The results of this procedure were observed during the next 9 months by esophagoscopy, cinefluoroscopy, esophageal motility studies, and histologic studies of postmortem specimens with special staining techniques. Esophagoscopy excluded the presence of a stricture. Cinefluoroscopy demonstrated esophageal dilatation and weak, incoordinated contractions in the lower esophagus. Esophageal motility studies disclosed a variable pattern including decreased resting sphincteric pressure and increased pressures in the body of the esophagus, which returned toward normal values. The swallowing patterns included premature simultaneous contractions in the body of the esophagus, absence of relaxation at the sphincter, and premature sphincteric contractions. Histologic studies demonstrated decreased numbers of ganglion cells and changes in their morphology.

39. Experimental Study of a New Operation for the Treatment of Reflux Esophagitis

NICHOLAS J. DEMOS,* and JOSEPH J. TIMMES, Jersey City, N. J.

Surgical technics for correction of reflux esophagitis associated with a sliding hiatal hernia are established. Considerably more difficult is the surgical correction or prevention of reflux esophagitis associated with wide diaphragmatic, especially lateral, defects, or with congenitally short esophagus, recurrent sliding hernias, or reflux caused by esophagostomy. An operation has been devised which cures reflux esophagitis through the use of a viable intercostal muscle pedicle containing intact the corresponding nerve and vessels. Reflux was produced in 45 dogs by two methods: (1) myomectomy of the lower esophagogastric area, and (2) esophagostomy. The reflux and the consequent esophagitis were verified by fluoroscopy, esophagoscopy, cinefiberscopy and histologic examination. At a second operation, the reflux was abolished by the intercostal pedicle method. The consistent absence of reflux and esophagitis was verified postoperatively using the above methods for over 18 months. The advantages of the new procedure are: (1) ease of performance at any level in the chest, (2) contraction of the pedicle simultaneously with the diaphragm, (3) easily available and bilaterally present pedicles, (4) a living functional sphincter whose tightness may be adjusted at will, (5) usefulness in any type of reflux and particularly in the difficult and recurrent cases, and (6) interposition of intestinal segments is avoided.

40. Mechanical Augmentation of Coronary Circulation in the Ischemic Heart, Angiographic and Hemodynamic Correlation with Prolonged Survival

JACOB ROSENSWEIG,* and SHEKHAR CHATTERJEE,* Montreal, Quebec.

Sponsored by EDOUARD D. GAGNON

Experiments were carried out to determine the functional capacity of mechanically induced collateral circulation in dogs with proximal stenosis of the anterior descending and circumflex arteries. Earlier studies indicated prolonged survival of 80% of treated animals. The SIMAS pump was used for diastolic augmentation for one hour, fourteen days after placement of constrictors. Twelve dogs were operated upon. Coronary blood flow was monitored by implanted flow probes. The animals were observed for one month, then sacrificed. Flow in the anterior descending artery fell from 50 c.c. per minute to 25 by the seventh day, with little change thereafter. During diastolic augmentation, the flow rose rapidly to 65. After discontinuation of pumping, it dropped gradually over several days, then maintained at 45 c.c. per minute. Circumflex

artery flow fell from 90 to 45, rose to 100 during diastolic augmentation, then settled at 80 c.c. per minute. At autopsy, both arteries were completely occluded proximally, but prominent intercoronary communicating vessels were demonstrated angiographically arising from either the right coronary or the septal artery. The findings suggest that prolongation of survival following diastolic augmentation results from opening of potential intercoronary channels which become functional, perfuse the occluded coronary artery and restore near normal blood flow.

41. Direct Coronary Artery Surgery Employing Retrograde Coronary Sinus Perfusion

ALLEN L. DAVIES,* GRAEME L. HAMMOND,* and W. GERALD AUSTEN,

Boston, Mass.

Prerequisites for successful coronary artery surgery include a dry operative field and a method of maintaining myocardial viability for the time periods necessary to perform endarterectomy and patch graft or direct anastomoses. A method of retrograde perfusion of the left coronary artery via the coronary sinus has been investigated and appears to fulfill these requirements. Twenty-three dogs underwent total cardiopulmonary bypass and one hour of left coronary artery occlusion while oxygenated blood was perfused retrogradely via the coronary sinus. Perfusion pressure if kept below 60 mm Hg. did not produce venule or capillary damage and permitted flows up to 40 cc/min. Blood oxygen determinations during retrograde perfusion demonstrated oxygen uptake by the left ventricle. EKG changes of ischemia during perfusion reverted to near normal post-operatively. Comparison of preoperative with postoperative left ventricular function curves demonstrated only minimal depression of left ventricular reserve. Seventeen additional dogs underwent either direct left coronary artery to left subclavian artery anastomosis or left coronary artery patch graft utilizing this method. Postoperative left ventricular function curves demonstrated only minimal depression. Postoperative EKG showed minor changes. This technique and its clinical applications will be discussed.

42. Local Coronary A-V Blood Gas, Carbohydrate, and Enzyme Gradients Following Acute Coronary Occlusion Before and After Selective Elimination of Preliminary Indirect Myo-cardial Revascularization

HILARY H. TIMMIS,* and PATRICK H. LEHAN,* Jackson, Miss.

Sponsored by JAMES D. HARDY

Although indirect myocardial revascularization procedures have been evaluated extensively by survival studies, there is little information concerning the metabolic protection afforded the experimental animal following acute coronary occlusion. Ten adult mongrel dogs were subjected to internal mammary artery implantation, application of a pedicle graft of pericardial fat and simultaneous ligation of a tributary of the longitudinal descending artery in the region of the implant. Following angiographic demonstration of arborization from the implant, thoracotomy was repeated for sampling of blood from the great cardiac vein and the left coronary artery. Coronary arterial-venous gradients of O₂ saturation, pCO₂, bicarbonate, glucose, lactate, pyruvate, lactic dehydrogenase and glutamic oxalacetic transaminase were measured (1) before and after ligation of the anterior longitudinal descending artery, (2) following occlusion of the arterial implant, (3) following division of all peripheral connections of the pericardial fat pad, (4) following removal of the pericardial fat pad and (5) before and after occlusion of the anterior longitudinal descending artery in animals not protected by myocardial revascularization. The results of these determinations and an appraisal of the cumulative and selective effect of techniques of myocardial revascularization listed above will be presented.

43. Relief of Posterior Myocardial Ischemia by Splenic Artery Implantation

ROBERT J. GARDNER,* BENJAMIN L. PLYBON,* DAVID D. GLASS,*

and HERBERT E. WARDEN, Morgantown, W. Va.

The internal mammary artery when implanted intramyocardially has been found capable of increasing blood flow to the adjacent heart muscle. Prolonged patency and the development of numerous anastomoses between the implanted vessel and the coronary system have been demonstrated experimentally and clinically such implants have benefited selected patients with myocardial ischemia. The internal mammary artery has been employed to revascularize the antero-lateral aspect of the left ventricular myocardium. This report concerns the experimental development and evaluation of the splenic artery as a source of blood for revascularization of the posterior myocardium. Either the isolated splenic artery or a pedicle consisting of the splenic artery and vein were implanted in the diaphragmatic myocardium in more than fifty dogs. The effectiveness of the implant was assessed in long term survivors by *in vivo* arteriograms and flow rate determinations. Further evidence of patency and splenic coronary anastomoses was obtained by additional arteriograms, histologic examination, and corrosion cast demonstrations on material obtained at autopsy. Patency rates ranged from 75-90% depending in part on the technique of implantation. *In vivo* flow rates ranged from 15-65 ml per minute. The factors influencing the results will be emphasized and discussed in detail.

*By invitation

WEDNESDAY AFTERNOON, APRIL 19, 1967

2:00 P.M. Scientific Session: REGULAR PROGRAM Imperial Ballroom

44. Early Esophagogastrostomy in the Treatment of Iatrogenic Perforation of the Distal Esophagus

JULIAN JOHNSON, CLETUS W. SCHWEGMAN,*

and HORACE MACVAUGH III,* Philadelphia, Pa.

Iatrogenic perforation of the distal esophagus is most often the result of an attempt to dilate a stricture, remove a foreign body, or pass a feeding tube through an obstructing carcinoma. In the last fifteen years we have operated upon six patients following this complication in our own hospital, starting the operation within six hours of the time of perforation. In all but one it seemed unreasonable to do a simple suture of the perforation since the distal obstruction was still present. The distal esophagus was resected and an esophagogastrostomy was done. One additional patient, who was esophagoscoped in another city, was operated upon at twelve hours. No primary lesion was recognized but a resection and esophagogastrostomy was done. In no patient did postoperative infection occur. One died in the hospital of a coronary occlusion. It is suggested that resection is an acceptable form of treatment for perforation of the lower esophagus when the diagnosis is made early. Sacrifice of the thoracic esophagus as previously described by us (*J. Thor. Surg.* 52:827, 1956) may be reserved for the patient in whom the diagnosis or treatment of this complication is delayed.

45. Carcinoma Arising in Hiatal Hernia

ORVILLE F. GRIMES, and F. FRANK ZBORALSKE,* San Francisco, Calif.

During the 20-year period 1946 to 1966, twelve patients with adenocarcinoma of the stomach arising in an esophageal hiatal hernia have been seen at the University of California Medical Center, San Francisco. A study of the case histories of this group of patients indicates that their symptoms were compatible with those usually seen in uncomplicated hiatal hernia. Dysphagia was often attributed to early stricture formation or to the inflammatory edema which accompanies esophagitis. Some patients in the group were aware of slight changes in symptoms, usually a worsening of the dysphagia. Special emphasis is placed upon the frequent difficulty in establishing a correct radiological diagnosis. Repeated x-ray examinations were often obtained before the lesion in the herniated portion of the stomach was visualized. The importance of a careful contrast study of the hiatal hernia is attested to by the fact that the clinical course in most of the patients in this series was poor because of the relatively advanced state of the lesion at the time of its discovery. Several case histories are presented to illustrate the subtle changes in symptomatology which occurred both early and late in the course of their illness. The necessity for a careful symptomatic evaluation and for follow-up radiological examinations in patients who have even slight degrees of dysphagia is paramount.

46. Hiatal Hernia in Infants and Children

JUDSON G. RANDOLPH, JOHN R. LILLY,* and JAMES E. MCCLENATHAN,

Washington, D. C.

Fifty-two infants and children with symptomatic esophageal hiatal hernia have been seen at the Washington Children's Hospital in the past five years. Thirty-five of these patients were under a year of age. Twenty infants were below the third percentile in weight. Fifteen of the 52 patients were hospitalized because of respiratory complications secondary to repeated aspiration; thirteen were anemic from blood loss. A careful esophagram was found to be of prime importance for diagnosis of significant gastric reflux. Esophagoscopy was reserved for those patients who did not respond to conservative therapy, or who bled. Gastric secretory studies in seven newborn infants with hiatal hernia failed to disclose hyperacidity. Standard growth and development curves of sixteen infants demonstrate the striking nutritional deficiency which untreated hiatal hernia can produce in the early months of life. Two-thirds of the patients responded well to conservative treatment. In nineteen patients, surgical correction of the hernia was required; four had associated pyloroplasty, and in one patient, vagotomy was performed. Esophageal replacement was necessary in only one patient. This study emphasizes the frequency of hiatal hernia in the infant and defines the indications for early corrective surgery in selected patients.

47. Congenital Posterolateral Diaphragmatic Hernia in the Newborn

J. JUDSON MCNAMARA,* ANOELO J. ERAKLIS,* and ROBERT E. GROSS,

Boston, Mass.

Congenital posterolateral diaphragmatic hernia is a common cause of death in newborn infants. This condition can be repaired with virtually no mortality in infants and children over one day of age, but carries a great risk for operation in the first 24 hours of life. The literature records fifty-nine infants less than 24 hours of age requiring diaphragmatic hernia repair; the mortality rate was 56%. One hundred and forty-two cases of congenital diaphragmatic hernia operated on at Children's Hospital Medical Center since 1940 were reviewed. Ninety of these patients were over twenty-four hours old. The mortality was 5% (in the past seventeen years, thirty-seven patients have been operated on with no deaths). Fifty-two patients were less than twenty-four hours of age at the time of surgery. Twenty-three of these died (44% mortality). Further examining this group, it was seen that of thirty-two newborn infants operated on prior to 1960, seventeen expired (mortality 53%) but since 1960, of twenty infants, only six have died (30% mortality). Comparison between the groups of patients prior to 1960 and since 1960 reveals several changes in management which appear responsible for the improved survival of these critically-ill newborn infants. These changes are discussed and the presently employed method of management is described.

48. The Superiority of the Glenn Operation for Tricuspid Atresia in Infancy and Childhood

W. STERLING EDWARDS, and L. M. BARGERON, JR.,*

Birmingham, Ala.

A systemic pulmonary artery shunt which imposes additional strain on the single (left) ventricle is usually performed for infants with tricuspid atresia because of the high mortality reported from a superior caval-right pulmonary shunt in the first year of life. Thirty-one infants and children have had the Glenn operation performed for tricuspid atresia over the past six years. In the first eleven patients the azygous vein was ligated and postoperative fluids were given according to the usual formula for infants and children. There were five deaths, a 45% mortality, and death seemed to occur from cerebral edema or hypovolemic shock. The last twenty consecutive patients have had the azygous vein left open to decompress the superior vena cava for 5-10 days, after which the azygous is occluded by tightening a loop ligature previously placed around the azygous and brought out to a subcutaneous button. Large volumes of fluid have been required to replace fluid lost as edema of the upper body. Fifteen of these patients have been less than 18 months of age, two died (13%). All the older children surveyed. Marked improvement in cyanosis and exercise tolerance have been maintained. The Glenn operation seems the operation of choice for tricuspid atresia at any age.

49. Correction of the Younger Tetralogy

A. R. C. DOBELL, and E. J. P. CHARRETTE,* Montreal, Quebec.

In our experience the mortality rate following correction of the tetralogy of Fallot has been tripled when the operation included detaching a previously formed aorto-pulmonary shunt. For this reason and with increasing confidence in our ability to correct the lesion, we have lowered the minimal size of patients accepted for correction. We have now operated upon 23 children between 14 months and 5 years of age. Initially, this series consisted of only those children in whom surgery was necessitated by severe spells, high hemoglobin and deep cyanosis. Recently, less severely ill younger children in whom surgery might have been delayed have been operated upon electively. Repair has been carried out through a transverse ventriculotomy in a bloodless, still field. Emphasis has been placed on mobilizing the crista supraventricularis medially and laterally, and on retracting it posteriorly with a prosthetic patch used to close the ventricular septal defect. Twenty-three younger children have undergone correction with one operative death. A second child died several months after operation with dilatation and fibrosis of the right ventricle, possibly caused by right coronary air embolism during the correction.

50. Surgical Treatment of Cardiac Defects Associated with Variations in Cardiac Position

DONAL M. BILLIG,* GRADY L. HALLMAN, ROBERT D. BLOODWELL,*

and DENTON A. COOLEY, Houston, Texas.

Repair of congenital cardiac defects may be made more difficult by the presence of positional anomalies such as dextrocardia, dextroversion and levocardia. Thirty-one patients with cardiac lesions and variations in cardiac position were operated upon. Thirteen patients had mirror image dextrocardia and 2 patients had isolated levocardia with abdominal situs inversus. Ten patients had cardiac dextroversion, and 6 patients had abdominal situs inversus with cardiac levoverion. In the 13 patients with mirror image dextrocardia, 8 had successful corrective operations and 5 had successful palliative procedures for a variety of cardiac defects and all survived. The two patients with isolated levocardia had successful closure of ostium secundum atrial septal defects. In only one of six patients with levoverion was corrective surgery possible. The remainder had palliative operations for uncorrectable lesions. Two of these expired in the early postoperative period. The 10 patients with dextroversion underwent palliative operations and four expired. The results indicate the serious nature of lesions associated with dextroversion and levoverion, as opposed to the usually correctable defects in the group with mirror

image rotations. This presentation will review anatomic features of cardiac positional anomalies as they influence the repair of congenital cardiovascular defects.

*By invitation

The American Association for Thoracic Surgery, 1966-67

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Members Deceased

JOHN B. BARNWELL
 ERNEST C. JANES
 JOHN H. GARLOCK
 ROBERT M. JANES
 LEW A. HOCHBERG
 LEO J. KENNEY
 ELLIOTT S. HURWITT
 HERBERT WM. SCHMIDT

THE AMERICAN ASSOCIATION FOR THORACIC SURGERY
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June 7, 1917

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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
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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
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1960-Miami Beach. President, William E. Adams
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1964-Montreal President, Robert E. Gross
1965-New Orleans President, John C. Jones
1966-Vancouver, B. C. President, Herbert C. Maier