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, 13 and 14 December 1973. The President JOHN GOODWIN, took the Chair at 9.00 a.m. during Private Business. At the Scientific Session the Chair was taken by WALLACE BRIGDEN.

Private Business

1 The President reported with deep regret the deaths of Maurice Campbell, a past-President of the Society and former Chief Editor of the *British Heart Journal*; of Peter Stock, and of three Corresponding Members – Paul White, Louis Katz, and Elliot Newman. The meeting stood in tribute.

2 The Minutes of the Annual General Meeting having been published in the *British Heart Journal* (1973, 35, 858-867) were taken as read and confirmed.

3 The Treasurer reported that not surprisingly costs continued to rise. The increase in subscriptions had itself been an expensive exercise: approximately one-third of the members needed reminders and some subscriptions were still outstanding. The Treasurer felt that to some extent this was due to internal organization, too many documents had to be sent out and they tended to be too long and were consequently not read; it was hoped to redraft and condense these; but the mistakes on the part of the Banks were very disturbing. The same thing applied to reservations for meals, which continued to take up too much time and cost a lot of money in letter-writing, phone calls, and checking, and it was hoped to simplify these forms too. But basically too many members were ignoring deadlines and advice, and co-operation here would reduce costs.

The Society's investments in the stock market had taken a hammering, but still stood appreciably above cost price in 1971; the market was continuing to fall. The investments which had done best were in the Unit Trusts – Charifund, Scotexempt Growth. The money needed shortly for VII World Congress grants was in short-dated Gilts. The suggestion that the Society's funds should be invested in fixed interest stock would be considered by the Finance Sub-Committee.

4 The Secretary reported that the Preliminary Notice about the Annual General Meeting in Newcastle on 18 April 1974 had been circulated; Dewar would chair the morning session and Jackson the afternoon session. An amendment to this notice was asked for – the Royal Station and Royal Turks Hotel were some *fifteen* minutes' walk from the meeting, not five.

5 The Secretary reported that the next Autumn Meeting would be in London at the Royal College of Physicians on 19 and 20 November – a Tuesday and Wednesday – 1974.

6 The Secretary reported that the invitation to hold the 1975 Annual General Meeting in Manchester had been accepted, and the date would be Thursday 17 April (not 18 as on the Agenda).

7 The Secretary reported that the suggested outline for the joint meeting with the Swedish Society in 1975 was to hold this in Stockholm; make it a 2-day scientific meeting with 3 days free for visiting hospitals, tours, etc. One morning programme would probably be for invited speakers, and the other sessions for short communications. English and Swedish papers would be mixed according to topic. Michael Oliver suggested that areas of Swedish cardiology where we in this country were not so far advanced should be covered at this meeting, and the Secretary replied that it was proposed to set up a joint Swedish/English selection committee to arrange the programme, and he would be most grateful for suggestions on topics and speakers. At present the travel agencies were unable to give any indication of prices in view of the general situation.

8 The President reported that there seemed no doubt that the VII World Congress in Buenos Aires in September 1974 would take place. The President of the Organizing Committee was very worried about the few registrations so far received from Europe, because of late arrival of documents, the uncertain political situation in South America, and the high cost. The Argentinians were very keen for a good representation from Great Britain; it was for them an event of national importance, and the British Cardiac Society should support the Congress in a positive way.

The Secretary reported that the date for registration at the basic rate had been extended from 31 August to 13 December. Abstracts of short communications must be sent through the British Cardiac Society who were asked to grade them into 3 categories, and the deadline for receiving these abstracts was 4 January 1974. Every abstract submitted would be forwarded to Buenos Aires and treated as 'accepted', but few would in fact be presented at the Congress. Forms and instructions for submitting abstracts had at last arrived and were available from the Executive Secretary.

The Secretary also reported that there was a certain amount of money to help support people going to the Congress, and Council proposed that support should first be given to members of the British Cardiac Society who had been invited to chair sessions or speak at the plenary sessions, as they would represent the Society;

in addition about twelve members could be supported at approximately £200 each. The approximate overall cost on the last estimates from agents was £400, and it was felt that this basis of support was more realistic than supporting more people with very small grants. Council had considered how to select the twelve members for grants and the following was proposed. All applications for grants must be received by 4 January, the same date as for abstracts. The abstracts would be graded by the Selection Committee into A, B, and C; and it was proposed to support one author from each paper graded A, and to use this abstract grading to select the twelve members.

9 The Secretary reported that the result of the referendum on the size of the Society was that about 100 members thought it was the right size now and about an equal number thought it should be bigger, though only 40 thought it should be unlimited; the suggestion that it should grow smaller brought only 8 votes. Under the Rules the Society could increase its ordinary members to 400. Council's interpretation of the referendum was that there should be no sudden large increase in membership, but that membership may be increased gradually to the 400; there was no mandate to become unlimited.

10 The President reported that the fourth meeting of the Liaison Committee of the British Cardiac Society and the Cardiology Committee of the Royal College of Physicians with the Department of Health and Social Security was due on 18 December. Items under discussion were – the mobility of consultants (where consultants might wish to move from area to area); career structure; distribution of senior registrar and registrar posts; and the possibility of the DHSS providing information on multicentre research projects. No decision had yet been reached on the form in which the Liaison Committee would make its reports.

To a question from Whitaker, the President replied that the 'mobility of consultants' was merely a suggestion that at certain stages in a career a consultant might wish to move from one post to another with a similar or different emphasis, and the DHSS might be able to help if a consultant himself desired to move and put forward a request.

There had been an increase in the number of consultant posts in cardiology from 53 in 1967 to 80 now; but the number of senior registrar posts had increased by only 3. The DHSS pointed out that there was fairly widespread ignorance of the exact number of consultants doing general medicine as well as cardiology, and the number of such posts that would be required. Steps were being taken to obtain the information.

The speciality now had a system of talking with representatives of the DHSS who had been exceedingly helpful, sensibly co-operative, and as interested as the cardiologists in discussing problems and illuminating areas of ignorance. Members were encouraged to bring suggestions and problems to the attention of the Liaison Committee for discussion.

11 The President reported that the Specialist Advisory Committee on Cardiovascular Disease to the Joint Committee for Higher Medical Training met on 12 December. The personnel had changed in June 1973 and the members were now – Walter Somerville, Ian Gray, Hamish Watson, Dennis Krikler, and A. J. Thomas, with himself as Chairman.

The question of the reallocation of registrar posts (not people) had been discussed, and the Department of Health and Social Security was looking into these proposals again. The Specialist Advisory Committee felt very strongly that registrar posts should not be removed from centres where comprehensive training was being given and allocated to other centres. The logical conclusion was the creation of more consultant posts, and this view would be represented to the J.C.H.M.T. The place of the general practitioner in hospitals was discussed with regard to cardiovascular disease. The S.A.C. felt that his role would probably be a limited one – perhaps to outpatient clinics. The S.A.C. had reported its view to the J.C.H.M.T. Requests were now being received by the Joint Committee for Higher Medical Training for recognition as training posts. The question of registrars as well as the training of cardiologists would have to be discussed, but provided the services of a centre were adequate for comprehensive training this counted rather than the grade of the trainee.

12 Towers reported that the Society of Cardiological Technicians was facing a crisis of confidence. They now had a career structure, better pay (though not yet sufficient), and they had lost their status as an examining and teaching body (with the recognition of the ONC and HNC). There was a lack of support by senior technicians, and they wondered whether the Society of Cardiological Technicians had any future at all. Council's view was that the Society of Cardiological Technicians would probably continue but would be much more of a scientific and social body rather than on the lines of the British Cardiac Society. It was hoped that a senior member of the Society of Cardiological Technicians would attend the next Council Meeting to express more clearly the views of that Society. Suggestions for points to be discussed were – that the Society in its present form had little to offer members; that it was unrealistic to expect technicians to pay a fee to belong to the Society and then to take an exam (now useless in their career) to obtain membership; that a society to cover the whole field might be preferable.

13 Working parties

The President asked the Chairman of the various Working Parties to give brief reports.

a) *Acute coronary care*

Lawson McDonald reported that meetings were held every six to eight weeks and it was hoped to present a report in May 1974.

b) *Rehabilitation*

Semple reported that rather more than half the work had been completed by the two subcommittees on (a)

exercise and (b) more general aspects, but he thought that a final report would not appear before autumn. Semple also mentioned that there had been some discussion at the meeting of the Cardiology Committee of the Royal College of Physicians on the form of these reports – either a short crisp document with recommendations, or a long postgraduate educational type of booklet. This would be discussed later by the Council of the Society and the Cardiology Committee of the College.

c) *Cardiac Muscle Research Group*

Peter Harris reported that the Group's first scientific meeting had been held on 12 December with an attendance of some 120. It was hoped to hold two meetings a year, one arranged in conjunction with the Autumn Meeting of the British Cardiac Society in London and another outside London in the summer or spring, the first of these being in Birmingham in 1974. Membership of the Group was open to anybody whether medically qualified or not, including members of the British Cardiac Society, of whom some 40 had expressed interest. He thought members of the Society needed to be more aware of this important aspect of modern cardiology and hoped very much that the evaluation which had been suggested would help in this direction.

In assessing the best ways of linking specialist groups to the main clinical British Cardiac Society to the benefit of both, the President reported that Council suggested that the affiliation of the Group with the British Cardiac Society should take the form of the following articles:

- (1) Availability of membership of the British Cardiac Society to scientific non-medical members of the specialist group.
- (2) Submission of papers by the group for British Cardiac Society meetings, and the nomination of someone with the necessary specialist knowledge to join the programme selection committee for the meeting in question.

d) *Suggested working party on primary prevention of cardiovascular disease*

Shaper reported that it had been suggested to set up a Working Party and the proposal had been put to the last meeting of the Cardiology Committee of the Royal College of Physicians who had agreed that a joint working party should be formed – arrangements were proceeding.

e) *Prevention of infective endocarditis*

Hugh Fleming reported that he had nothing to add at this stage. He was continuing to gather facts and hoped to be able to report shortly.

14 *Echocardiography symposium*

Hollman reported that this meeting held on 26 October at University College, London, had been very successful. It had been attended by nearly 200 members, technicians, and guests. It was in fact the first time the Society had ever held a symposium. After the meeting there was an exhibition of commercial equipment.

15 *Young research worker's prize*

The Secretary reported that the organization was now complete, advertisements had been sent out, and the rules were available for any young research worker who wished to submit an entry.

The first Committee consisted John Hamer, Derek Gibson, and himself, and they would co-opt other judges according to the topics of the papers submitted.

16 *British Heart Foundation – European Travelling Fellowship*

Shillingford reported that there was a good deal of ignorance of what was happening in Europe in cardiology; there were active centres in Paris, Bordeaux, Marseilles, Milan, Amsterdam, and Brussels. To enable young and active research workers to make a tour of important centres in Europe the British Heart Foundation offered two fellowships a year and the successful candidates would be able to spend 24 to 48 hours in each of a series of centres. The itinerary would be arranged in association with the countries' research departments. Applicants should be aged under 40 and the final selection would be made by interview. He would like to suggest that on return from their tours the successful applicants might report to the Society on their visits and the various aspects of research in the countries of the E.E.C.

17 *Any other business*

(a) *Annual General Meeting, Newcastle*

Hollman reminded members that abstracts for Newcastle should be submitted by 20 January 1974.

(b) *Guests at the Society's Dinner*

The Secretary reported that the convention had been for only the speaker, on each scientific paper, to be eligible to attend the dinner as a member's guest. Council had discussed this and agreed that any author whose name appeared on the scientific programme of a meeting of the British Cardiac Society could be invited by a member to attend the Society's Dinner at that meeting.

(c) *Failure of pacemakers*

Members were asked to save any electrodes from pacemakers that failed through a break in the wire or a disconnection, i.e. any failure of the wire between the pacemaker and the heart muscle, for examination by A.W.R.E. This was to ensure that atomic pacemakers did not fail before their 10 to 15 years expected life span because of a failure elsewhere in the wiring. The address was – A.W.R.E., Pacemaker Research Department, Didcot.

The Society dined together at the Zoological Gardens Restaurant with John Goodwin in the Chair. The guests included Professor and Mrs Cyril Clarke, Brigadier E. B. W. Cardiff, and D. A. Holmgren.

Scientific Communications

Terminology

Max Zoob

It is axiomatic that clear thinking produces clear modes of expression and that the use of inaccurate or ill-defined terms hampers clarity of thought. Current cardiological terminology contains many such expressions. Others are self-contradictory or perpetuate faulty methods or fallacious and outmoded theories; others again lead to false deductions and some are needlessly ugly. Bad terminology muddles teaching, perplexes the student, and may impede progress.

In this paper examples taken from common parlance, current textbooks, and recent journals are constructively or destructively criticized under the following headings:

- 1) *Terms perpetuating faulty methods*: Venous distension. Pulse deficit.
- 2) *Terms perpetuating fallacious or outmoded theories*: Decomensation. Unipolar leads.
- 3) *Inaccurate terms*: Pulsus paradoxus. Mitral incompetence etc. Rotating tourniquets. Cardioversion. Countershock. Congestive cardiomyopathy. Early and mid-diastolic murmurs. Arrhythmias and anti-arrhythmic drugs.
- 4) *Terms leading to false deductions when description alone is needed*: Mitral area. Tricuspid area etc. A₂, P₂. Regurgitant and ejection murmurs.
- 5) *Self-contradictory terms*: High-output failure. Bradytachycardia.
- 6) *Tautologous terms*: Irregularly irregular. Friction rub.
- 7) *Ugly classicisms*: Positive inotropic or chronotropic effect.
- 8) *Terms implying non-existent phenomena*: Hepatojugular reflux. Subvalvar mitral regurgitation.

It is hoped that this paper may lead to a critical re-examination of terms in current use and to a systematic review of cardiological nomenclature.

Electrocardiographic changes in A₂ England/42/72 influenza infection in patients treated at home

D. Verel, C. Ward, and D. F. Rickards (last two introduced)

In 43 patients treated for influenza by their general practitioner at home, A₂ England/42/72 infection was shown by serial blood studies during the 1972-73 epidemic. Changing electrocardiographic abnormalities attributable to influenza were found in 19 of 43 patients (44%). The changes observed by repeated electrocardiograms over several weeks included complete heart block, atrial fibrillation, nodal rhythm, sinus bradycardia, and a variety of changes in the QRS complex suggesting localized myocardial damage. The findings indicate that mild influenza treated at home may present with clinical features difficult to distinguish from myocardial infarct and can cause permanent electrocardiographic changes.

Electrocardiographic changes in subarachnoid haemorrhage: role of catecholamines and effects of beta-blockade

J. M. Cruickshank and G. Neil Dwyer (both introduced by A. M. Johnson)

Mechanisms underlying electrocardiographic changes in subarachnoid haemorrhage are ill understood. Increased sympathetic drive has been suggested as an important factor but direct evidence has been scanty.

In the present study, 40 cases of subarachnoid haemorrhage (16 men, mean age 41; and 24 women, mean age 42) had repeated electrocardiograms and 24-hour urinary metanephrine and normetanephrine estimations over a period of two weeks. Electrocardiograms remaining normal throughout were associated with normal catecholamine levels over the period of observation. In contrast, patients whose electrocardiograms were abnormal over the two-week period showed very high catecholamine levels.

Electrocardiographic components showing a strong correlation with high catecholamine levels were peaked P waves, short PR interval, and peaked T waves. Weaker correlations occurred with T wave inversion, prolonged QTc, tall U waves, and pathological Q waves. The prognostic significance of these changes was discussed.

In five selected cases, orally administered propranolol 80 mg was observed to modify all of these changes except for the pathological Q wave. The findings are reported in detail and discussed.

Comparison of two- and nine-day mobilization in patients admitted to hospital with myocardial infarction

M. J. Hayes, G. K. Morris (both introduced), and J. R. Hampton

A total of 189 patients with uncomplicated myocardial infarction was randomly selected for early or late mobilization and discharge from hospital. Patients were admitted to the study after 48 hours in a coronary care unit provided that they were free of pain and showed no evidence of heart failure or significant dysrhythmias. Random selection was achieved by monthly crossover of the three medical wards to which the patients were transferred. One group of patients was mobilized immediately and discharged after a total of nine days in hospital, and the second group was mobilized on the ninth day and discharged on the sixteenth. The two groups were comparable in terms of age, sex, site of infarct, incidence of previous infarction, the highest SGOT levels, and systolic and diastolic blood pressure on admission to the trial.

No differences occurred between the two groups in the incidence of deep vein thrombosis detected clinically or by the ¹²⁵I fibrinogen scanning, clinical pulmonary embolism, episodes of chest pain, reinfarction, left ventricular failure, or dysrhythmia. Assessment at six weeks after infarction showed a readmission rate of

5.3 per cent in the early mobilization group and 5.3 per cent in the late mobilization group. The overall mortality was 6.5 and 7.3 per cent in each group, respectively. There was no significant difference between the two groups in terms of mobility at the end of six weeks.

Echocardiographic features of hypertrophic obstructive cardiomyopathy

C. S. de la Calzada, G. Ziady, V. Georgios, and T. Hardarson (all introduced by J. F. Goodwin)

Echocardiographic characteristics of 50 patients with proven diagnosis of hypertrophic obstructive cardiomyopathy were analysed. The main echocardiographic abnormalities found in this series were as follows. a) An abnormally slow diastolic slope of the anterior leaflet of the mitral valve was found in 47 patients (94%); b) an abnormal forward movement of the anterior leaflet of the mitral valve towards the interventricular septum during systole in 44 (88%); and c) the presence of prominent interventricular septal echoes in 46 patients (92%).

No correlation was found between the diastolic slope and the end-diastolic pressure of the left ventricle, or the gradient across the outflow tract of the left ventricle. When the septal echoes were not abnormally prominent, there was no demonstrable outflow tract gradient at rest. When the mitral echogram showed a forward movement of the anterior leaflet of the mitral valve towards the septum during systole, an outflow tract gradient at rest could always be demonstrated.

The minor diameters of the left ventricle in end-systole and end-diastole were also measured by reflected ultrasound in 19 patients. It showed that end-systolic diameter was $3.4 \text{ cm} \pm 0.8$ and the end-diastolic diameter was $4.2 \text{ cm} \pm 0.6$ (SEM). These values were significantly smaller than in 12 normal subjects ($P < 0.01$), (normal end-systolic diameter, 3.8 ± 0.8 ; normal end-diastolic diameter, 4.8 ± 0.4).

In conclusion, echocardiography is a sensitive method for the diagnosis of hypertrophic obstructive cardiomyopathy and in many cases for judging the severity of the haemodynamic derangement such as the presence or absence of outflow tract gradient. Therefore, it can be used with confidence in the screening and follow-up of the patients with this disease.

A new development in ultrasound, using a multi-transducer technique

R. B. Priddy, E. Knight, and N. Bom (last two introduced)

A total of 250 patients with a variety of cardiac conditions whose diagnoses were confirmed by catheterization and angiography or surgery were studied with a new ultrasound machine which has an 8 cm long transducer consisting of 20 elements which are fired sequentially. The resultant echogram gives a two-dimensional dynamic section through the heart.

A cine film has been made of normal and pathological hearts. The ventricular walls, the interventricular septum,

the aortic root and valves, and the mitral valve cusps and their chordae tendineae, can be identified readily in the beating heart without catheterization or injection of radio-opaque fluids. Measurements of end-systolic and end-diastolic volumes both from the angiogram and from the ultrasound showed a satisfactory correlation in 39 patients.

The abnormal motion of diseased valves, both mitral and aortic, can be seen dramatically.

In congenital heart disease the method probably has most to offer. Overriding of the aorta can be seen in Fallot's tetralogy and enlargement of the right heart in right ventricular volume overload situations. Several newborns with transposition have been examined.

It is possible that the use of this technique may make cardiac catheterization avoidable in some cases.

Echocardiography in the evaluation of the newborn infant with cyanotic congenital heart disease

Michael J. Godman and B. S. Langford Kidd (introduced)

Ultrasound recordings have been made in 45 sick newborn infants with cyanotic congenital heart disease and in 50 newborn infants without heart disease. The amplitude of motion of the anterior leaflet of the mitral and the tricuspid valve, the anteroposterior diameter of the right ventricle, left ventricle and left atrium and the anteroposterior diameter and location of the great arteries were determined. The findings in the cyanotic infants were correlated with angiographic appearances or necropsy results. Twelve cases of hypoplastic left heart syndrome were identified by small left ventricular dimensions (0–11 mm), hypoplastic or atretic mitral valve, and a hypoplastic aortic root (0–7 mm). Pulmonary atresia with intact ventricular septum (5 cases) was identified by a small right ventricular dimension (0–6 mm) and a hypoplastic tricuspid valve; and tricuspid atresia by a small right ventricular dimension and absent tricuspid valve echo (2 cases). Discontinuity of the ventricular septum with the anterior wall of the aorta identified overriding of the ventricular septum in 7 cases of tetralogy of Fallot and 1 case of truncus arteriosus. The abnormal spatial relation of the great arteries was established in 6 cases of D-transposition.

Echocardiography can be a rapid and accurate method in the diagnosis of congenital heart disease in the newborn and adds considerably to the evaluation before cardiac catheterization.

Reciprocal tachycardia using a left-sided bypass (type A) in patients with type B Wolff-Parkinson-White

R. A. J. Spurrell (introduced), D. M. Krikler, and E. Sowton

Two patients with classical type B Wolff-Parkinson-White syndrome have been studied using intracardiac recording techniques and programmed electrical stimulation of the heart.

In Case 1, right atrial premature beats showed a type B Wolff-Parkinson-White electrocardiographic pattern. At an atrial premature beat interval of 350 msec this appearance changed to a type A Wolff-Parkinson-White pattern, and at an atrial premature beat interval of 230 msec supraventricular tachycardia was initiated. During tachycardia retrograde left atrial activation occurred before right atrial activation, suggesting that the bypass functioning retrogradely during tachycardia was on the left side of the heart as seen in type A Wolff-Parkinson-White.

Case 2 also had the surface electrocardiographic appearances of type B Wolff-Parkinson-White, but during reciprocal tachycardia this patient also showed retrograde left atrial activation occurring before right atrial activation, again suggesting a left-sided bypass.

Both these patients have a right-sided atrioventricular bypass which is used antegradely during sinus rhythm. During tachycardia this bypass is not used but a left-sided bypass functions.

This study emphasizes the importance of an adequate electrophysiological study in patients with the WPW syndrome who are being considered for operation for their dysrhythmia. If the surface electrocardiographic appearances are relied upon the wrong bypass tract may be cut at operation.

Anomalous atrioventricular conduction associated with complete block of the nodal-His pathway: an electrocardiographic study

Philippe Coumel (introduced), Dennis Krikler, Robert Slama, and Yves Bouvrain (last two introduced)

We report 4 cases of complete and permanent atrioventricular block combined with the Wolff-Parkinson-White syndrome. The block was congenital in 2 cases, surgical in 1, and degenerative in the fourth; its level was demonstrated by His bundle electrography. In 2 cases pre-excitation involved a Kent bundle (left in 1, right in the other), and in 1 James plus left Mahaim fibres; in the fourth case, right ventricular pre-excitation could have been caused by either situation. Anomalous conduction was permanent in two cases and intermittent in the others. In all 4 cases conduction in the anomalous pathways behaved according to the all-or-none law, with Mobitz-II second-degree block or supernormal conduction, both anterogradely and retrogradely: this could be found spontaneously, after depressive drugs like ajmaline, or after isoprenaline. Retrograde conduction was always more consistent than anterograde, possibly explaining some cases of unidirectional AV block or apparently pure intranodal reciprocating rhythm.

In a fifth case pure anomalous conduction was seen on one occasion during sinus rhythm, representing transient failure of conduction down the nodal-His axis. Structural or functional factors affecting the anomalous or normal pathways may influence the expression of the Wolff-Parkinson-White syndrome.

Prognosis of idioventricular rhythm after cardiac infarction

Malcolm Clarke (introduced) and John Hamer

A slow idioventricular escape rhythm was detected in 121 out of 1000 consecutive patients monitored in a coronary care unit. In all but 2 patients the dysrhythmia was associated with acute inferior or posterior cardiac infarction.

Despite the reported good prognosis, 68 of these patients developed serious ventricular dysrhythmias. Where ventricular tachycardia occurred, it was frequently of the same focus of origin as the idioventricular rhythm.

The reported benign nature of this dysrhythmia is not confirmed by our experience, and treatment with atropine and antiarrhythmic drugs simultaneously is recommended. Since starting this therapeutic regimen, the incidence of ventricular tachydysrhythmias has fallen dramatically.

Autonomic neuropathy and the heart in diabetes

R. Lloyd-Mostyn, P. J. Watkins (both introduced), and S. Oram

Cardiac innervation in 12 diabetics with autonomic neuropathy has been studied by observing responses of heart rate and blood pressure to sympathetic stimulation (mental arithmetic, posture and Valsalva manoeuvre) and blockade (propranolol); parasympathetic stimulation (carotid sinus pressure, phenylephrine, and Valsalva) and blockade (atropine); and noting the effect of lobeline on chemoreceptor afferents.

The investigation has shown that the heart may be completely denervated, or suffer selective denervation involving the vagus alone. Afferent pathways responsible for cardiovascular reflexes are rarely affected and Sharpey-Shafer's conclusion that this is normally the cause of the abnormal Valsalva response is not confirmed.

The completely denervated heart is unresponsive to all the above stimuli and has a fixed rate. Cardiac output cannot be increased by an increase of heart rate in these patients who are liable to syncope when venous return falls during standing (postural hypotension). Cardiac arrests from obscure causes have been recorded in two patients, and great caution is required when prescribing drugs or giving anaesthetics which may affect cardiac function.

Autonomic responses in chronic complete heart block

D. H. Dighton (introduced by A. Leatham and H. Siddons)

Twenty patients with idiopathic chronic complete heart block were investigated using recently developed tests of pacemaker function.

The mean resting ventricular rate was 40 a minute and the mean atrial rate was 79 a minute. Eleven patients had a narrow QRS complex and 9 had bundle-branch block. Twelve of the patients had sudden syncopal attacks, and three had syncope of gradual onset. Five patients were asymptomatic.

Ventricular responses to a standard intravenous bolus dose of isoprenaline ($5 \mu\text{g}/70 \text{ kg B.W.}$) were reduced in 14 of the 20 cases including all 9 patients with bundle-branch block. In the remaining 6 cases the ventricular responses were within normal limits. These patients all had narrow QRS complexes and may have congenital complete heart block.

Atrial responses were reduced in 12 patients, 10 of whom also had reduced ventricular responses, indicating that in disease of the conducting tissue presenting as complete heart block the atrium is frequently affected.

Of the 14 patients with reduced ventricular responses, 11 had frequent attacks of sudden syncope. It seems that patients with reduced ventricular responses are especially liable to sudden syncope and may therefore always require pacing. It is possible that some with normal atrial and ventricular responses may not require pacing.

Doppler blood velocity studies in aortic stenosis

Dan Tunstall Pedoe (introduced by N. A. J. Hamer)

The jet of blood through a stenosed aortic valve generates large vortices in the flow which are convected downstream. A technique of demonstrating these vortices in the subclavian arteries has been developed using Doppler ultrasound. The Doppler signal is displayed in the form of a sound spectrograph, a method of displaying the uniformity or non-uniformity of the blood velocity within the beam of ultrasound.

In normal subjects the blood velocity across the vessel appeared uniform, changing its velocity *en masse*, throughout the cardiac cycle. In 7 patients with tight aortic stenosis the spectrographic analysis showed intermittent increases in the bandwidth of the Doppler signal, indicating non-uniformity of the blood velocity across the diameter of the vessel and strongly suggesting the passage of turbulent vortices in the flow. These findings are discussed in relation to the physical signs in aortic stenosis and the possible development of this method as a non-invasive diagnostic technique.

Aortic blood velocity and flow measured by transcutaneous aortovelography

R. F. Sequeira, B. R. M. Crook, L. H. Light (all introduced), and *E. B. Raftery*

The haemotachograph is an ultrasonic Doppler-shift instrument designed to measure velocity in the transverse aorta from a transducer in the suprasternal notch. In individual patients, mean velocity should be proportional to the cardiac output. The accuracy of this instrument was tested in 20 patients at cardiac catheter-

ization under resting conditions and during atrial pacing up to 160 a minute. Cardiac outputs were measured by dye-dilution and compared with calculated values obtained from the mean aortic velocity and the diameter of the transverse aorta measured from aortograms. No significant correlation was observed, but when the mean aortic velocity was compared with cardiac output, a good correlation was found (coefficient of variation = 13%). In 7 patients a catheter-tipped electromagnetic flow probe was positioned in the transverse aorta, and simultaneous measurements of peak velocity and acceleration were compared. Very good proportionality was found between the two methods (coefficient of variation = 6%). We conclude that transcutaneous aortovelography is an accurate non-invasive technique for measuring some indices of left ventricular function and can be used to follow percentage changes in cardiac output. Absolute determinations of cardiac output will demand more accurate methods of measuring the cross-sectional area of the aorta.

Stress-strain characteristics of left ventricular myocardium in man

D. G. Gibson and D. J. Brown (introduced)

Continuous measurements of left ventricular pressure were made by micromanometer and of dimension and posterior wall thickness by echocardiography in 30 patients with cardiomyopathy or valvular heart disease. From these, the stress-strain relation of a region of myocardium in the posterior wall was derived throughout diastole. This was complex, showing an early diastolic period of rapid change corresponding with the end of ventricular contraction, a middle period when wall stiffness was very low, and a late period when wall stiffness was finite and relatively constant. Stress-strain characteristics in this last period were related to cardiographic evidence of left ventricular hypertrophy: in its absence the average value of elastic modulus was 200 g cm^{-2} , while in its presence, it was 1400 g cm^{-2} . The stress-strain characteristics of left ventricular myocardium could be related to the pattern of filling throughout diastole.

Catheter for simultaneous measurement of aortic flow and left ventricular pressure

A. Rickards (introduced) and *R. Balcon*

A standard 8F USC1 cardiac catheter has been modified to accept an electromagnetic flow sensitive transducer and a catheter tip pressure manometer allowing simultaneous measurement of left ventricular pressure and aortic blood flow velocity during cardiac catheterization. A distal extension on the catheter allows manipulation and improves stability of the flow sensor in the ascending aorta.

This catheter has been used to date in 16 patients at routine cardiac catheterization with simultaneous measurement of right ventricular pressure with a second catheter tip manometer in 12. Data will be presented showing the effect of pacing on aortic flow (directly related to cardiac output) left and right ventricular pressures and rates of change of these pressures. The relation between the measured variables and their significance was discussed. It was also shown that some of the left ventricular events that occur during cardiac ischaemia induced by pacing are mirrored in the right ventricle.

Assessment of left ventricular performance in infants, children, and adults using single plane cine-angiocardiology

Michael Tynan, H. H. Kaye, D. S. Reid, F. Ozme, and A. S. Hunter (last four introduced)

A validation study was performed by comparing the actual volume with volumes calculated from cine x-rays of 34 postmortem casts of human left ventricles from 1.6 ml to 135 ml ($r=0.967$).

Sixty patients (age range 1 day to 64 years) were studied using right anterior oblique cine-angiocardiology. Left ventricular end-diastolic, end-systolic volume, ejection fraction, and mean rate of circumferential shortening were calculated in all patients.

Fourteen patients had no left heart disease; 8 had a clinical diagnosis of endocardial fibroelastosis. These two groups were used to test the separation given by the above measurements between normal and abnormal left ventricular performance. Left ventricular end-diastolic volume gave statistical separation ($P<0.02$) but with a large overlap between the groups. Ejection fraction gave statistical separation ($P<0.001$) with some overlap, mean rate of circumferential shortening gave statistical separation ($P<0.001$) without overlap. Of 23 patients with left ventricular volume overload, 9 with pressure overload, and 6 with ischaemic heart disease, 4 had both depressed ejection fraction and mean rate of circumferential shortening, and 8 others had normal ejection fraction with depressed mean rate of circumferential shortening. Thus while the ejection fraction gives a good indication of left ventricular performance, these data suggest that the mean rate of circumferential shortening may be a more sensitive index. Moreover both indices can be obtained from the examination of two frames of the single plane cine-angiogram and are therefore easily obtained in patients of all ages.

Coronary angiography using Judkins method

Jane Garrett, E. Knight, E. M. Fawzy (all introduced), Ronald B. Pridie, E. B. Raftery, and M. K. Towers

The records of 306 patients who had coronary angiography performed at Harefield Hospital between May

1970 and March 1973 have been reviewed. All but 18 were done using the Judkins technique. Five patients died after the investigation; 2 had been submitted to immediate operation under aortopulmonary bypass, and the other 3 succumbed after intervals of 3, 36, and 72 hours. All 3 had grossly dilated and poorly contracting ventricles. Only 2 patients required femoral thrombectomy: both suffered a severe drop in blood pressure at the time of catheterization.

Failure to enter both coronary arteries diminished greatly as the operators became more experienced. Latterly new operators had as low a complication rate as more experienced catheter operators, as all learners served a severe apprenticeship, first assisting and then being assisted by an experienced investigator during up to 30 examinations.

Of the 350 coronary angiographs, 309 were performed without any complication (even trivial or transitory) – a complication rate of 18 per cent, and successful catheterization of both coronary arteries was achieved in 82 per cent. The complication rate fell to 6 per cent and the success rate rose to 88 per cent for the last 100 Harefield Hospital patients.

Problems with total correction after aorta to right pulmonary artery anastomosis

Jane Somerville, Rosa Barbosa (introduced), Donald Ross, and Eckhardt Olsen

Thirty-six patients with pulmonary atresia and Fallot's tetralogy had total correction 1 to 8 years after a successful aorta to right pulmonary artery shunt. Death occurred in 12 patients, yet 7 of these had good correction without surgical complications. This unexpectedly high mortality prompted us to see if the shunt had contributed to it.

In the 7 patients immediately after correction, there was persistent pulmonary hypertension. The left pulmonary artery and sometimes the proximal right were small. Further attempts to reconstruct and remove localized strictures failed to relieve the high pressure. Pulmonary arteriolar disease was not found at necropsy and the vessels in the left lung were thin walled.

Ages of patients at the time of the shunt, sizes, durations, clinical and anatomical effects were compared in the group of patients who did well after total correction and those who died unexpectedly with central pulmonary hypertension. Patients with Fallot's tetralogy who were under 3 years at the time of shunt and those with pulmonary atresia were at risk for unsuccessful correction if the shunt only perfused the right lung and was left over 3 to 4 years.

This shunt is still considered to be useful in severe cyanotic heart disease and has many advantages. To prevent serious problems after correction, early investigation is recommended however satisfactory the clinical state, in order to determine the size and distortion of pulmonary artery anatomy and plan the timing of future operations.

Primary repair of ventricular septal defect in infancy

M. de Leval, J. F. N. Taylor (both introduced), and J. Stark

Banding of the pulmonary artery has been used as the operation of choice in the treatment of infants with ventricular septal defects and intractable heart failure. The mortality rate of this operation was about 10 per cent and subsequent total correction carried an additional morbidity and mortality. Further experience and good results in open heart surgery in the first year of life in other diagnostic groups encouraged us to perform closure of ventricular septal defects in patients in severe heart failure during the first months of life. Since May 1971, 18 infants were operated on. Their ages ranged between 3 to 9 months (mean 5.3 months) and weight between 3.0 to 7.4 kg (mean 4.8 kg). All were in severe heart failure, and not responding to full medical treatment. In 5, heart failure persisted despite pulmonary artery banding. Operation was performed using cardiopulmonary bypass with moderate hypothermia in 13 patients and under circulatory arrest in deep hypothermia in 5. All survived and are well. In one infant the ventricular septal defect reopened and was successfully closed 9 weeks after the first operation. Primary closure of a ventricular septal defect is recommended as the treatment of choice for infants in intractable heart failure.

Is there a diuretic agent reflexly regulated by atrial receptors?

C. T. Kappagoda, E. M. Whitaker, H. M. Snow (all introduced), and R. J. Linden

Stimulation of left atrial receptors in the anaesthetized dog results in a diuresis, and it is widely believed that this response is caused by a reflex inhibition of the secretion of antidiuretic hormone (e.g. Gauer, Henry, and Behn, 1970). In the present investigation, the effects of stimulating left atrial receptors in the dog by distending balloons in the left atrium and at the pulmonary vein-atrial junctions on both urine flow and the antidiuretic activity of plasma were determined. The antidiuretic activity of plasma was measured by comparing the effects of intravenous injections of dog plasma and known doses of vasopressin on the urine flow in water loaded rats anaesthetized with ethanol.

The left atrial receptors were stimulated 12 times in 10 dogs and a diuresis was observed in each instance (mean 86.7%; range 4-283). There was no correlation between the diuresis and the antidiuretic activity of the plasma.

In 3 other dogs, 6 tests were performed after ablation of the pituitary gland and a diuresis was obtained in each instance.

It is concluded that stimulation of atrial receptors causes a diuresis which is mediated by a blood-borne

agent which is not antidiuretic hormone, and it is suggested that a diuretic agent is responsible.

Reference

Gauer, O. H., Henry, J. P., and Behn, C. (1970). The regulation of extracellular fluid volume. *Annual Review of Physiology*, 32, 547.

Influence of formulation on absorption and clinical effect of digoxin

T. R. D. Shaw, M. R. Howard (both introduced), and John Hamer

Digoxin tablets in use in the United Kingdom vary widely in their dissolution rate. Seven types of tablet, representing a range of dissolution rates, were used by 38 patients. The dosage of digoxin remained constant but pronounced differences were found in the mean plasma digoxin levels and clinical response achieved with these brands. Some patients were particularly sensitive to differences in the brand of tablet used and showed up to fourfold increases in digoxin level. The *in vitro* dissolution rate of the tablets correlated well with steady state digoxin level and should be a valid way of ensuring uniformity of potency.

Administration of digoxin powders indicated that digoxin particle size is a major factor in digoxin absorption and is the main cause of variation between the brands.

The absorption and clinical response to very rapidly dissolving digoxin tablets have been assessed in normal volunteers and patients. The incidence of nausea and vomiting is higher with these preparations, but the mechanism is obscure.

Systemic arterial pressure after homograft aortic valvar replacement

Clive Layton, James Monro (both introduced), Wallace Brigden, Alastair McDonald, Lawson McDonald, and John Weaver

For this study 116 patients have been followed for 6 months to 5½ years after successful aortic valvar replacement with an irradiated homograft; 39 patients (33.6%) have subsequently developed systemic hypertension with a diastolic pressure greater than 95 mmHg. In 3.4 per cent hypertension was first noted in the immediate postoperative period and the prevalence then rose to 52.6 per cent at 5 years. The incidence of hypertension in men (38.9%) was greater than in women (15.4%; $P < 0.05$), and patients with preoperative aortic regurgitation developed hypertension more frequently (50.0%) than those with aortic stenosis or mixed lesions with dominant stenosis (26.8%; $P < 0.05$).

Hypertension was found to be a major determinant of late failure of the irradiated homograft in our patients. Significant regurgitation has occurred in 13.8 per cent of the patients and necessitated reoperation in 4.3 per cent. In hypertensive patients before starting treatment the incidence of homograft failure was 40.0 per cent as compared to 7.8 per cent in the normotensive group ($P < 0.02$), and in hypertensive patients receiving hypotensive therapy it was 11.1 per cent which did not significantly differ from the normotensive group.

Possible mechanisms of the development of hypertension in these patients were discussed.

Saphenous vein grafting of coronary arteries in patients with heart failure

A. D. Goldberg (introduced), M. Yacoub, R. Wray (introduced), E. B. Rafferty, M. Towers, W. Somerville, and R. Pridie

In a series of 200 patients with ischaemic heart disease treated by saphenous vein grafting, heart failure was the indication in 20 and angina with heart failure in 20. Six patients received 3 grafts, 30 received 2 grafts, and 4 received a single graft. The left ventricular ejection fraction was less than 40 per cent in all but one. The mean follow-up period is 13.4 months (range 4–27). In the heart failure group there was one operative death and 7 late deaths (mortality 40%). Mean survival time is 11.0 months (4–23). Symptomatic improvement has occurred in 45 per cent and work resumed by 25 per cent. Diuretic therapy has been discontinued in 20 per cent. In the angina with failure group only 2 late deaths have occurred (mortality 10%). Mean survival time is 13.3 months (5–24). Symptomatic improvement has occurred in 85 per cent, and 70 per cent have resumed active work. Diuretic therapy has been discontinued in 70 per cent. There was no significant change in the cardiothoracic ratios on chest radiography. We conclude that myocardial revascularization in patients presenting with angina and heart failure can be achieved with low long-term mortality and significant symptomatic improvement. In contrast patients presenting with heart failure alone have a high late mortality and little symptomatic improvement.

Stented tissue heart valve replacement

Marian I. Ionescu, Brojesh C. Pakrashi, David A. S. Mary (last two introduced), and Geoffrey H. Wooler

Between April 1969 and March 1973, 213 patients had heart valve replacement with stented autologous or homologous fascia lata or with heterologous pericardial grafts. There were 111 single aortic, 95 single mitral, and 7 tricuspid replacements.

The incidence at each hospital and late mortality for the entire series was 10 per cent and the main causes were myocardial failure and infective endocarditis.

The majority of patients obtained significant symptomatic improvement. In the aortic group there was a statistically significant reduction in cardiothoracic ratio and in the voltage of the electrocardiogram.

Regurgitant murmurs developed in 11.6 per cent of aortic and 51.6 per cent of mitral patients (37.5% of mitral murmurs have not increased in intensity). None of these mitral patients requires reoperation.

Graft failure has not occurred in the aortic and tricuspid groups. Six mitral fascial grafts have failed and were removed. All showed similar degrees of pathological changes (thickening and retraction of one of the cusps). There were 7 thromboembolic incidents (5 transient). Anticoagulants were not used.

The results of haemodynamic studies and hydrodynamic experiments are discussed. An explanation for graft dysfunction in the mitral position is presented.

The long-term survival rate (up to 54 months) of 190 patients is shown in an actuarial analysis.

Influence of acidosis on ATP hydrolysis by contractile proteins of cardiac muscle

G. J. Williams, M. R. Stephens (both introduced), and J. R. Muir

It has been suggested that competition between hydrogen and calcium ions for binding sites on the regulatory protein troponin, as a result of intracellular lactic acidosis in myocardial ischaemia, may account in part for the depression of contractile state.

In this study the ability of cardiac myosin, actomyosin, and myofibrils to hydrolyse ATP has been measured at different hydrogen and calcium ion concentrations. The K_m ATP for cardiac myofibrillar ATPase activity was also measured at different hydrogen ion concentrations. In the absence of calcium, myofibrillar, myosin, and actomyosin ATPase activities are maximal at pH 8.0. At any given calcium ion concentration the myofibrillar ATPase activity is depressed by lowering the pH. The K_m ATP was 1×10^{-6} M and was not influenced by pH, indicating that the inhibition of the myofibrillar ATPase was not competitive in nature.

These results indicate that a fall in pH reduces cardiac myofibrillar ATPase activity. This action is not explained by a simple competition between hydrogen and calcium ions for binding sites of troponin.

Fibrosis and the myocardium – study of their normal development and relation

Peter Caspari, Keith Gibson (both introduced), and Peter Harris

The normal development and the distribution of the fibrous matrix of the rabbit heart was examined and its relation to the developing ventricles was studied. Collagen content and distribution were estimated biochemically in

the fetus, and at 1 day, 1 week, 1 month, and 6 months after birth. Total heart and ventricular weights were measured at these stages.

In the fetus, collagen was present in small equal amounts in both ventricles.

One week after birth the collagen concentration had doubled but remained equal in both ventricles.

From this stage to maturity there was a progressive increase in collagen concentration in the right ventricle, but left ventricular concentration remained unchanged. Thus, at 6 months right ventricle collagen concentration was double that in the left.

Our results also show that throughout development the total collagen content in each ventricle increases progressively and that a constant ratio between the ventricles is maintained.

Therefore the fibrous tissue matrix develops independently of the changes in ventricular muscle. The ventricular concentrations become different during development because the left ventricle hypertrophies much more than the right and thus fibrous tissue becomes less concentrated.

Influence of hypertonic mannitol on regional myocardial blood flow during and in the absence of acute myocardial ischaemia in the conscious intact dog

Ian Hutton, G. H. Templeton, D. E. Fixler, and J. T. Willerson (all introduced by T. D. V. Lawrie)

In this study the influence of mannitol (25%) on regional myocardial blood flow and on haemodynamics has been determined in 10 conscious intact dogs without myocardial ischaemia and in 6 conscious intact dogs with acute myocardial ischaemia produced by proximal reversible left anterior descending occlusion. Regional myocardial blood flow was measured with radioactive microspheres. In the normal dogs mannitol resulted in increases in maximal rate of left ventricular pressure change of 23 per cent ($P < 0.005$); mean blood pressure increased with mannitol from 101 ± 5 to 116 ± 8 mmHg ($P < 0.001$). Mannitol increased blood flow to the right ventricle by 77 ± 14 per cent, to the left ventricle by 81 ± 13 per cent, and to the ventricular septum by 82 ± 16 per cent. In dogs with acute myocardial ischaemia maximal rate of left ventricular pressure change increased 16 per cent ($P < 0.025$). Mannitol increased flow to the ventricular septum 32 ± 10 per cent ($P < 0.05$), to non-ischaemic portion of the left ventricle 30 ± 9 per cent ($P < 0.02$), and to the total left ventricle by 23 ± 9 per cent ($P < 0.05$). Collateral coronary blood flow in the ischaemic area increased with mannitol 15 ± 9 per cent, but this change was not significant. These data suggest that mannitol increases regional myocardial blood flow and improves ventricular function both in conscious normal dogs and in conscious dogs with acute myocardial ischaemia.

Significance of left ventricular dyskinesia at rest in patients with ischaemic heart disease

H. N. Khattri, B. Sharma, M. Raphael (all introduced), R. E. Steiner, and J. F. Goodwin

Regional left ventricular dyskinesia is regarded as objective evidence of myocardial ischaemia in patients with ischaemic heart disease. To assess the significance of dyskinesia, left ventricular cineangiograms were studied in 125 patients with ischaemic heart disease who underwent coronary arteriography. Forty-nine patients had evidence of dyskinesia. Distribution of dyskinesia was apical (32), inferior (8), anterior (2), apical and inferior (5), anterior and inferior (1), and anterior and apical (1). Thirty-four patients had a history and/or electrocardiographic evidence of myocardial infarction. Eleven patients had no history of myocardial infarction and their electrocardiograms were normal. Their coronary angiograms were analysed according to the scoring technique of Friesinger *et al.* (1970). All 49 patients were found to have significant lesions of one or more coronary arteries.

Apical dyskinesia was not associated with any particular electrocardiographic pattern, but nearly all the patients with apical dyskinesia had significant lesions of the left anterior descending artery. Inferior wall dyskinesia correlated well with the electrocardiographic evidence of inferior infarction and significant lesions of the right coronary artery.

The further significance and correlations of electrocardiographic findings with coronary artery lesions and the presence of dyskinetic areas were discussed in detail.

Reference

Friesinger, C. G., Page, E. E., and Ross, S. R. (1970). *Transactions of the Association of American Physicians*, 83, 78.

Localization of left ventricular regional ischaemia during exercise in angina pectoris

B. Sharma (introduced) and S. H. Taylor

Equating the lesions demonstrated by coronary arteriography to the region of ischaemic myocardium from which symptoms arise remains a major problem in coronary artery surgery for angina pectoris.

Imbalance in coronary blood supply and myocardial oxygen requirements results in a reduction in contractile function, which can be expected to be reflected in retarded contraction of the region of the ventricle to which the arterial supply is defective. Such areas of dyskinesia may be seen by observing the sequence of contraction during left ventricular angiography. In patients with exercise-induced angina, myocardial ischaemia only develops during exercise; thus dyskinetic areas associated with exercise pain must be sought during exercise.

Left ventricular biplane cineangiography was, therefore, performed at rest and during exercise in 8 men in whom angina pectoris was only precipitated during exertion. A close correlation was established between the

site of coronary artery obstruction and the related area of left ventricular dyskinesia. This correlation allowed the separation of 'benign' obstructions of the major coronary arteries from those obstructions associated with ventricular dysfunction. This method of localization of regional left ventricular ischaemia furnishes an important adjunct to coronary arteriography when coronary surgery is contemplated in patients with exercise-induced angina pectoris.

Effects of reperfusion after coronary occlusion

W. R. Ginks, H. D. Sybera, B. E. Sobell, and J. Ross, Jr. (all introduced by A. Leatham)

The question of whether or not the size of a myocardial infarct, measured one week after coronary occlusion, can be diminished by coronary artery reperfusion, was examined in dogs. In 10 control experiments the anterior descending coronary artery was permanently ligated while in 21 other studies the occlusion was released after three hours. The size of the acute infarct was estimated by (1) epicardial electrocardiography, and (2) documentation of the area of hypoperfusion using calibrated photographs. One week later, at necropsy, a measure of anatomical infarct size was made. In control dogs, the gross infarct size at one week averaged 64 ± 7 per cent of that estimated from the acutely injured area. Of the reperfused animals, 8 (38%) had haemorrhagic infarction when infarct size was 52 ± 6 per cent of that initially predicted, while 13 dogs (62%) had considerable limitation in infarct size which measured 10 ± 3 per cent of that estimated acutely. Transmural specimens of myocardium were obtained at necropsy for measurement of myocardial creatine phosphokinase (CPK) activity from sites initially used for epicardial electrocardiography. In control dogs, ST segment elevation predicted myocardial CPK (IU/mg protein): $\log \text{CPK} = 0.075 \text{ ST} + 1.18$ ($r = -0.73$; $n = 77$ sites) while in those dogs with limited infarction there was striking preservation of CPK activity: $\log \text{CPK} = -0.166 \text{ ST} + 1.36$ ($r = 0.69$; $n = 46$ sites). Thus reperfusion can result in pronounced tissue salvage after coronary occlusion but may frequently be complicated by myocardial haemorrhage.

Left ventricular function after aortic valve replacement

Ricardo Seabra-Gomes, Richard Sutton (both introduced), and John Parker

Left ventricular performance after operation was investigated in 15 patients undergoing routine aortic valve replacement. Cardiac output (dye dilution), left and right atrial and arterial pressures were measured together with systolic time intervals; pre-ejection period (PEP), left ventricular ejection time (LVET), and calculated PEP/LVET ratio, before operation and during the first 48 hours after operation: inotropic drugs were not used. Cardiac output and stroke volume, normal

before operation, were significantly reduced ($P < 0.001$) as was left atrial pressure ($P < 0.05$), and peripheral vascular resistance was raised ($P < 0.005$) at 4 hours after operation. Thereafter none of these parameters differed from preoperative values with the exception of stroke volume which remained significantly reduced ($P < 0.001$) at 48 hours. Heart rate was raised ($P < 0.001$) throughout the postoperative period studied.

Before operation the pre-ejection period was 17 per cent below and the left ventricular ejection time 8 per cent above predicted values (Weissler). At 4 hours after operation pre-ejection period was $+47.5$ per cent ($P < 0.001$) falling to $+30$ per cent at 48 hours ($P < 0.001$), left ventricular ejection time was -25 per cent at 4 hours ($P < 0.001$) and remained so at 48 hours. PEP/LVET was $+104$ per cent at 4 hours ($P < 0.001$), falling to $+83$ per cent at 48 hours ($P < 0.005$).

These results suggest that, though left ventricular pump function approaches the preoperative state rapidly, systolic time interval abnormalities reflect persistent reduction in left ventricular performance up to 48 hours after cardiopulmonary bypass.

Value of isometric exercise in assessment of left ventricular function

R. J. Vecht (introduced) and E. M. M. Besterman

A review is made of 37 patients with various cardiac pathologies, stressed by isometric exercise, using hand grip during routine cardiac catheterization. Resting measurements of heart rate, left ventricular systolic, end-diastolic, aortic or femoral artery and pulmonary artery pressures were recorded and repeated after a standardized handgrip. All these measurements showed significant increases during isometric effort.

By separating those patients with resting left ventricular end-diastolic pressures less than 12 mmHg from those with higher values, 3 groups emerged.

Group 1 consisted of 13 patients with normal hearts or mild to moderate cardiac disease whose resting and handgrip left ventricular end-diastolic pressures remained below 12 mmHg. The mean cardiac index for the group was $3.7 \text{ l./min per m}^2$ and left ventricular cineangiography showed normal contraction.

In group 2 there were 9 patients with moderate to severe heart disease. The mean cardiac index for the group was $2.6 \text{ l./min per m}^2$. The resting left ventricular end-diastolic pressure was below 12 mmHg, but rose above this level during handgrip.

In group 3 there were 15 patients with resting left ventricular end-diastolic pressures above 12 mmHg, rising yet further during handgrip. This group had moderate to severe cardiac disability with a mean cardiac index of $2.6 \text{ l./min per m}^2$.

Patients in groups 2 and 3 did not differ clinically or on left ventricular cineangiography, most showing reduced contractility, but 3 patients in group 3 died during a 6-month follow up.

It is concluded that handgrip is a safe stress test, occasionally inducing ventricular extrasystoles and rarely

angina, and allowing an intermediate group of patients to be unmasked (group 2) whose cardiac reserve was reduced compared to group 1 during isometric exercise and who, though clinically and radiologically indistinguishable from patients in group 3, differed in resting left ventricular function and appeared to have a better immediate prognosis.

Effects of propranolol on left ventricular function segmental wall motion and diastolic compliance in man

D. John Coltart, Edwin L. Alderman, Sherilyn C. Robison, and Donald C. Harrison (all introduced by J. P. Shillingford)

Precise quantitation of the slope and intercept of left ventricular pressures and volume curves was obtained using a manometer-tipped angi catheter before and after the administration of 0.15 mg/kg of propranolol in 10 patients, 8 of whom had coronary disease. All measurements were obtained during suspended normal inspiration at the same atrial paced heart rates. Pressures and volumes were measured at 33 msec intervals from simultaneous high fidelity pressures and single plane right anterior oblique ventriculograms. After propranolol, mean ejection fraction, cardiac output, and maximum dp/dt declined slightly. End-diastolic volumes increased in 5 of the 10 patients by more than 10 per cent. Analysis of log_eP vs. V graphs (diastolic compliance) showed only minor changes in 7 of the 10 patients, with end-diastolic volumes below 200 ml. The 3 patients with end-diastolic volumes greater than 200 ml showed increases averaging 23 per cent and significantly increased diastolic compliance. Computer analysis of left ventricular wall motion showed little effect of propranolol on segmental wall motion. We conclude that when variables such as heart rate and respiration are controlled, propranolol has minimum effects on ventricular function and compliance; however, increases in end-diastolic volumes and compliance may be encountered in severely diseased ventricles.

Assessment of value of catheter biopsy of the heart

E. H. Mackay, W. A. Littler (both introduced), and P. Sleight

The results of 23 patients undergoing cardiac catheterization and right ventricular biopsy with the Konno endomyocardial biopome are reported.

They include 14 female and 9 male patients aged 11 to 61 years, with clinical diagnoses of idiopathic cardiomyopathy (11 cases), hypertrophic obstructive cardiomyopathy (5 cases), ? ischaemic heart disease (3 cases), and 6 others including muscular dystrophy (1 case).

From 21 cases 35 tissue samples were produced for light microscopy after paraffin wax or Araldite embedding. These showed no abnormality (5 cases),

probable hypertrophic obstructive cardiomyopathy (2 cases), interstitial fibrosis suggesting ischaemia (5 cases), variable fibre hypertrophy (12 cases), and complete fat replacement of myocardial fibres in the dystrophic patient.

Electron microscopy from 16 patients generally confirmed these findings. Five cases were essentially normal, 2 confirmed hypertrophic obstructive cardiomyopathy, 2 showed severe fatty change, and the remainder showed tubular dilatation, mitochondrial damage, and glycogen changes suggesting cardiomyopathy or anoxia.

Serology and tissue culture for viruses were negative in 7 cases.

There was no morbidity from the procedure and in one patient who died 33 days later the biopsy site was healing normally.

We conclude that the technique is safe, may help to resolve doubtful clinical findings, and is worth further study.

Transvenous cardiac biopsy – application of new method for diagnosing heart disease

Philip K. Caves, John Coltart, Margaret E. Billingham, Edward B. Stinson, and Norman E. Shumway (all introduced by Desmond Julian)

A new instrument and technique are described for the performance of transvenous endomyocardial biopsies. The catheter biopsy forceps are introduced into the right internal jugular vein percutaneously through a sheath. Biopsies are obtained from right ventricular endomyocardium under fluoroscopic control. Removal of the sheath leaves the vein intact.

119 biopsy procedures performed in 16 new cardiac transplant recipients have enabled the histological diagnosis to be made of cardiac allograft rejection in man for the first time. The histological changes provided the earliest indication of acute graft rejection, reflected the severity of rejection episodes, and were reversible with successful treatment.

Twenty-two procedures in 10 patients 6 months to 3 years after cardiac transplantation defined the myocardial structural changes which may occur in long-term survivors.

Transvenous endomyocardial biopsies from 29 patients with a clinical and haemodynamic diagnosis of non-obstructive cardiomyopathy provided a new diagnostic method for the histological evaluation and classification of these disorders. It is hoped that serial biopsies will be of great value in assessing their progression and prognosis.

Transvenous endomyocardial biopsies may be performed in 5 minutes under local anaesthesia. This simple, safe procedure represents an important advance in human cardiac transplantation and may be of great value in the assessment of patients with primary myocardial disease.