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Reports of Scientific Meetings

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Conference on Recent Advances in Cardiac Surgery

Under the sponsorship of Harvard Medical School, a course on recent advances in cardiac surgery was held April 20 and 21, 1972, at the Shriners Burn Institute, Boston, Massachusetts. Although most presentations were surgically oriented, this report presents aspects of particular interest to anesthesiologists.

P. Hallowell reviewed the indications and treatment of respiratory problems associated with cardiac surgery. He emphasized that the pulmonary disease in these patients is primarily vascular; pulmonary vessels may react to hypoperfusion, as in tetralogy of Fallot, to hyperperfusion secondary to a left-to-right shunt, or to chronic passive congestion, as in the patient with mitral stenosis. Dyspnea is a frequent symptom of pulmonary venous congestion. Dr. Hallowell used his interpretation of the upper, middle, and lower lung zone model of West to indicate the need to maintain a positive end-expiratory airway pressure (PEEP) to avoid lung collapse and prevent further shunting. The Boston group manually ventilates all patients during open-heart anesthesia to ensure PEEP. The importance of measuring left-sided pressures with a Swann-Ganz catheter, in preference to a left atrial catheter, was emphasized.

Postoperatively, the respirator is set to deliver tidal volumes of 15 ml/kg body weight. This large V_T prevents the patient from fighting the machine, as well as protecting against the development of atelectasis. To wean patients from the ventilator, a Briggs T-piece with an $F_{I_{O_2}}$ of 0.4–0.6 is used. After 15 minutes, expiratory minute volume, vital capacity on the T-piece, and arterial blood gases are measured. Dr. Hallowell emphasized observing the patient and noting the amount of respiratory effort and dyspnea. Criteria for extubation include a Pa_{O_2} greater than 125 torr on the T-piece with an $F_{I_{O_2}}$ of 0.4–0.6, Pa_{CO_2} stable and less than 55 torr, vital capacity greater than 10 ml/kg, a respiratory rate of less than 30/min, and the absence of dyspnea. With borderline values, the decision to extubate is delayed. The duration of postoperative respiratory assistance is highly variable. Following extubation, pulmonary function is again evaluated. Dr. Hallowell does not hesitate to use PEEP and steroids postoperatively in patients who have dyspnea.

M. Laver described his technique for hemodilution of patients undergoing cardiac surgery. Arterial blood is withdrawn and stored for retransfusion in a quantity sufficient to reduce hematocrit to less than 20 per cent. The shed blood is replaced with balanced salt solution in a volume ratio of 3 for 1. At the end of the operation Lasix (furosemide) is given to all patients to evaluate renal blood flow and achieve a negative water balance. The major advantages of this technique are the conservation of bank blood, elimination of the hazards of blood transfusion, and a lowered blood viscosity, which enhances tissue perfusion during hypothermia and bypass. Dr. Laver foresees a use of this technique in other areas, such as neurosurgical procedures involving vascular tumors.

J. W. Harthorne discussed the patient with chest pain. He emphasized the importance of a history which includes the nature of the pain, its precipitating factors, duration, frequency, success of therapy, and associated diseases. Laboratory studies are not very helpful, since resting ECG is normal in 50 per cent of resting patients with coronary heart disease and normal in 25 per cent after exercise. In later discussion, Dr. Harthorne indicated that he would continue using propranolol up to the morning of operation in patients undergoing coronary bypass procedures.

E. Mundth reviewed current operative techniques of coronary artery surgery for angina and chronic heart failure. The MGH surgeons use the saphenous vein–coronary artery bypass graft almost exclusively, frequently in association with coronary artery endarterectomy. For success, postoperative flow through the graft must be greater than 50 ml/min. Of such grafts, 75–85 per cent are still patent by the end of the second week after operation. At autopsy, the major graft pathology is the appearance of intrinsic intimal fibrous hyperplasia. In this series a single-vein bypass graft

has been successful in relieving angina in 70 per cent of patients, while a double-vein bypass graft relieved angina in 75 per cent.

C. A. Sanders discussed the pathophysiology of acute myocardial infarction and cardiogenic shock. In 1963, 40 per cent of patients dying from myocardial infarction died of cardiac arrhythmias, 40 per cent of power failure (cardiogenic shock), 8 per cent from embolism, and 3 per cent from rupture. In 1969, with the advent of intensive monitoring and therapy in coronary care units, arrhythmias accounted for less than 1 per cent of myocardial infarction deaths; 93 per cent were due to power failure, 3 per cent to embolism, and 3 per cent to rupture. Myocardial infarction appears to be a dynamic process. There is a central area of infarction surrounded by periinfarcted areas which are reversibly damaged. Therefore, the aim of therapy is to minimize the area of permanent damage. It would be desirable to increase coronary flow to this compromised area without increasing myocardial oxygen demand. All pharmacologic agents which dilate coronary vessels, however, also increase myocardial oxygen demand. The most frequent hemodynamic findings with myocardial infarction are a left ventricle filling pressure greater than 20 torr, a cardiac index less than 2.0 l/min/m^2, a mean arterial pressure of less than 60 torr, and a decreased Pa_{O_2}. At the present time, Dr. Sanders continuously monitors ECG, systemic and pulmonary pressure, CVP, respiratory rate, and urinary output. Intermittently, he measures pulmonary arterial wedge pressure, blood gases, and cardiac output. With the introduction of the Swann-Ganz catheter, measurement of CVP has become less common, since this only measures indirectly that which the wedge pressure measures directly. With myocardial infarction there is a redistribution of pulmonary blood flow which correlates with the presence of increased left atrial pressure. Therapeutic measures currently employed include: 1) volume replacement, correction of acidosis (not a sustained problem), and administration of oxygen (not much information to support this concept); 2) electrical pacing; 3) pharmacologic assistance, including the administration of catecholamines and digitalis. Dr. Sanders described an ingenious coupled pacing technique. One electrode is inserted through an antecubital vein into the atrium, while the other is passed through the internal jugular vein into the ventricle. The heart chambers are alternately stimulated, correlated with the ECG. Compared with a single pacing technique, coupled pacing increases cardiac output and arterial pressure and decreases CVP. Thus far, however, the technique has not changed mortality.

M. J. Buckley described use of aortic balloon counterpulsation for cardiogenic shock. Dr. Buckley inserts a segmented balloon retrograde through the femoral artery until resistance is reached at the aortic arch. The balloon has a safe electrical interface which is triggered from an electrocardiogram through an automatic timing device. This activates a pneumatic drive which inflates the balloon during diastole. Retrograde flow thus fills the coronary arteries without increasing myocardial oxygen demands. The machine has numerous built-in safety devices, including a limited volume, automatic leak detection, and automatic loading. Dr. Buckley visualizes its ready application intraoperatively in treating myocardial ischemia on the operating table.

Surgical treatment of acute complications of myocardial infarction was discussed by W. M. Daggett and E. D. Mundth. Surgical treatment of coronary artery disease is a direct development of selective coronary angiography, which allows anatomic definition of the disease, a necessary prerequisite to surgical treatment. Internal mammary artery implantation may sometimes be suitable for patients in whom direct bypass operations cannot be done. However, the future role of internal mammary artery implantation is unclear. More commonly, the saphenous vein is used to bypass the coronary artery occlusion or stenosis, the vein being reversed as valves prevent retrograde flow. The saphenous vein is a good arterial substitute, since hydrostatic pressures approach arterial levels in the standing patient. The vein is normally thick-walled and resistant to aneurysm formation. Although early results have been encouraging, the long-term fate of endarterectomized segments is not known. The current indications for coronary artery bypass are: 1) angina pectoris unrelieved by medical treatment; 2) previous myocardial infarction; 3) congestive heart failure. Early results of bypass grafting have been dramatic in selective patients, but success appears inversely related to the amount

of myocardium destroyed by previous infarction. The long-term surgical results and the effect on the natural history of disease remain to be determined.

In their discussion of the medical and surgical treatment of dissecting aneurysm, R. DeSanctis and M. Buckley emphasized the advantages of the Wheat–Palmer medical management concept. The aims of therapy are to reduce systolic blood pressure to 100–120 torr and concurrently to reduce the velocity of ventricular contraction. To achieve this, they utilize trimethaphan, reserpine, propranolol, methyldopa, chlorothiazide, and sedation, as needed. They report a 50 per cent overall survival rate when the aneurysm is treated medically. The major complication of therapy is hypotension. Aneurysms (of the distal aorta) are frequently treated surgically. From an anesthetic point of view, the major problem occurs postoperatively, when interstitial edema may develop in the lung compressed during thoracic aneurysm repair. Dr. Buckley believes that an increasing A-aD_{O_2} is a prime indication for steroid therapy; he uses 1–2 g methylprednisolone every six hours.

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Drugs and Their Actions

ROUTE OF ADMINISTRATION AND EFFECTIVENESS OF PROPRANOLOL Certain unpredicted disparities between the β-adrenergic blocking effects of propranolol given by different routes have been described. For a given plasma concentration, the effect is greater 2 hours after oral administration than after iv administration. A metabolite with beta-blocking properties, 4-hydroxypropranolol, is detectable in blood after oral but not after iv administration. The authors have tried to clarify these disparities by using the principles of bioassay to study the relationship between the effects of a drug and its plasma concentrations. The effects of propranolol in five young adults were measured by a standardized test of isoproterenol sensitivity. The iv dose of isoproterenol necessary to increase the resting heart rate by 25 beats/min (*i.e.*, chronotropic dose = CD_{25}) was determined before and 15 minutes, three hours, and six hours after iv injection of 20 mg propranolol. CD_{25} was also determined for each of five consecutive days before and two and six hours after oral administration of two single doses of 20 to 80 mg of propanolol, the second dose being double the first. One of these single doses was selected for the long-term study and given every six hours. CD_{25} was measured two and six hours after the twenty-first dose on the sixth day. Plasma samples after each test were assayed fluorometrically for propranolol only, not for the metabolite. Two hours after oral administration of single dose of propranolol, the degree of beta blockade associated with a given plasma propranolol concentration was greater than that seen with the same concentration achieved iv. This disparity was no longer present after six hours. Following long-term oral administration, the β-blocking effects of similar plasma levels were not different from those achieved following iv administration. This is explained by the formation after single oral doses of the active metabolite, 4-hydroxypropranolol, which has a shorter half-life than propranolol. The metabolite is not produced after iv administration of single doses. At the end of a six-hour dosage interval and after chronic oral administration, the effects of propranolol could be attributed entirely to the plasma levels of the parent drug. (*Cleveland, C. R., and Shand, D. G.: Effect of Route of Administration on the Relationship β-Adrenergic Blockade and Plasma Propranolol Level, Clin. Pharmacol. Therap. 13: 181–185, 1972.*)