Proceedings of the British Cardiac Society

THE AUTUMN MEETING of the British Cardiac Society was held at the Royal College of Physicians, London, on Thursday and Friday, 4 and 5 November 1971. The President, SIR JOHN McMICHAEL, took the Chair at 9.30 a.m. during Private Business. At the Scientific Session which followed, the Chair was taken by ALASTAIR HUNTER.

Private Business
1 The President reported with deep regret the deaths of Twort and Doris Baker.
2 The Minutes of the Annual General Meeting having been published in the Journal (1971, 33, 607–616) were taken as read and confirmed.
3 The Treasurer reported that the Society's investments stood at nearly £12,000. In line with stock market prices there had been some recent appreciation in value. He had recently reviewed the holdings with the Society’s Broker who was generally satisfied with the behaviour of the shares and recommended no change at this time. £1,000 had been taken out of the Deposit Account and invested in 84% Bass Charrington Debentures for the Sinking Fund, bringing this to £1,500, with £500 left on deposit, on Broker’s advice, for easy availability.

Expenses of all kinds were rising inexorably, and though he was exploring ways and means of getting work done more cheaply most increases had to be accepted. Members’ subscriptions just about covered current expenses; but the actual position would be known when the books for 1971 were closed at the end of the year.

The financial accounts of the VI World Congress of Cardiology had now been closed and the Society had received a further £1,967.26. It had been agreed that £500 should be given from the Society to the Lord Alexander Appeal Fund of the British Heart Foundation; that £1,000 should be held in reserve to assist members with some of their travelling expenses to attend the VII World Congress; and the remainder be put into the Society’s general fund.

4 The Secretary reported that arrangements for the Annual General Meeting in Dublin on 23 March 1972 were proceeding satisfactorily.

5 The Secretary reported that arrangements had been made to hold the next Autumn Meeting on 9 and 10 November 1972 at the Royal College of Physicians, but the possibility was being explored of holding the dinner elsewhere.

6 The Secretary reported that the Annual General Meeting in 1973 would be held on 12 April in Glasgow, immediately before the meeting of the Association of Physicians.

7 Goodwin reported that the findings of the Cardiology Committee of the Royal College of Physicians on Career Structure in Cardiology had gone to the Department of Health, but no official reaction to the report had been received.

8 Goodwin, as Chairman of the Specialist Advisory Committee on Cardiology of the Joint Committee on Higher Medical Training, reported that the Committee had now formulated provisional recommendations for training programmes for Groups I and II cardiological consultant work, and for paediatric cardiology. It seemed likely that the Groups II and III outlined in the Report of the Cardiology Committee of the Royal College of Physicians on Cardiological Staffing and Career Structure could in future be merged. The Specialist Advisory Committee had recommended 8 years training for Group I and II and Paediatric Cardiology, which included 1 year pre-registration jobs, 3 years general medical training, and 4 years (in the case of Group I) and 3 years (in the case of Group II) in specialist training in a Special Cardiac Medical-Surgical Centre. The 4th year for Group I should include some general medicine. Paediatric Cardiology presented additional difficulties, but should include 2 years’ adult cardiology and 2 years’ paediatric cardiology in addition to general paediatrics and neonatal paediatric training, probably to be taken in the 3 years of general professional training.

Goodwin emphasized most strongly the firm recommendation of his Committee that the utmost flexibility regarding the training schedules must be maintained with regard to the order in which training should be taken, and the background of trainees. No training programme should be so rigid that its requirements would permit people with unorthodox backgrounds but of special brilliance to be excluded.

The recommendations had been presented to the members of Council, who had added their comments and suggestions, and the report had been discussed and agreed provisionally at the meeting of the full Committee for Higher Medical Training in October.

9 Davison and Oram reported on the results of discussions they had had with Dr. Lees of the Department of Health and Social Security on cardiological technicians' pay and conditions. They felt that they had had a full opportunity to explain the position and they were hopeful that a sympathetic view would be taken of the need for appropriate salary scales for cardiological technicians.

10 The Secretary informed the Society that a memorandum had been received from Dr. Lees of the Department of Health and Social Security with regard to the possibility of interference with the function of demand pacemakers. Dr. Lees was anxious to establish a register of demand pacemakers, and members were requested to notify Dr. Lees of the name and address of any patient, and the make and model of the pacemaker being used.

Following the Scientific Meeting on the Thursday, the Thomas Lewis Lecture — 'Function of Nerves of the Heart' — was given by Linden.

After the Scientific Meeting on the Friday, the National Heart Hospital St. Cyres Lecture — 'The Skeleton in Heart Disease' — was given by Jefferson.

The Society dined together at the Royal College of Physicians, with McMichael in the Chair. The guests included Professor J. N. Morris. The President spoke about recent developments including progress in the creation of chairs of cardiology by the British Heart Foundation.
Nitrous oxide analgesia in acute myocardial infarction

F. Kerr, D. J. Ewing, J. B. Irving

Many drugs used for pain relief in myocardial infarction have circulatory effects. An agent that relieves pain without major haemodynamic effect would be advantageous. In 15 patients with acute myocardial infarction we studied the analgesic and cardiorespiratory properties of a 50 per cent nitrous oxide 50 per cent oxygen mixture (Entonox, B.O.C.). During a control period the patients breathed air via an air force mask connected to a demand valve. With a three-way tap, transfer to Entonox, breathed through a similar assembly, was accomplished without the patient’s knowledge. In 5 patients the cardiac index was measured with indocyanine green and intra-arterial pressures recorded at 5-minute intervals. After a 20-minute control period Entonox was administered for 30 minutes: mean heart rate fell 5 minute, mean arterial pressure remained constant, cardiac index fell 0.4 l/min per m², and systemic vascular resistance rose 334 dynes sec cm⁻²/m². Blood gases in 6 patients showed a rise in arterial Po₂ of 35 mmHg during Entonox administration, returning to the control level on withdrawal. Complete pain relief was demonstrated in all patients with no significant side-effects. We conclude that Entonox is a safe and effective analgesic in acute myocardial infarction.

A study of the incidence of venous thrombosis following myocardial infarction

B. J. Maurer and R. Wray (introduced)

Using the ¹²⁵I-fibrinogen isotope technique, 100 patients with acute myocardial infarction have been studied to define the incidence of venous thrombosis complicating this illness. None of the patients was given anticoagulants routine, but in 10 patients anticoagulants were employed at an early stage in the illness for reasons other than the treatment of venous thrombosis. Of the 90 patients who were not given anticoagulants, 34 (37%) developed a calf vein thrombosis. None of the 10 patients given anticoagulants developed thrombosis. In 10 of the 34 patients the thrombus was bilateral. In all, the thrombus began in the calf. In 7 limbs the thrombus extended to involve the veins of the thigh and the femoral vein. In one patient the thrombus extended to the popliteal vein. When such extension was noted these patients were given anticoagulants. Over 50 per cent of the thrombi were found in the first 72 hours. No patient in this series sustained a major pulmonary embolus. The incidence found in these patients is very similar to that recorded in patients who have recently undergone surgery.

Atrial gallop in diagnosis of early coronary heart disease

P. G. F. Nixon and H. J. N. Bethell (introduced)

The clinical diagnosis of early coronary heart disease traditionally depends upon the history and the electrocardiogram, little of importance being expected or obtained from the examination of the heart sounds and pulsations.

The purpose of this communication is to report findings from a series of 159 cases of coronary heart disease without evidence of myocardial infarction, hypertension, or valvular disease.

One hundred and eleven patients had classical angina pectoris and the resting electrocardiogram was abnormal in 21 (18%). In the remaining 48 patients, the diagnosis of coronary heart disease was made from abnormalities of the electrocardiogram at rest or after exercise. The resting electrocardiogram was abnormal in 24 (50%).

In 108 of the patients, the heart sounds and pulsations were recorded by low frequency phonocardiography and apex cardiography, with the patient in the left lateral or semilateral position. The tracings were examined for fourth heart sounds and enlargement of the atrial components (A’ waves) of the apex cardiogram. In the 71 patients in the classical angina group, the tracings were abnormal in 65 per cent, and the resting electrocardiogram abnormal in 17 per cent.

It is concluded that physical examination in the left lateral position, by revealing palpable and audible atrial gallop rhythm, may be more useful than the resting electrocardiogram in detecting early coronary heart disease.

Significance of atrial sound in acute myocardial infarction

E. D. Bennett, C. R. Smithen (both introduced), and E. Sowton

The incidence and significance of the atrial sound was assessed in 20 patients with acute myocardial infarction. High frequency phonocardiograms were recorded from the left atrial border and apex on several occasions in all patients. Pulmonary artery pressures were measured with a flow guided catheter. Simultaneous electrocardiograms were also obtained.

Atrial sounds were present in all cases. The interval between the P wave of the electrocardiogram and the initial deflection of the atrial sound of the phonocardiogram (PG interval) was measured. The ratio of PG interval to the PR interval of the electrocardiogram progressively increased from 81 per cent on the first day to 89-3 per cent on the fourth day, demonstrating that with resolution of the infarction, the atrial sound moved towards the first heart sound. Those patients with a complicated clinical course had a significantly smaller PG/PR ratio than those patients whose course was entirely uncomplicated.

There was a significant correlation between this ratio and the pulmonary artery diastolic pressure, suggesting that those patients with the greatest degree of left ventricular dysfunction had the shortest PG intervals (r = 0.52, y = 37–14x, P < 0.001).

It is concluded that in acute myocardial infarction an atrial sound is universally present and that the PG interval reflects alterations in the clinical and haemodynamic state of the patient.

Lowering of blood cholesterol by dietary recommendations in middle-aged men

A. G. Shaper, Jean W. Marr, J. A. Heady, and J. N. Morris (last three all introduced)

Male civil servants aged 40-49 years, who had previously participated in a questionnaire on leisure activity, took part in a further study designed to assess whether a significant reduction in blood cholesterol level could be achieved in a free-living population by simple dietary recommendations. The study involved 5 visits over a 6-month period and included physical examinations, electrocardiography, detailed dietary studies, biochemical measurements (including blood cholesterol, triglycerides, uric acid, glucose, fatty acid patterns), and studies of the blood fibrinolytic activity. Two groups of men were given dietary advice and two groups remained as the controls.

The control groups showed an increase in blood cholesterol level over the
winter months of the study. The groups given dietary advice showed a fall in blood cholesterol level on reassessment at 6 weeks and maintained this lowered level at 4 months. Body weight increased in the control group and fell in the dietary group, but within the diet group, there was no significant relation between the amount of weight change and the amount of cholesterol change in individual subjects. The control group was then provided with the dietary recommendations and all subjects will be re-examined at 12 months from the start of the study.

Changes in skinfold thickness, blood pressure, and fibrinolytic activity were also observed over the initial 6 months of the study. Relations between diet and these measurements will be discussed with reference to the possible significance of this study to the primary prevention of coronary heart disease.

**Supervised physical training after myocardial infarction**

*C. M. Morgans* (introduced by D. W. Barratt)

Supervised physical training in men aged 35 to 65 recently recovered from myocardial infarction is being studied. Twenty-three men form the exercise group and 22 are controls. The exercising patients trained three times weekly for three months in a hospital gymnasium. The control group received routine aftercare.

Parameters measured before and if possible after three months include heart rate, pulmonary artery pressure, and venous oxygen saturation, measured at rest and during supine exercise on a bicycle ergometer, using a float catheter.

One patient in each group has died. A significant (*P < 0.05*) fall in resting and exercising heart rates occurred in the exercise group. A smaller insignificant fall occurred in the controls.

The investigation consisted of measurements during a 20-minute period of cycling at 100, 200, 300, and 400 kpm/min. In those patients in the exercise group who were unable to complete the cycling period because of angina pectoris or 2 mm ST segment depression, there was an improvement in exercise tolerance after the training period. The improvement correlated with lower exercising heart rates.

Resting diastolic pulmonary artery pressures were raised in one-third of the patients and exercising diastolic pulmonary artery pressures were raised in two-thirds. There were no significant changes at the second investigation. Mixed venous oxygen saturations were also unchanged.

A self-rating depression scale has been used to assess possible changes in mood.

A short film showing the exercises used in training is available.

**Initial experiences of routine automated electrocardiographic interpretation**

*P. W. Macfarlane* (introduced) and *T. D. V. Lawrie*

In a previous communication to the British Cardiac Society a technique for electrocardiographic interpretation by computer was described and results discussed. The present communication reports the initial experiences of introducing the method into a large general teaching hospital for routine purposes.

During the first six months of operation, 3,455 3-lead electrocardiograms were interpreted by a computer sited within the hospital. The number recorded monthly was increased gradually and in the sixth month was 725, representing almost 40 per cent of the total hospital requirement.

In parallel with this introduction, a series of lectures was given to medical staff to explain the diagnostic principles of 3-lead electrocardiography. This facilitated acceptance and minimized criticism of the computer interpretations.

Significantly erroneous interpretations totalled under 4 per cent, while a further 4·5 per cent of computer reports had minor discrepancies. These results have led to further modifications to wave recognition techniques and criteria, together with insistence on higher technical standards of electrocardiographic recording.

The conclusion reached is that the method will prove acceptable for routine purposes in any centre where there is adequate scientific support. Technically satisfactory electrocardiograms input to the computer will produce satisfactory interpretations as output.

**Computer storage of catheterization data – preliminary report of a co-operative study**

*J. P. Blackburn* (introduced), *D. C. Deuchar*, *P. R. Fleming*, *G. A. H. Miller*, and *D. G. Morgan* (introduced)

Data from 1600 cardiac catheterizations performed at 3 separate hospitals from 1 January 1970, to 30 June 1971, have been stored using a digital computer. A specially designed form is used on which can be recorded not only the numerical data derived from the procedure but also, by means of a coding system, a description of the technique of catheterization, the chambers and vessels entered and details of angiography. In addition it is possible to record the effect of interventions such as the administration of drugs. The diagnostic coding permits not only a statement of the diagnosis but also allows the expression of clinical doubt about the nature and severity of the lesion.

Print-outs are sent to the participating hospitals weekly; a copy of the original form is retained for reference until the print-out is available.

Programmes have been written to permit a wide range of data retrieval and analysis, and some results of such analyses will be presented. The project is a first step towards constructing a comprehensive system of data retrieval relating to hospital cardiological practice, while the co-operative nature of the project increases the pool of data available for analysis.

**Cardiovascular data analysis on a small digital computer**

*C. J. Mills* (introduced) and *I. T. Gabe*

The general problem of analysing data during cardiovascular investigation has become greater in recent years with the increase in the number of variables recorded and with the necessity to measure records in a more detailed way. To facilitate such analysis, a small digital computer – a PDP-12 – has been programmed to process left ventricular pressure together with pressure and velocity records from the aorta. Data are accepted in analogue form either directly from the patient or from a tape recorder. It is converted to digital form and stored on one of two magnetic tape units. After calibration, subsequent processing includes, (1) a system for averaging records over a predetermined number of beats to produce estimates of and statistics on systolic, diastolic, mean, and maximum rates of change of pressure and velocity; (2) beat-to-beat calculation of similar sets of variables; and (3) calculation of harmonic content of aortic pressure and velocity wave forms and the computation of vascular impedance.
Intracellular action potential in hypertrophic obstructive cardiomyopathy

D. J. Coltart and S. J. Meldrum (both introduced by John Hamer)

Some skeletal muscular dystrophies are known to be associated with cardiomyopathy, and Meerschwan and Hootsmans (1971) have reported abnormal electromyographic potentials in the skeletal muscles of patients with hypertrophic obstructive cardiomyopathy. In view of these findings we have studied the intracellular action potential in specimens of myocardium removed at operation in 2 patients with hypertrophic obstructive cardiomyopathy, using the microelectrode technique, and compared the findings with action potentials in tissue from other hypertrophied hearts.

Repolarization was greatly prolonged in the tissue and the rate of depolarization was reduced. There were also characteristic abnormalities in the effective refractory period and the contractile response. The usual 'quinidine-like' effect of propranolol on the action potential could be demonstrated.

The findings of an abnormal myocardial and skeletal muscle potential in patients with hypertrophic obstructive cardiomyopathy support the view that this condition might be a generalized muscular dystrophy with early major cardiac manifestations.

Reference

Spectrum of pre-excitation and its elucidation by His bundle electrography

Dennis Krikelas, Charles Smithen (introduced), and Edgar Sowton

We review 4 patients with different aspects of the pre-excitation syndrome, studied by His bundle electrography. Two had type A Wolff-Parkinson-White conduction, both with recurrent paroxysmal tachycardia. In one, ventricular extrasystoles appeared to be important in the production of the arrhythmias; tachycardia could not be initiated by right heart stimulation, but surprisingly we could do this in the other case with type A conduction. Though Case 3 had type B WPW conduction, we were unable to initiate an arrhythmia nor did he suffer from paroxysmal tachycardia. In Cases 1 and 2, His bundle electrophysiology showed only mild pre-excitation during sinus rhythm, though in one the degree varied spontaneously: pacing caused the His-V interval to decrease sharply to zero as the major part of depolarization occurred via the bypassed bypass. In Case 3, with conspicuous pre-excitation in sinus rhythm, a similar response occurred on pacing. The fourth patient had the syndrome of a short PR and normal QRS interval, with a short P-His interval on the electrocardiogram; he suffers from paroxysmal atrial flutter.

The possible mechanisms for the different modes of conduction seen in pre-excitation were presented, with special reference to the occurrence of arrhythmias and their control.

Effects of glucagon on myocardial contractility and cardiac output

John Hamer, Derek Gibson, and John Coltart (introduced)

Intravenous glucagon has been recommended as an inotropic agent in the management of low cardiac output states.

We have investigated the effect of 2 or 3 mg glucagon intravenously at cardiac catheterization in 3 patients with serious aortic stenosis, using thermo-dilution curves to measure left ventricular volume. There was a striking rise in cardiac output (from 4.4 to 6.3 L/min), due to moderate increases in heart rate (from 81 to 90 per min) and stroke volume. There was a considerable increase in end-diastolic volume, but mean circumferential shortening rate, an index of contractility, was unchanged or fell. Left ventricular systolic pressures rose slightly and there was a considerable increase in wall force, possibly due to the Starling effect in the larger left ventricle.

The maintenance of the shortening velocity in the presence of an increase in wall force may be an indication of some inotropic effect, but there is no evidence of an increase in contractility which could produce the observed rise in cardiac output. It seems likely that a rise in splanchnic blood flow is produced, and that the cardiac changes are largely secondary to the increase in venous return. The therapeutic value of this response in cardiac disease is questionable.

Alpha-adrenergic blockade in treatment of heart failure

S. H. Taylor, P. A. Majid, and B. Sharma (the last two introduced)

The adrenergic alpha-receptor blocking drug, phentolamine, was administered to 12 patients with severe progressive left ventricular failure due to ischaemic heart disease. The rationale for the use of this drug in this circumstance was based on two considerations; that the reflex increase in systemic resistance that accompanies the onset of pumping failure may further aggravate the left ventricular failure by increasing the pressure-work load on the ventricle; that in heart failure the redistribution of the blood volume towards the heart and lungs may further increase left ventricular dilatation. The drug was administered intravenously in a dose of 1-2 mg/min sufficient to lower the systemic arterial blood pressure by 20-30 mmHg. This resulted in an immediate relief of symptoms simultaneously with a substantial reduction in the left ventricular end-diastolic and pulmonary artery mean pressures, and a significant increase in stroke volume and cardiac output. These changes were maintained throughout the three-hour period of infusion. Patients who were able to exercise also had a significant improvement in symptoms, an increase in the cardiac output, and a decrease in the left ventricular end-diastolic pressure response to exercise. Chest x-rays showed a conspicuous clearing of pulmonary oedema and reduction in heart size after the drug. The benefits of this treatment are probably predominantly due to the effects of the drug in lowering the systemic vascular resistance thus reducing the cardiac pressure-work load and volume. However, the drug may also directly support the metabolism of the failing heart by release of the suppression of insulin secretion, and its bronchodilator action may also contribute to the relief of symptoms in patients with cardiac asthma. This approach to the treatment of severe heart failure may usefully complement conventional treatment with digitalis and diuretics and may be of particular value in situations where digitalis is contraindicated.

Beat-to-beat analysis of left ventricular pressure-volume relations in atrial fibrillation in man

D. G. Gibson
Using an echocardiographic method during diagnostic cardiac catheterization, simultaneous records of left ventricular dimensions and left ventricular and aortic pressures were made for periods of up to 50 consecutive cardiac cycles in patients with atrial fibrillation. From these data, end-diastolic, end-systolic, and stroke volumes were determined and correlated with intraventricular pressure, allowing the diastolic distensibility of the left ventricle to be described, and pressure-volume loops to be constructed for single cardiac cycles. Left ventricular wall tension, derived from cavity diameter and systolic pressure, and mean circumferential fibre shortening rate, derived from stroke volume, cavity diameter, and ejection time, were determined on a beat-to-beat basis, and were shown to correlate with previous pulse intervals. The relation between left ventricular tension-time, an index of myocardial oxygen consumption, and external cardiac work was also shown to be dependent on diastolic filling time and stroke volume. These methods can thus be used to examine the interrelations between various aspects of left ventricular function in a single patient, as well as giving a more complete description of cardiac performance in the presence of atrial fibrillation on a beat-to-beat basis.

Reversion of ventricular tachycardia by pacemaker stimulation

M. A. Bennett (introduced) and B. L. Pentecost

Transvenous cardiac pacing has been used with success in the prevention of recurrent drug-resistant ventricular tachyarrhythmias. Despite pacing, however, ventricular tachycardia and fibrillation may recur. With the pacing catheter situated in the right ventricle, the reversion of ventricular tachycardia to sinus rhythm was achieved by pacing, in seven patients after acute myocardial infarction. The technique involved pacing at a rate in excess of the existing tachycardia until ventricular capture was achieved. Cessation of pacing after a few seconds was usually followed by sinus rhythm. Because ventricular tachyarrhythmias were recurrent in the presence of sinus rhythm, the ventricular capture rate was sometimes slowed to the point when ventricular premature beats first appeared. The heart was then paced slightly in excess of this critical rate. The technique of reversion seems a useful extension to the employment of transvenous pacing in the prevention of recurrent ventricular tachyarrhythmias.

Familial atrial cardiomyopathy with heart block

R. E. Nagle, B. Smith, and D. O. Williams (last two introduced)

We have studied a cardiomyopathy affecting 3 out of 5 sibs, characterized by first degree heart block and supraventricular rhythms progressing over some years to persistent atrial standstill, with complete loss of response to direct atrial stimulation. At least 2 children of one of the patients appear to be similarly affected.

We have found only 4 previously reported cases of this arrhythmia, 3 of whom occurred in a family with amyloid disease. Post-mortem examination of a member of the family showed no evidence of this condition.

Systemic arterial supply to lungs in pulmonary atresia and its relation to pulmonary artery development

Keith Jefferson, Simon Rees, and Jane Somerville

The pattern of systemic arterial supply to the lungs and its relation to pulmonary artery development has been studied angiographically in 30 patients with pulmonary atresia and ventricular septal defect. Necropsy findings were available in 3 of the patients. The findings reveal that the systemic arteries fall into two groups. In one group the arteries were small, multiple, tortuous, and uncountable in number, with widespread sites of origin from the aorta and its branches, and in patients with this type of arterial supply the central pulmonary arteries were invariably present. Full development of the central pulmonary arteries was also present when the ductus was patent.

In the other group, the systemic arteries were much larger, less tortuous and countable, varying from one to five in number. With one exception they arose from the descending aorta below the isthmus and entered the lungs via the hilum to become continuous with the hilar pulmonary arteries, at which point there was usually a stenosed segment.

Patients with larger arteries as the sole source of supply to the lungs had absent or incompletely formed central pulmonary arteries.

The findings are discussed in relation to the implications for surgical treatment and to accepted concepts of pulmonary circulation development.

Significance of continuous murmurs in cyanotic congenital heart disease

Fergus Macartney, Philip Deverall (introduced), and Olive Scott

Six patients (age 3–25 years) with ventricular septal defect and 'pulmonary atresia' were studied in whom the entire pulmonary blood supply was from large 'bronchial' arteries arising distal to the ascending aorta, and not from a persistent ductus arteriosus (PDA). All had continuous murmurs. Selective 'bronchial' arteriography showed detailed anatomy. To evaluate the likely result of surgical anastomosis of a right ventricular conduit to a suitable point in a bronchial artery, pulmonary resistance (Rp) was measured as the total resistance to flow distal to that point, as determined by bronchial artery catheterization and the Fick technique.

Of 12 'bronchial' arteries catheterized, only one had significant orificial stenosis. Rp in the 5 patients without such stenosis was 21–65 units m² (mean 40), breathing room air. Breathing 100 per cent oxygen produced a rise in pulmonary flow in 4 patients, but Rp remained severely raised (14–39 units m²; mean 34) implying inoperability by the above technique.

By contrast, 2 patients whose entire pulmonary flow traversed a persistent ductus arteriosus, had severe ductal stenosis, but lacked the usual continuous murmur probably because of inadequate ductal flow.

We conclude that a continuous murmur is an unreliable guide to anatomy or pulmonary resistance in such patients.

Twelve years follow-up after surgical correction of Fallot's tetralogy in childhood

Riaz Haider, P. Finnegan, S. Sanchos-Fornos (all introduced), L. D. Abrams, S. P. Singh, and C. G. Parsons

Eight patients have been reassessed approximately 12 years after one-stage correction of Fallot's tetralogy. It has been shown that right atrial mean pressure, right ventricular systolic and end-diastolic pressures, pulmonary artery pressure, and pulmonary vascular resistance were all essentially normal at
rest and during exercise. Arterial oxygen saturation was within the normal range. The systolic pressure gradient across the right ventricular outflow tract was less than 20 mmHg at rest in all patients. The right ventricular/systemic ratio ranged from 14 to 42 per cent. The response of cardiac output to exercise, and the relation between oxygen consumption and cardiac output were normal. No patient had a shunt at ventricular level.

By the methods employed we were unable to show any significant abnormality of cardiac function at rest or during exertion. There was no detectable difference in the cardiac function of patients with a competent pulmonary valve and those with incompetence associated with a prosthetic patch in the right ventricular outflow tract and/or pulmonary artery.

It is concluded that in these 8 patients cardiac function is normal 12 years after total correction of Fallot’s tetralogy and that the prognosis appears to be good even when there is residual pulmonary incompetence.

Late results of fascia lata reconstruction of the right ventricular outlet

Fergus J. Macartney, Olive Scott, and Marian I. Ionescu

Twenty previously reported patients who have survived reconstruction of the right ventricular outlet with a fascia lata composite graft have been followed for up to 19 months. All are symptomatically improved, with a normal exercise tolerance, requiring no medication. All have pulmonary ejection systolic murmurs and three have murmurs of pulmonary incompetence. The cardiothoracic ratio on x-ray has remained unchanged from before operation in each case.

However, postoperative cardiac catheterization in 8 patients (6 to 16 months after operation) has revealed, in each case, a systolic pressure gradient between the right ventricle and pulmonary artery, resulting in a right ventricular systolic pressure of 40-112 mmHg. The gradient across the valve graft varied from 5-70 mm, while the gradient between graft tube and pulmonary artery was 0-40 mm. Selective right ventricular angiocardiography has shown satisfactory motion of the fascial valve cusps in 3 patients, but in 2 the cusps could not be visualized and in 3 there was considerable narrowing of the fascial conduit at the valve site. Pulmonary arteriography in one patient revealed mild pulmonary incompetence.

The value of fascia lata reconstruction of the right ventricular outlet appears to be limited by the high incidence of postoperative pulmonary stenosis.

Influence of extracellular potassium concentration on ouabain effects in human cultured cells

D. McGall, J. V. Lamb (both introduced), and T. D. V. Lawrie

Experiments have been carried out to determine the effects of prolonged ouabain treatment on the ionic contents of a strain of cultured cells derived initially from human right atrium (Girardi et al., 1958). Preliminary experiments showed that sensitivity to cardiac glycosides was similar to other human tissues. Treatment of the cells with low concentrations of ouabain, including those concentrations that would be encountered in clinical practice, for varying intervals of time from 8 hours to 5 days, was carried out. The intracellular Na rose, and intracellular K fell, to new steady levels, and these new levels were linearly related to the concentration of ouabain used.

Reducing the extracellular K concentration increased the changes in the ionic contents of the cells brought about by the low concentrations of glycoside, whereas in the presence of increased extracellular K concentration the ouabain had a less obvious effect. Both of these effects were significant (P < 0.001). At each concentration of K however, the 24-hour ionic levels remained linearly related to ouabain concentration.

In a further series of experiments the cells were exposed to tritiated ouabain, in concentrations identical to those used in the preceding experiments, for 24 hours. The amount of glycoside bound at the end of this time was dependent on the concentration of ouabain used and inversely related to the extracellular K concentration.

It is concluded that extracellular K influences the effect of the glycoside by modifying the amount of the glycoside bound to the cell membrane.

Reference


Changes in serum and urinary magnesium levels in patients undergoing open heart surgery

M. P. Holden (introduced), M. I. Ionescu, and G. H. Wooler

Magnesium is quantitatively the fourth most important cation in the body after sodium, potassium, and calcium, particularly in myocardial function. There is increasing evidence that divalent cations are essential controlling factors in the transfer of monovalent ions across cellular membranes. For these reasons, we investigated possible changes in serum and urinary magnesium levels in patients undergoing open-heart procedures.

In 38 patients were studied and a control group of 33 patients undergoing general thoracic operations was investigated at the same time.

Some patients with mitral disease, in congestive heart failure and receiving diuretics, had low serum magnesium levels before operation.

The serum magnesium levels in all patients fell during perfusion and remained low for the first 3 postoperative days. The levels in the serum were normal by the time of discharge from hospital 2 to 3 weeks later. There was a decreased amount of magnesium in the urine during the first 3 postoperative days.

The biological importance of magnesium and its role in myocardial function was reviewed and the value of magnesium therapy discussed. The clinical effects of giving magnesium to these patients and those undergoing cardiovascular surgery was discussed.

'Jet lesion' in aortic valve endocarditis

L. Gonzalez-Lavin (introduced), Jane Somerville, and Donald N. Ross

During the course of infective endocarditis the aortic valve is frequently affected and becomes regurgitant. The resulting jet of blood disseminates the infecting bacteria in a retrograde fashion that may impinge on the mitral valve with variable destructive effects and aggravate the already compromised left ventricular function.

From June 1965 to December 1970, 292 patients were operated upon at the National Heart Hospital for aortic regurgitation; in 54 of them the regurgitation was a result of bacterial endocarditis. Of these 54 patients, 19 were found to have secondary infective in-
volvement of the mitral valve. This 'jet lesion' may be present in the form of pitting, ulcerations, vegetations, or perforations, or in a combination of these manifestations and possibly with associated rupture of chordae tendinae. Its presence has been consistently in the anterior cusp of the mitral valve. The mitral valve lesion can often be corrected with a conservative procedure, as in 14 of the 19 presented patients.

An awareness of the frequent co-existing 'jet lesion' phenomenon in aortic valve endocarditis is essential as surgical attention to both valves is imperative to achieve a good haemodynamic result.

**Development of a pump and its use in prolonged left ventricular bypass**

C. R. W. Gray (introduced) and C. E. Drew

During the past 5 years a ventricular type pump has been developed, which is unique in that the ventricle, valves, and cannulae are formed from a single silicone rubber moulding. The surface presented to blood is smooth, making anticoagulation unnecessary.

The drive system is hydraulic so that in the event of rupture of a silicone part, blood can only mix with normal saline. The control system is pneumatic and permits independent variation of systolic and diastolic duration and stroke volume.

Thirty-five experiments have been performed on calves. Bypass from left atrium to aorta was attempted for 24 hours. The bypass was then discontinued and the animal allowed to survive. Monitoring of blood pressures, blood gases, haematological and biochemical parameters was performed throughout bypass. Postmortem histological studies were carried out.

Short cine loops illustrating the mode of action of the pump and its operation during bypass were shown.

A brief reference to the clinical application of the pump was given.

**Clinical and haemodynamic results of mitral valve replacement with Starr-Edwards prostheses**

J. S. Wright (introduced), E. Wyn Jones, C. S. McKendrick, N. Coulshed, and E. J. Epstein

Clinical and haemodynamic data have been analysed on 100 patients who formed a consecutive series undergoing mitral valve replacement with Starr-Edwards prostheses, models 6120 (Silastic ball) and 6300 (Stellite ball, cloth covered cage). The preoperative findings have been correlated with surgical mortality.

Postoperative catheter studies have been carried out on 33 of the 76 survivors. The subjective results, good in about one-third of cases, have been compared with the objective clinical, radiological, and haemodynamic findings, with often a surprising lack of positive correlation.

Obstruction and leakage have been important causes of late failure, and a total of 8 repeat operations have been carried out on 6 patients for these reasons. Myocardial failure, persistent pulmonary hypertension, and persistent tricuspid regurgitation have all contributed to the production of disappointing late results, and an attempt has been made to relate these to the preoperative findings.

An appraisal has been made of the quality of life attained for the survivors of this operation.

**Mitrval valve repair: results at 5 and 10 years**

R. J. Donnelly (introduced), D. R. Smith, M. I. Ionescu, and G. H. Wooler

Results are presented from 46 patients surviving open conservative surgery for mitral valve disease between 1957 and 1966. At the present time 36 patients have been traced and reviewed. All 36 patients underwent surgery 5 years or more ago, and 14 of these underwent surgery 10 years or more ago.

In order to give the results more relevance to present-day practice, the cases have been divided into those in whom annuloplasty would be indicated today, i.e. with either a dilated annulus alone or a dilated annulus with minimal cusp and chordal involvement, and those with what would now be considered poor indications for repair, i.e. with significant cusp and chordal disease.

At 5 years 22 out of 24 patients and at 10 years 5 out of 6 patients with good indications for repair were in class I or II of the N.Y.H.A. functional classification. These results contrasted conspicuously with those in which attempts were made to repair valves with significant cusp disease though a small number of these patients have survived without further operation for 12 and 13 years.

Radiological, electrocardiographic, phonocardiographic, and haemodynamic data are presented together with the clinical results.

**Mitrval valve replacement using fresh 'unstented' semilunar valve homografts**

Magdi Yacoub, Malcolm Towers, and Walter Somerville

Unstented fresh semilunar valve homografts were used to replace the mitral valve in 160 patients ranging in age between 9 and 70 years. The aortic valve was replaced at the same time in 42 patients and the tricuspid valve in 5 patients. The total hospital mortality was 8 per cent; there were 2 deaths in the last 73 single mitral replacements. The indication for operation was severe mitral valve disease, unsuitable for mitral valvotomy or repair.

We believe that mounting semilunar valve homografts on rigid stents interferes with their function. The technique used in this series avoids the use of a rigid prosthesis in the normally mobile mitral ring, preserves the sinuses of Valsalva of the homograft, prevents any protrusion into the ventricular cavity or outflow tract, and excludes all prosthetic material from the circulation.

The longest follow-up has been 27 months. There were 6 late deaths unrelated to homograft function. Morbidity comprised transient haemolytic anaemia (1), and fungus endocarditis (2) requiring re-replacement. Three patients have residual pulmonary or myocardial disease. The remaining patients are improved. Haemodynamic findings (22 patients) in general support the favourable clinical result. Anticoagulants were not used. There was no thromboembolism or evidence of homograft degeneration during the period of follow-up.

**Late results of replacement of aortic valve in aortic wall disease**

A. M. Rowshanzamir, M. P. Singh (both introduced), and H. H. Bentley

Aneurysm of the ascending aorta, associated with aortic valve regurgitation, has been treated by replacement of the ascending aorta by a graft with transplantation of the coronary arteries into the graft, and simultaneous replacement of the aortic valve in 11 patients.

Nine patients had Marfan's disease, one had yaws, and one had syphilis.
Nine patients are alive and well, eight back at work and one convalescing.

The first case in which this new technique was used was reported in 1968, and the follow-up of these patients is described.

**Diagnosis of organic tricuspid valve disease**

P. J. Molloy and J. Cleland (introduced)

Thirty-five patients who had tricuspid valve replacement have been studied. All save one were in the course of multiple valve replacement. Preoperative diagnosis was made in a few cases early in the series but became more accurate later. Principal diagnostic points were, enlargement of the right atrium in the absence of pulmonary hypertension or frank congestive failure, the presence of a raised jugular venous pressure in the absence of significant left ventricular failure, and catheter evidence of a tricuspid valve gradient. The difficulties in diagnosis arise in the presence of pulmonary hypertension beyond 50 mmHg, atrial fibrillation, and congestive failure. A case is made for operative inspection as well as digital palpation during operation. All patients who had the valve replaced had organic disease confirmed histologically suggesting that organic disease is commoner than appreciated, and a more aggressive approach to treatment is indicated.

**Assessment of presence and severity of ischaemic heart disease by measurement of changes induced by atrial pacing in lactate concentration in blood from coronary sinus**

Brian Livesley, Patricia F. Catley (both introduced), and Samuel Oram

Under aerobic conditions the myocardium utilizes lactate as a substrate. In patients with ischaemic heart disease when anaerobic metabolism develops the lactate concentration of blood in the coronary sinus exceeds that of the arterial supply. Under these conditions the changes in the lactate concentration can be small. An accurate enzymatic method for estimating lactate now allows these small changes to be measured. In patients with ischaemic heart disease atrial pacing can induce acute myocardial ischaemia. Three groups of patients have been studied: with ischaemic heart disease proved, with it suspected on clinical grounds alone, and normal controls.

From study of 30 patients our results indicate that measurement of the changes induced by atrial pacing in the lactate concentration of blood from the coronary sinus provides a reliable semiquantitative method of assessing the severity of ischaemic heart disease and detecting its presence when results of less sophisticated methods are equivocal.

**Venous grafts in treatment of coronary heart disease: I. Preoperative and operative findings**

Richard Sutton, Lorenzo Gonzalez-Lavin (both introduced), Keith Jefferson, Lawson McDonald, Michael Petch (introduced), and Donald Ross

Sixty patients with coronary heart disease were treated by coronary venous grafts, at the National Heart and Guy's Hospitals up to June 1971. There were 53 men and 7 women, aged 37 to 71 years of age, with an average of 50 years. Patients were studied before operation and are now being studied postoperatively by clinical examination, chest radiography, electrocardiography, submaximal exercise tests, atrial pacing, lipid analysis, coronary arteriography, and left ventricular angiography. The indications for operations were angina pectoris that was resistant to medical treatment in 45 patients, cardiac failure in 10, a resistant ventricular dysrhythmia in one, and associated 'cardiogenic shock' in 4. The last two indications led to emergency procedures.

Single vein bypass was performed in 25 patients, double vein bypass in 33 and the other 2 patients had a triple vein bypass. Twenty-three patients had additional procedures: 8 underwent resection of left ventricular aneurysms, 5 had plication or excision of akinetic areas, and 7 had surgical correction of valvar disease. In 3 an acquired ventricular septal defect was closed. The hospital mortality in those patients who were treated for resistant angina pectoris and cardiac failure was 5.5 per cent; 3 of the 5 patients, who had emergency operations, died.

The place of venous bypass grafts in the management of coronary heart disease will be discussed in relation to the above findings, and in conjunction with the postoperative findings on these patients.

**Venous grafts in treatment of coronary heart disease: II. Postoperative findings**

Charles Smithen (introduced), Edgar Sowton, John Dow, and Donald Ross

Ten patients who had venous bypass operations for severe angina pectoris were reinvestigated from 3 to 6 months after operation. In 9 patients there was significant clinical improvement and 8 were totally free from pain despite extensive physical exertion. All these patients had at least one graft patent and functioning well, with good distal runoff: the last had no clinical improvement and both grafts were blocked.

Nine patients had no angina pectoris or ST segment depression during maximal exercise; the last was the patient with no functioning graft. The mean total work performed during the exercise test increased by 186 per cent from a mean of 1371 kpm before operation to a mean of 3786 kpm after (P < 0.05), and the mean heart rate, at limiting effort, increased by 38 per cent from 113/min before operation to 156/min after (P < 0.05).

In 7 patients studied by atrial pacing before operation angina pectoris and ST segment depression averaging 1.7 mm occurred at a mean heart rate of 130/min. After operation no angina pectoris or ST segment depression was induced in 6 of the patients.

The resting left ventricular end-diastolic pressure after operation did not increase with atrial pacing in 9 patients but was raised in 3.

**Resection of left ventricular aneurysm**

B. N. Pickering, John Graber (both introduced by John Goodwin), H. H. Bentall, W. P. Cleland, D. Ross, M. Yacoub, and A. K. Yates

Resection was carried out in 48 patients with left ventricular ischaemic aneurysm. There were 6 hospital deaths. The follow-up of the first 26 patients in the series was submitted to actuarial analysis which showed an 88 per cent survival rate at 1 year after resection and a 71 per cent survival rate 5 years after resection.

Detailed study of 23 patients from Hammersmith Hospital showed that the usual indication for operation was severe disability from persistent left ventricular failure (in 22 out of 23 patients). Intractable angina (in 8 patients), repetitive dysrhythmia (in 5
patients), and systemic embolization (in 3 patients) provided additional indications for resection.

Aneurysm of the left ventricle or a large akinetic area can gravely depress total left ventricular function. Resection of the non-contractile area with reduction in cavity size is followed by a most gratifying fall in the raised left ventricular end-diastolic pressure with subsequent relief of failure and angina.

The diagnosis of aneurysm was confirmed by angiocardiography but clinical suspicion of aneurysm was alerted by the finding of an abnormal apex impulse (10 patients), gallop rhythm (in all 23 patients), a suggestive bulge on chest radiography (12 patients), and premature mitral valve closure on the echocardiogram (5 out of 7 patients).

It is now policy to carry out selective coronary arteriography as part of the preoperative investigation, and in the 13 patients in whom this information was available the anterior descending branch of the left coronary was diseased in all, but in addition the circumflex was involved in 6 patients and the right coronary artery in another 6 patients.

Close study of the severe haemodynamic derangement was made in 10 patients. This has confirmed the value of surgical treatment in selected cases and should be combined with aorto-coronary vein bypass grafting to adjacent territories when indicated.