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 November 1969. The President, Sir JOHN McMICHAEI, took the Chair at 9.00 a.m. during Private Business. At the Scientific Session which followed, the Chair was taken by Frances Gardner.

Private Business

1 The President reported with deep regret the deaths of Hugh Barber, Evan Jones, and Charles Baker.

2 The Minutes of the Annual General Meeting having been published in the Journal (1969, 31, 791) were taken as read and confirmed.

3 The Treasurer reported that the General Fund investments were still £592, with £2300 in the deposit account and £598 in current account.

There had been substantial increases in the subscriptions to the International and European Societies of Cardiology, the total having risen from £75 to £135.

There had been no significant increase in the cost of printing the booklet or in secretarial expenses.

The Congress Fund held £1775 and the Thomas Lewis Lecture Fund £1173 in investments and £1211 in cash.

The investments of the Society were under review by a subcommittee of Council, but so far no change had been advised because of the unsettled economic situation. The matter would be reviewed again shortly.

4 It was announced that Council were proposing to change the method of election of officers and Council Members; details would be sent to members well before the 1970 Annual General Meeting, and if approved the revised rules could be ratified at that meeting.

Council also proposed to abolish the category of Associate Member, new members being elected straight to Ordinary Membership. This, too, would need ratification at the next Annual General Meeting, and members not attending could vote by post.

5 Goodwin reported that a further questionnaire regarding senior registrars in cardiology had been sent by the Cardiology Committee of the Royal College of Physicians to 98 members of the Society who were doing Group I or II cardiological work, as previously defined. The replies so far received indicated that about half the consultants had a senior registrar, who spent most or all of his time in cardiology. Of the last 3 holders of their senior registrar posts, 27 became consultants in Group I or II, 36 in general medicine, and 15 emigrated. Cardiac surgery was available in the same hospital as the senior registrar in cardiology in only 32 of 46 instances.

Six consultants had cardiac surgery in the same hospital, but no senior registrar.

Goodwin said that the analysis, which was only preliminary, would be discussed at the Cardiology Committee of the Royal College of Physicians with a view to asking the Department of Health to agree to more consultant appointments in cardiology, and to more training in cardiology for intending general physicians. More senior registrar appointments in cardiology would be likely to stem from the former request.

6 The Secretary reported that the Annual General Meeting in 1970 would be held on the 23 and 24 April, as a joint meeting with the Dutch Society of Cardiology in Amsterdam.

7 The Chairman of the Organizing Committee of the VI World Congress of Cardiology reported that arrangements were well advanced for the 1970 Congress. Approximately 25,000 brochures had been sent out throughout the world with full particulars of the arrangements and the programme.

8 The Secretary reported that in view of the work involved in organizing the VI World Congress of Cardiology in London in September 1970, there would be no Autumn Meeting of the Society that year.

9 The Secretary reported that the Society of Cardiological Technicians were holding an exhibition at the Middlesex Hospital on Friday afternoon and Saturday, and asked members to support them. Forty firms were exhibiting cardiac instruments and apparatus. The Technicians had arranged buses to take members to and from the Middlesex Hospital from 4.0 p.m. on Friday.

After the Scientific Meeting on the Thursday, the Thomas Lewis Lecture - 'The Coronary Circulation in Man: Anatomical and Physiological Studies' - was given by Professor Richard S. Ross.

After the Scientific Meeting on the Friday, the National Heart Hospital St. Cyres Lecture - 'A Decade of Congestive and Hypertrophic Cardiomyopathies' - was given by John Goodwin.

The Society dined together at the Royal College of Physicians, with Sir John McMichael in the Chair. The guests included Professor Richard Ross and Dr. Margaret Haigh. The President spoke warmly of the Chairman's management of an excellent meeting and gave an appreciation of a long connexion with Professor Richard Ross and his work. He also warned that standard of work in cardiology might be endangered by coming legislation and that suggested N.H.S. reorganization should be closely scrutinized if progress were to be maintained.

Assessment of 20 patients after internal mammary implantation

R. Balcon, D. G. Leaver (introduced), D. N. Ross, J. K. Ross (introduced), and G. E. Sowton

A group of 20 patients with severe ischaemic heart disease was assessed before and at least one year after a revascularization procedure. They were placed into four grades according to clinical severity. The assessment consisted of clinical examination, with particular attention to signs of left ventricular dysfunction, electrocardiogram, chest x-ray, and selective coronary angiography. An objective assessment was obtained by an atrial pacing test. The assessment after operation included internal mammary in place of coronary angiography.

The operation consisted of internal mammary artery implantation, bilateral in 17 patients and unilateral in 3. Five had some additional procedure performed.

Sixteen patients survived more than one year and 12 of these (75%) were subjectively improved. They represent 60 per cent of the original group. The
objective assessment by atrial pacing correlated well with the clinical results. Angiographic evidence of communication of the implanted vessel with the coronary artery tree was shown in only 3 patients, and 13 of the 18 vessels assessed were occluded. There was thus no correlation between angiographic findings and clinical results, and the physiological basis for the observed clinical improvement has not been explained.

Thromboembolism after prosthetic valve replacement

C. L. Sarin, E. Yalav (both introduced), and M. V. Brainbridge

Increasing surgical experience, improved cardio-pulmonary bypass techniques, and better understanding of post-operative care have lowered the operative mortality in cardiac valve surgery to acceptable levels. The long-term function of artificial valves is now assuming increasing importance. In the assessment of this, one major factor is evaluation of the risk of thromboembolism in patients who survive prosthetic valve surgery, as embolism is said to be responsible for 50 per cent of late deaths.

One hundred and six patients were discharged from St. Thomas' Hospital between 1965 and March 1969 after insertion of prosthetic valves: 77 had single valve, 22 double valve, and 7 triple valve replacements. All patients were anticoagulated 72 hours after operation and maintained on oral anticoagulant therapy indefinitely. The patients were followed for periods of 6 months to 4 years, and any symptoms which could possibly be attributed to thromboembolism were regarded as such unless proved otherwise.

Two patients have been delivered of healthy normal infants at full term. Four patients have had nose bleeds on one occasion each, only one being severe enough to warrant hospital admission. Three patients had neurological disorders which could have been due to embolic episodes; all of these recovered with minimal residual disability. One patient died of thromboembolism. She had multiple emboli to kidney, spleen, mesenteric vessels, and central nervous system. This patient at necropsy had thrombosis on the wall of the left atrium, the prosthetic valves being free of clot.

The risk of subsequent embolism is the main argument for preferring homografts to prosthetic valves. In this series the risk was 4 per cent, with only 1 death (1%).

Use of cloth-covered mitral valve prostheses to reduce incidence of embolism

J. M. Reid (introduced), R. S. Barclay, and J. G. Stevenson

One hundred and thirty-one patients underwent mitral valve replacement between June 1965 and August 1969, with an early mortality of 23-6 per cent (i.e. 31 deaths within 3 months of operation). The Starr-Edwards prosthesis was used in all, but since March 1968 we have used the latest modified version, with a stellite sphere and the metal cage totally covered with cloth. This is reputed to prevent clot formation and subsequent emboli. The 131 patients were thus divided into two groups, those before and those after the introduction of the modified valve, and the two groups have been compared for the incidence of systemic emboli.

In the total series of 131 patients there were 13 emboli: 4 occurred within 3 months of operation, and 9 between 4 months and 3½ years. In these 13 patients, valve calcification was present in 7 (compared with 45 in the series of 131), 4 had previous valvotomies (compared with 50 in the series of 131), and the mean age was 41 years (range 22-50 years).

Group 1 consisted of 85 patients who have been followed for 18 months to 6 years. There were 27 deaths and 58 survivors. Of the 58 survivors, 12 (21%) sustained emboli, 6 (10-5%) within 6 months of operation.

Group 2 consisted of 46 patients who have been followed for 6 to 18 months. There were 9 deaths and 37 survivors. To date only 1 (2-7%) has sustained an embolus (at 5 months) within 6 to 18 months of operation.

These results indicate a conspicuous reduction in embolic complications with the use of the new cloth-covered valve. Anticoagulants are, however, still necessary.

Analysis of dynamics of mitral Starr-Edwards valve prosthesis using reflected ultrasound

D. C. Siggers, Srivapor A. Srivongse (both introduced), and Dennis Deuchar

The movement of the mitral Starr-Edwards valve prosthesis has been studied in 16 patients, using reflected ultrasound. The pattern of movement during the period of mitral closure resembles that of mitral stenosis. However, simultaneous recordings of left ventricular and pulmonary capillary vein pressures show no significant gradient across the valve, and left ventricular angiogram shows only minimal regurgitation in early systole in the normally functioning valve.

The pattern of movement shown by the ultrasound cardiogram of this valve is due to the composite movement of the cage and the ball. During initial valve closure, the ball does not move in relation to the cage, so that this part of the complex, consisting only of cage movement, resembles the stenotic pattern.

Phonocardiography with synchronous ultrasound cardiography shows that multiple opening clicks are due to the ball 'bouncing' in the apex of the cage. The speed of opening of the mitral Starr valve is affected by gravity, especially if the ball is metal.

In the light of these findings, more careful analysis of the ultrasound cardiogram of the mitral valve has shown that the pattern of movement of the anterior cusp is also a composite picture, which includes the movement of the valve ring.

Fascia lata replacement of heart valves

Marian Ionescu (introduced), and Donald Ross

Replacement of the aortic valve with homografts and autografts is an established procedure which has been used for the past 5 to 6 years. In the mitral and tricuspid regions, homograft and heterograft valves have proved useful, but size has sometimes been a limiting factor. Also, these non-viable tissues, particularly the heterografts, have shown evidence of deterioration and failure.

Fascia lata for replacement of the aortic valve has been used successfully by Senning for over 4 years, with retained flexibility and viability of this tissue.

By fixing this tissue on preformed metal formers it has been adapted successfully for replacement of the mitral and tricuspid valve, and in the aortic area it provides a rapid means of valve replacement with living tissue.

Clinical results were presented.
Some effects of propranolol on left ventricular ejection and phases of systole in conscious dog

Alexander Harley and Joseph C. Greenfield (both introduced by G. Howitt)

Beta adrenergic blocking agents have both chronotropic and inotropic effects. The latter cannot be fully assessed unless the former are overcome, since many haemodynamic parameters are rate dependent. This study examines some effects of propranolol on left ventricular ejection in relation to heart rate. Phasic aortic pressure and flow were recorded in conscious previously instrumented dogs at particular heart rates before and after propranolol. During sinus rhythm propranolol reduced heart rate, cardiac output, and peak flow, but increased duration of ejection and total systole. Stroke volume changed very little. During atrial pacing it could be shown that at the same stroke volume and heart rate, the duration of ejection, and often of total systole, remained unchanged by propranolol. Even so, the maximum rates of increase of aortic flow and pressure were lower after propranolol. The percentage of stroke volume ejected during the second half of ejection increased in spite of unchanged duration of ejection. These results show that beta blockade may not alter the duration of the phases of systole, provided that heart rate and stroke volume do not change. Instead, the temporal pattern of left ventricular ejection is modified.

Effects of atropine and propranolol on baroreflex in man during rest and exercise

B. Gribbin, E. Strange Petersen, T. G. Pickering (all introduced), and P. Sleight

Baroreflex sensitivity can be measured in man by relating the reflex bradycardia to a transient rise of blood pressure produced by intravenous phenylephrine, and expressed as mm Hg rise of systolic pressure (Smyth, Sleight, and Pickering, 1969). The effects of autonomic blockade on this reflex were investigated in 7 healthy subjects both at rest and during exercise.

Propranolol increased reflex sensitivity in resting, supine subjects, but atropine, or atropine with propranolol, abolished the reflex pulse slowing.

During graded supine muscular exercise, the reflex was diminished proportionally to the intensity of the exercise. Propranolol reduced the tachycardia and rise of arterial pressure accompanying the exercise, but now had little effect on the reflex, while atropine blocked it as before.

The duration of the rise of arterial pressure produced by the phenylephrine injections at rest was increased by atropine with propranolol, but the effect was less during exercise, i.e. reflex bradycardia is a more effective means of buffering transient pressure rises at rest than during exercise.

Thus the reflex cardiac slowing is almost wholly vagal, both at rest and during exercise, when it diminishes pari passu with the decrease in vagal tone.

Reference


A comparative study of dextro-alprenolol, dextro-propranolol, and practolol in treatment of ventricular ectopic beats

David Bennett, Eldon Smith (both introduced), and Edgar Sowton

D-alprenolol and D-propranolol are the dextro isomers of alprenolol and propranolol. They are potent local anaesthetics, possessing only very little beta-blocking activity. Practolol (ICI 50172) is a relative cardio-selective beta-blocking agent, with little or no inotropic action. A preliminary trial had shown that D-propranolol and D-alprenolol were as effective as lignocaine in suppressing ventricular ectopic beats.

The present controlled comparative trial was performed on 19 patients with chronically occurring ventricular ectopic beats. Each patient received at least two of the drugs, and some received all three. Each patient was studied on two or three separate occasions. Monitoring of the ectopic beats was carried out on the Lan-Electronic ectopic detector which integrates each QRS complex, the deflection thus produced being proportional to the area enclosed by the QRS. The ectopic beats produce large deflections which can be easily identified and counted.

All three drugs produced a statistically significant reduction in the incidence of ectopic beats. The effectiveness of each did not seem to be related to the underlying aetiology of the ectopic beats. No side-effects were noted, and 6 patients were started on oral therapy with satisfactory results.

Comparison of haemodynamic effects of oxprenolol (transcisor), alprenolol (aptin), and sotalol (MJ. 1999) in man

D. G. Gibson, J. Hoy (introduced), and Edgar Sowton

The haemodynamic effects of intravenous injection of oxprenolol, alprenolol, and sotalol have been compared during submaximal exercise in subjects with normal cardiac function. All three caused dose-related reductions in heart rate, but their relative potencies did not correspond with in vitro activity as competitive inhibitors of the chronotropic effects of isoprenaline. Reduction in cardiac output was directly related to the change in heart rate, but increases in ejection time and reduction in mean systolic ejection rate were not. Sotalol caused greater increase in ejection time and reduction in mean systolic ejection rate than alprenolol or oxprenolol, while practolol, studied by identical techniques, caused less. Since stroke volume was unchanged, and comparisons were made at equal heart rates, these changes reflect a reduction in the rate of left ventricular fibre shortening. The differences were not due to quinidine-like activity, since sotalol lacks this property, or to intrinsic sympathomimetic activity, which is shown by practolol as well as alprenolol and oxprenolol. It was concluded that there was no unique relation between changes in heart rate and left ventricular function mediated by the sympathetic nervous system in man.

Pattern of onset and cessation of atrial fibrillation in man

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

Atrial fibrillation may be provoked by premature atrial depolarization occurring within the relative refractory period of the atrium. This observation, though illustrating a mode of onset of atrial fibrillation, does not, however, eliminate circus movement as the sustaining mechanism. It seemed possible that a study of the spontaneous rever- sion of atrial fibrillation to sinus rhythm might throw further light on the nature of the arrhythmia. Eight patients were studied in whom intermittent atrial fibrillation followed myocardial infarction. The electrocardiogram was continuously recorded from right atrial and unipolar chest leads onto magnetic tape. It was possible to
identify and analyse 23 episodes of the onset of atrial fibrillation and 19 of spontaneous reversion to sinus rhythm.

The onset of atrial fibrillation always followed premature atrial depolarization during the relative refractory period, the interval between the preceding P wave and the premature depolarization being approximately 280 msec.

Sustained atrial fibrillation was characterised by the appearance of irregular atrial wave formation. At cessation of atrial fibrillation the atrial wave form changed to that of a supraventricular tachycardia. Termination of the tachycardia was followed by an electrical pause and the reappearance of sinus rhythm. The electrical pause exceeded the length of subsequent cardiac cycles, suggesting override suppression of the sinu-atrial node by the ectopic pacemaker.

These findings suggest that the onset and termination of atrial fibrillation can be attributed to the changing rate of discharge of an ectopic atrial pacemaker.

Association of prolapse of posterior cusp of mitral valve and atrial septal defect

Alastair McDonald, Alan Harris, Keith Jefferson, John Marshall (introduced), and Lawson McDonald

The frequency of a cleft anterior cusp of the mitral valve in atrioventricular defects is well known, but evidence of congenital abnormalities of the mitral valve in atrial septal defect of the ostium secundum type is lacking.

In 9 patients with ostium secundum defects, prolapse of the posterior cusp of the mitral valve has been shown by left ventricular angiography; the examination was performed to exclude ostium primum defect because there were atypical auscultatory or electrocardiographic findings. There were 6 women and 3 men aged 18 to 48 years. Associated mitral regurgitation, diagnosed clinically on the basis of an apical pansystolic murmur, was present in 6 patients. In 2 of the remaining 3 patients the scalar electrocardiogram was not typical of a secundum defect. The clinical and angiographic findings of prolapse of the posterior cusp of the mitral valve with atrial septal defect were related to the anatomy found at operation, and compared with the findings in patients without an atrial septal defect. The aetiology and significance of the mitral lesion were discussed.

Q waves and coronary angiography in cardiomyopathy

G. Gau (introduced), J. F. Goodwin, Celia Oakley, M. J. Raphael (introduced), and R. E. Steiner

Selective coronary angiography was carried out by either Sones' or Judkins' technique in 24 patients during diagnostic investigation of suspected primary cardiomyopathy.

In 3 patients with non-specific electrocardiographic abnormalities, the coronary angiograms showed advanced diffuse coronary atheroma to which the left ventricular failure was then attributed. In 6 patients the coronary arteries were normal despite unequivocal infract patterns in the electrocardiogram. They were therefore considered to have congestive cardiomyopathy, and necropsy in 4 revealed neither coronary artery disease nor evidence of past myocardial infarction.

Among patients with clinical and haemodynamic evidence of hypertrophic cardiomyopathy, 4 had focal infarct patterns in the electrocardiogram. Neither they nor 5 other patients with hypertrophic cardiomyopathy showed evidence of coronary atheroma on coronary angiography.

It was concluded that electrocardiographic stigmata of focal infarction may occur in the absence of either coronary atheroma or localized fibrosis in both the congestive and the hypertrophic groups of cardiomyopathies.

Hypertrophy and obstruction of outflow tract of left ventricle

A. Kristinsson, S. Van Noorden, E. G. J. Olsen (all introduced), J. F. Goodwin, Lawson McDonald, Celia Oakley, and Jane Somerville

Severe hypertrophy of the outflow tract of the left ventricle is known to occur in aortic valve stenosis and discrete subvalvar stenosis. It is not clear, however, whether this hypertrophy differs from that in hypertrophic obstructive cardiomyopathy.

This study was an independent comparison between the clinical picture and the histological data in 19 patients. The patients were divided into 2 groups based on the clinical, haemodynamic, angiographic, and surgical findings, without knowledge of the histology. In the first group there were 9 patients with aortic valve stenosis and 4 patients with discrete subvalvar aortic stenosis, and in the second group 6 patients with left ventricular hypertrophy but no structural fault, who were considered to have hypertrophic obstructive cardiomyopathy.

In ignorance of the clinical diagnosis and using a combination of histological, histochemical, and electron microscopical criteria, the patients were divided into three pathological groups: 6 patients in whom all criteria for a diagnosis were present, 5 patients definitely lacking these criteria, and 8 patients who were difficult to classify.

In this blind study of hypertrophied left ventricular muscle it proved possible to distinguish myocardium removed from patients with hypertrophic obstructive cardiomyopathy from myocardium of patients with organic aortic stenosis.

Vectorcardiogram in mitral valve disease

John Hamer

The Frank system vectorcardiogram has been studied in 61 patients with severe mitral valve disease to determine the value of the vectorcardiogram in the recognition of the relative degree of left and right ventricular hypertrophy in this situation.

Analysis is based on the spatial pattern of the QRS loop. The vectorcardiograms show a continuous gradation from posterior to anterior direction, the extremes indicating dominant left and right ventricular hypertrophy, respectively. The usual evidence of right ventricular hypertrophy is delayed in mitral valve disease by the vertical electrical position of the heart. The vectorcardiogram appeared to be more successful than the electrocardiogram in the recognition of severe right ventricular hypertrophy. An unusual rightward displacement of the QRS loop was found in patients with tricuspid valve disease. The vectorcardiogram rarely showed large QRS voltages in left ventricular hypertrophy, though these changes were often evident in the conventional electrocardiogram.

Comparison of 3 and 12 lead cardiodiagram computer interpretations

Peter W. Macfarlane, A. R. Lorimer (both introduced), and T. D. V. Lawrie

In a previous communication to the British Cardiac Society, the technique for computer interpretation of electrocardiograms was described. This communication deals with a comparison...
of the computer interpretation of the 12 lead electrocardiogram and the 3 orthogonal lead vectorcardiogram.

The electrocardiograms and vectorcardiograms from 1100 subjects, comprising normal subjects and others with one of a wide range of clinical abnormalities, were analysed. Over the whole spectrum of abnormalities, the 3 lead system proved of equal diagnostic value to the 12 lead system. In particular, the vectorcardiogram detected inferior myocardial infarction more often than the electrocardiogram, and likewise ventricular hypertrophy in many patients with hypertension or rheumatic heart disease. In cases where one tracing was normal and the other abnormal, the vectorcardiogram showed greater correlation with clinical abnormalities than the electrocardiogram. Both lead systems behaved similarly in respect of false positive and false negative findings.

With the added advantage of reduction in computer analysis time and storage requirements, the results of this study indicate that the 3 orthogonal lead vectorcardiogram is the system of choice for routine computer interpretation of cardiograms.

**Cardiac rhythm display using joint interval histogram**

*D. J. Rowlands*, G. Howitt, C. Taylor, P. G. T. Hanson, and E. T. L. Davies (the last three introduced)

Observation and analysis of changes in cardiac rate and rhythm during long periods of electrocardiographic monitoring are tedious and time consuming. Much information can be gained by following only changes in RR interval. This simplification facilitates the use of automatic data processing equipment, making possible the analysis of a large volume of data.

Changes in RR interval can be displayed using the joint interval histogram in which each interval is plotted against its successor. This serves to emphasize conditional relations between adjacent intervals. Simple apparatus has been used to digitize each RR interval. This information, on punched paper tape, is fed into a computer and instantaneous heart rate plots as a series of joint interval histograms. The number of beats contained within each histogram may be varied; in general we have included 100 or 1000 beats in each histogram.

The use of this technique in the comparative assessment of anti-arrhythmic drugs, and for on-line display in the intensive coronary care situation, is planned.

**Closed-chest cardiac resuscitation at the end of the 18th century**

*D. G. Julian* and M. F. Oliver

In 1774 the ‘Society For The Recovery of Persons Apparently Drowned’ was formed. In the following year, this became the Royal Humane Society. In the Proceedings of these Societies over the next 30 years the following techniques of resuscitation were described: mouth-to-mouth and mouth-to-nose breathing, endotracheal intubation with artificial ventilation, rhythmic sternal compression, and the application of electrical shocks to the chest. The indications for these methods, according to the recommendations of the Societies, and of Allan Burns in 1809 and of Aldini in 1819, included drowning, electrocution, and cardiac arrest in acute coronary disease.

The essential similarity of the methods used in the late 18th century to those of today has not been previously reported.

**Survey of acute coronary disease outside hospital**

*A. Armstrong* and Barbara Duncan (both introduced by M. F. Oliver)

In order to obtain information concerning the incidence and characteristics of acute coronary disease in a community, a notification survey was undertaken in the City of Edinburgh in 1967–1968. In a period of one year, approximately 1300 patients were notified as having been treated for an acute heart attack at home or in hospital or as having died without obtaining medical aid.

More than 70 per cent of deaths occurred outside hospital, and in 90 per cent of these medical aid had not been obtained during the final fatal illness.

For those patients admitted to hospital, the median interval from onset of symptoms to admission to hospital was less than 4 hours. The main cause of delay was the time interval between onset of symptoms and the call to the general practitioner.

The implications of these findings in relation to the provision of immediate treatment and of coronary care service were discussed.

**Immediate and long-term experience of acute coronary insufficiency**

Dermot Murnaghan, Noel Hickey (both introduced), and Ristéard Mulcahy

This communication records the authors' experience of patients with acute coronary insufficiency during an 18-month period in a coronary care unit. The syndrome is defined, and the ratio of incidence of acute coronary insufficiency to myocardial infarction is recorded. The frequency of arrhythmias and other implications, and the length of stay in hospital, are compared between the two groups.

Thirty per cent of acute coronary admissions to the coronary care unit were classified as acute coronary insufficiency. The frequency of arrhythmias and complications was much less among those with this diagnosis and they had a significantly shorter hospital stay. No serious arrhythmias or deaths occurred among the 78 patients with acute coronary insufficiency.

A significantly greater number of acute coronary insufficiency patients had returned to work after 7 weeks' total disability, but this favourable experience was no longer evident after 14 weeks. The same proportion of patients failed to return to work as compared with patients with myocardial infarction.

The mortality of patients with acute coronary insufficiency seen over a six-year period was worse than among patients with myocardial infarction, but the difference was not statistically significant.

**Study of infarcted myocardium in cardiac shock**

*C. Hanarayan*, M. A. Bennett, D. B. Brewer (all introduced), and B. L. Pentecost

Therapeutic failure in cardiogenic shock suggested the need for a detailed necropsy study of the heart in that condition. Shock following myocardial infarction was defined as consisting of arterial hypotension, oliguria, disturbed cerebration, clinically poor peripheral perfusion, with an accompanying metabolic acidosis. The heart was studied in 20 patients who died in this condition. Nitro Blue tetrazolium was used to show the site of infarction. This dye stains normal myocardium blue and leaves the colour of the infarcted tissue unchanged. The area of myocardial infarction in the heart slices was determined by a point-counting technique, and the weight of
infarcted tissue was calculated by relating the slice area of infarction to the whole slice weight. The technique provided good definition between recently infarcted and non-infarcted myocardium, proving superior to conventional methods.

In the shock syndrome the pattern was one of massive muscle destruction involving 30–70 per cent of the total ventricular muscle mass. The apex was regularly involved, but otherwise the distribution of muscle injury was variable.

These findings provide a basis for the failure of conventional medical treatment in this condition.

Haemodynamic changes after a diuresis in acute myocardial infarction
Anne E. Tattersfield (introduced), and M. W. McNicol

A large diuresis was induced in 34 patients with myocardial infarction and left ventricular failure by the intravenous administration of 80 mg. frusemide. Measurement of pulmonary and brachial artery pressure, cardiac output, and packed cell volumes permitted an analysis of the changes in the 6 hours after intravenous frusemide. Initially, the haemodynamic changes appeared to be predominantly due to acute fluid depletion, the changes in pulmonary artery pressure and stroke volume being influenced by the volume of the diuresis and the basic haemodynamic situation. There was an over-all fall in pulmonary artery pressure and stroke index. The fall in stroke index was greatest in the patients with the highest pretreatment stroke index. Later changes (at 4 and 6 hours) showed that cardiac output was maintained though systemic arterial pressure decreased. Ventricular work was probably decreased at this time.

Insulin secretion in myocardial infarction
S. H. Taylor, P. A. Majid, J. R. W. Dykes, J. Stoker, and C. Saxton (the last four introduced)

Hyperglycaemia is frequently observed in severely ill patients after acute myocardial infarction. In the past, this has usually been attributed solely to the increase in circulating catecholamines. However, further studies have now shown that a different mechanism may be involved, namely that of a suppression of insulin secretion. Observations have been made on patients with acute myocardial infarction: 5 patients were in circulatory shock, 4 were hypotensive without other evidences of shock, and in 12 patients the disease was uncomplicated. The results have been compared with those obtained in 12 normal subjects in the same age-group. Immunoreactive insulin was measured before and after a standardized insulinoergic stimulus with intravenous tolbutamide. In patients in circulatory shock the insulin secretion response was completely suppressed but gradually returned to normal over succeeding days with the improvement in their circulatory state. Insulin secretion was partially suppressed in the hypotensive patients but unaffected in the patients with uncomplicated infarction. The prime factors responsible for this physiologically important change were probably the severe reduction in pancreatic blood flow and the high levels of circulating catecholamines. The therapeutic importance of this finding is emphasized by recent observations that the damaged myocardium uses glucose preferentially, and also that the absence of insulin may seriously aggravate the systemic acidosis present in these seriously ill patients.

Free fatty acid induced arrhythmias during experimental myocardial infarction in dogs
V. A. Kurien (introduced), and M. F. Oliver

We have previously shown in patients after acute myocardial infarction, a positive correlation between raised serum free fatty acids and the incidence of serious arrhythmias and of death.

Studies have now been made in 50 mongrel dogs in which myocardial infarction was induced under anaesthesia by occluding the left circumflex coronary artery. Plasma free fatty acid levels were raised by giving heparin to activate lipoprotein lipase, and a glyceride emulsion as a substrate for lipolysis. Ventricular arrhythmias, including ventricular tachycardia, developed in the infarcted dogs 5–30 minutes after the maximum observed free fatty acid levels were attained. Propranolol sulphate modified the response to heparin and reduced the frequency of ventricular arrhythmias. No changes in cardiac rhythm occurred when heparin or intralipid was given alone, before or after infarction.

These findings suggest that raised plasma free fatty acid levels can lead to arrhythmias, independent of catecholamine activity. Heparin further raises already high levels, and its use may be unwise after acute myocardial infarction.

Phosphate loss from ischaemic dog myocardium
P. Owen, L. Opie, G. Shulman (all introduced), and M. Thomas

There is still doubt about the best way of assessing hypoxia of the heart by means of chemical measurements of coronary venous blood. We therefore draw attention to an increased phosphate concentration found in the local venous blood leaving a small zone of acutely ischaemic dog myocardium. When compared with other observed metabolic changes, such as lactate discharge, increased lactate/pyruvate ratio, increased glucose arteriovenous difference, and potassium release, it is apparent that phosphate loss is a reliable index of ischaemia in these circumstances. The increase in venous phosphate is large and rapid. Measurements of tissue high-energy phosphate compounds (adenosine triphosphate and phosphocreatine) show that these may be the source of the increased inorganic phosphate concentration. The tissue inorganic phosphate concentration is, however, decreased rather than increased, which indicates increased transfer of inorganic phosphate from within to without the cell during myocardial ischaemia.

Calcium transport in the failing myocardium in rats
J. R. Muir, N. S. Dhalla, J. M. Ortega, and R. E. Olsen (all introduced by Peter Harris)

Isolated rat hearts perfused without substrate provided a model in which to study biochemical changes in failing myocardium. There is a decline in the ability of mitochondria and microsomes to accumulate calcium in the absence of oxalate after 30 minutes perfusion. Calcium binding by mitochondria fell from control levels of 47 ± 8 μmole/mg. protein to 17 ± 5 μmole/mg. protein after 30 minutes and by microsomes from 29.8 ± 5.1 μmole/mg. protein to 15.2 ± 4.8 μmole/mg. protein. This drop coincided with the start of the decline in myocardial contractility. Calcium uptake by microsomes in the presence of oxalate decreased from control levels of 534 ± 32 μmole/mg. protein to 160 ± 27 μmole/mg. protein.
mg. protein after 2 hours perfusion at which time myocardial contractility had dropped to below 10 per cent of control levels. This change in calcium uptake by microsomes is associated with an increase in its ATPase activity from 1.91 ± 0.21 μmoles Pi/mg. protein/minute to 3.00 ± 0.31 μmoles Pi/mg. protein/minute, suggesting that there is an uncoupling of the microsomal ATP-dependent calcium pump in late stages of heart failure due to substrate lack. Changes in calcium binding occurred in association with the onset of contractile failure, whereas changes in calcium uptake in the presence of oxalate were delayed and probably represent irreversible disorganization of intracellular membranes.

Changes in compliance of peripheral veins after myocardial infarction

B. F. Robinson, C. Nachev, and J. Collier (the last two introduced)

Changes in compliance of dorsal hand veins were studied in 19 patients with recent myocardial infarction, 9 patients who had had cardiac pain without infarction, and 6 with non-cardiac disorders. Venous compliance was measured by determining the size of a selected hand vein at a standard con- gesting pressure.

Venous compliance was reduced on the first day in all patients with infarction, the average being only 37 per cent of the control recorded during convalescence. In contrast, the veins showed little or no constriction in patients with cardiac pain who had not suffered infarction, and the average compliance, which was 89 per cent of control, was significantly greater than that in the infarct group; similar results were obtained in patients with non-cardiac conditions.

The constriction of the hand veins after infarction usually relaxed gradually over the course of a few days, and similar changes were observed in a superficial forearm vein in the 4 patients in whom this was studied. The venoconstriction appeared to be mediated predominantly by the sympathetic nerves and did not result from peripheral cooling; theafferent mechanism was uncertain.

Central venous pressure was usually raised on admission and subsequently fell as the veins relaxed. The findings were consistent with the view that systemic venoconstriction is an important cause of increase in the venous pressure after infarction.

Pulmonary venous response to hypoxia in dogs

H. M. Snov, C. M. Furnival (both introduced), and R. J. Linden

Case reports of high altitude pulmonary oedema without evidence of left heart failure (Hultgren et al., 1961; Hultgren, Spickard, and Lopez, 1962), evidence from cattle suffering from brisket disease (Kuida, Tsagaris, and Hecht, 1963), and measurements of pulmonary wedge pressure in anaesthetized dogs during hypoxia all suggest that constriction of the pulmonary veins may contribute to the rise in pulmonary artery pressure during hypoxia.

In the anaesthetized dog, the effects of hypoxia on the relation between blood flow and pressures in the pulmonary artery, pulmonary vein, and left atrium have been investigated; the pulmonary blood flow and left atrial pressure were controlled independently. The arterial PO₂ was reduced to about 30 mm. Hg.

Pulmonary venous pressure increased during hypoxia in each dog and in 13 out of 16 tests on 12 dogs. During hypoxia the mean increase in pulmonary artery pressure was 9.8 (range 4.0–25) cm. H₂O and mean increase in pulmonary vein pressure was 1.9 (range 0.5–5.5) cm. H₂O. There were no changes in left atrial pressure. It is concluded that the pulmonary veins contribute a significant proportion (about 18%) of the increase in pulmonary vascular resistance during hypoxia.

Sinus bradycardia, sino-atrial block, and lazy sinus syndrome

David B. Shatt, and Denis C. Eraut (introduced)

This communication described 41 patients with chronic bradycardia associated with a slow atrial rate. None of the subjects had myxoeclma or other conditions commonly associated with bradycardia, nor were they taking drugs likely to slow the heart. Common symp- toms were syncope and angina, but few patients had signs of cardiac disease other than bradycardia. With one exception the electrocardiographic features were not those described in sino-atrial block, and it is suggested that in the majority of these patients the inherent rhythmicity of the sinus node is disturbed and resulted in sinus brady- cardia. A surprising feature has been that 9 of the 41 patients in the study have developed atrial fibrillation or flutter.

Potassium changes after open heart surgery

Michael Kettleswell, Roger White, and Peter Saunders (all introduced by John Hamer)

Measurements of total exchangeable potassium were made in 13 patients before cardio-pulmonary bypass and repeated 5 or 7 days after operation. Initial levels were low generally, and a mean fall of over 400 mEq was found over the period of study. Balance studies confirmed the post-operative potassium loss. Plasma potassium levels increased soon after operation, falling later to below pre-operative levels. Red cell electrolytes were also measured and were found to change in the opposite direction to the plasma electrolytes. Though part of the potassium loss was undoubtedly due to tissue catabolism, there also appeared to have been a general leakage of potassium from viable cells.

In view of the large post-operative loss of potassium, it is suggested that potassium supplements at this stage should be larger than those generally given, particularly in the later post-operative period. It is imperative that the plasma levels should be followed carefully in order to avoid dangerous hyperkalaemia in the first day or two when there may be oliguria.

Exchangeable potassium was measured in a further 10 patients at least 6 months after operation and compared with the pre-operative values. The majority showed a substantial increase in exchangeable potassium. Body weight also increased, and the findings were consistent with restoration of a depleted body cell mass.

Dissipation of turbulence in aortic stenosis

D. S. Tunstall Pedoe, C. Clark, D. L. Schulz (all introduced), and G. de J. Lee

The use of a thin film anemometer bead attached to a cardiac catheter has al-
Renal function and plasma flow after aortic valve replacement

D. C. Fluck, J. S. Cameron, J. H. Esbenshade, R. Gilkes, and L. Lopez Bescos (the last four introduced)

Creatine and PAH clearances have been measured in 16 patients before and after aortic valve replacement. Measurements were made before operation and serially after operation up to the sixth post-operative day. This study was performed in conjunction with measurements of cardiac output and intracardiac pressures. Simultaneous creatinine and insulin clearances were measured in 3 patients on 15 occasions. In 5 patients renal vein blood was obtained in the pre- and post-operative periods.

There was a close correlation between insulin and creatinine clearance. Creatinine clearance was normal before operation, fell in the immediate post-operative period, and gradually rose to normal values by the sixth post-operative day. PAH clearance was low before operation, further reduced after, but rose above pre-operative values by the sixth day. However, in the 5 patients from whom renal vein blood was obtained, it was found that the PAH extraction was incomplete; further, the extraction varied considerably in each patient, being 30 to 100 per cent extraction in one, and 16 to 42 per cent in another.

The incomplete extraction of PAH shows that it is only possible to calculate renal plasma flow under these circumstances when renal vein blood is available. However, though it was usually much higher than the PAH clearance, the calculated plasma flow tended to move in parallel. It was low before operation, fell lower on the second post-operative day, and only returned to pre-operative levels as late as the sixth day. The filtration fraction was raised before operation, rose higher on the second post-operative day, and fell again by day 6.

The percentage of the cardiac output perfusing the kidneys was usually reduced both before and after the operation. In addition, there was generally, in an individual patient, no constant relation between the changes in renal and systemic flow.

Determination of plasma digoxin levels by radioimmunoassay

D. A. Chamberlain, R. J. White, M. Howard, and T. W. Smith (all introduced by John Hamer)

A rapid and specific method for the measurement of blood digoxin levels has not been available until recently. Radioimmunoassay provides a method which is sensitive in the therapeutic range and suitable for clinical use.

Antibody (produced by Smith and Haber at Massachusetts General Hospital) is raised in rabbits immunized with an albumin-digoxin conjugate, and has satisfactory specificity. Competition for binding sites occurs between the digoxin present in the patient's serum and commercially available tritiated digoxin. Free and bound digoxin are separated using dextran-coated charcoal. Plasma levels are determined by comparison with a standard curve derived from serum containing known amounts of the drug. The method is sufficiently sensitive to determine circulating levels in the therapeutic range.

Preliminary results based on this method show that the therapeutic range in patients with controlled atrial fibrillation is usually between 0.5 and 2.0 mg/mL. Most patients showing evidence of digoxin toxicity have levels above 2.0 mg/mL.

Clinical assessment of electrical impedance cardiography in estimation of stroke volume

Alexander Harley, Robert J. Bache, and Joseph C. Greenfield (all introduced by G. Howitt)

The increasing need for an atraumatic method to monitor cardiac output prompted a re-evaluation of thoracic impedance cardiography. A 4-electrode high frequency impedance bridge was used to investigate instantaneous resistive thoracic impedance clinically, together with cardiac pressures, conventional cardiac output measurements, and aortic blood flow by the pressure gradient technique. Impedance measurement proved innocuous. Linear correlations were found between the maximum negative impedance derivative and stroke volume. These were closer within individuals than between individuals.

The same applied to empirical estimates of cardiac output by the impedance method and by the indicator dilution technique. Studies in patients with heart block identified an impedance component due to atrial systole, and showed that beat-to-beat variations in stroke volume at fixed ventricular rates were consistently reflected by the impedance cardiogram. Similar results were obtained from studies during spontaneous pulsus alternans. The linear relation between stroke volume and the maximum impedance derivative was not consistently affected by isoprenaline. Studies with different electrode configurations showed that the upper thorax produced most of the impedance change observed, and that the signal was not related to arterial pulsations in the neck or arms. We conclude that this method may prove clinically useful in assessing changes in cardiac output.

Haemodynamic effects of glucagon

Evan Fletcher, G. Murtagh, S. Lai, and P. F. Binning (last three introduced)

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