British Cardiac Society

The 55th Annual General Meeting was held in Edinburgh on 31 March and 1 April.

The Annual Dinner was held at the Royal College of Physicians of Edinburgh and R. M. Marquis was in the Chair.

At the Private Business Meeting the retiring President, J. F. Goodwin, introduced the newly-elected Officers and Council member. They are: President, W. Somerville; Honorary Secretary, G. A. H. Miller; Treasurer, D. Krikler; Honorary Assistant Secretary, B. L. Pentecost; Council Member, Celia Oakley.

At the Scientific Meeting, with R. M. Marquis in the Chair, the following short communications were given.

NATURAL HISTORY OF POSTINFARCTION ANGINA PECTORIS

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St. Vincent's Hospital, Dublin 4

Four hundred and seventy-one male survivors of a first myocardial infarction under 60 years were followed for a period of two years. All were subjected to a long-term exercise and secondary prevention programme. An early return to work was encouraged. One hundred and seventy-three (36.7%) suffered from postinfarction angina pectoris of whom 50 had preinfarction angina of at least three months' duration. The two-year mortality was similar for the angina and non-angina groups but the recurrence of non-fatal attacks was higher in the anginal group. The difference was just short of the 5 per cent level of significance. Nearly 40 per cent of patients with angina showed improvement or resolution of their symptoms at the end of the period of follow-up. Forty-three per cent remained unchanged. Only six patients showed sustained disimprovement. Ninety-four per cent of the non-anginal group and 89/7 per cent of the anginal group had returned to work by the end of the period of follow-up. Only four patients suffered from disabling angina. No anginal patient was subjected to bypass surgery and 70 per cent received no specific antianginal treatment such as beta-blockers or glyceryl trinitrate.

Controlled trial of fibrinolytic therapy in unstable angina

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Unstable angina is frequently a premonitory symptom of myocardial infarction. We report the results of a single blind controlled trial designed to assess the influence of fibrinolytic therapy in this setting.

The diagnosis of unstable angina was based on W.H.O. guidelines. Unequivocal electrocardiographic evidence of ischaemia was mandatory. Patients were excluded before randomization by any contraindication to fibrinolytic therapy or if angina stabilized during a short observation period.

Over two years 40 patients were accepted to the trial. They were randomly allocated to treatment with streptokinase for 24 hours followed by warfarin or to warfarin therapy alone. Treatment of both groups was otherwise similar.

Of 20 patients treated with streptokinase only 1 suffered a cardiovascular event—sudden (presumably arrhythmic) death 8 days after treatment. Of 20 patients treated with warfarin alone, 3 died suddenly and a further 5 developed myocardial infarction.

The excess of cardiovascular events (myocardial infarction and sudden death) in the warfarin treated group is significant. (P < 0.02.)

Reference


Possible explanation for protective action of long-term beta-adrenoceptor blockade after myocardial infarction

A. E. G. Raine and E. M. Vaughan Williams
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Beta-adrenoceptor antagonists are clinically effective antianginal and antidysrhythmic agents and have recently been shown to improve the prognosis of...
myocardial infarction, but their mode of action has not been wholly explained. While experimental investigation has concentrated on elucidating the acute effects of beta-blockade, full therapeutic benefit in patients is not seen for several weeks. The electrophysiological effects of prolonged administration of three different beta-adrenoceptor antagonists were, therefore, studied.

Rabbits were dosed with propranolol, practolol, acebutolol or saline. Electrocardiograms were recorded throughout the treatment period. These showed that in all treated animals rate-corrected QT interval (QTc) began to lengthen after 5 days' dosing, and by day 15 reached a constant prolongation (+11.0%, SEM 1.1, P < 0.001). Subsequent microelectrode studies on atria and ventricles of the hearts removed after 6 weeks' treatment showed significant prolongation of action potential duration in all treated animals which paralleled the in vivo QTc lengthening.

It is concluded that prolonged beta-adrenoceptor blockade induces a long-term adaptation in cardiac function quite distinct from the acute effects of beta-blockade. Since an increase in action potential duration is known to be antisyndrhythmic, this could account for the protective action of long-term beta-blockade after myocardial infarction.

**Surgical treatment of aneurysms of ascending aorta**

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Among 75 patients treated surgically for ascending aortic aneurysms during a 5-year period, there was haemodynamically significant aortic regurgitation in 67. The valve was replaced in 56 patients, using either a fresh aortic homograft (51) or a Starr-Edwards prosthesis (5). In 11 cases it was possible to conserve the patient's own valve by repair and resuspension of the cusps. Coronary artery involvement necessitated reimplantation in 7 while in 4 dissection extending into the proximal coronary was bypassed with vein grafts. Twenty-seven patients were operated as emergencies for acute dissection or rupture with an early mortality of 15 per cent, while operative mortality was 4 per cent for elective procedures. There were 2 late deaths, and 1 patient with the Marfan's syndrome required a second operation for recurrent aortic regurgitation after valve repair. Histological examination of the aortas disclosed a wide range of underlying pathology. Medionecrosis in 44, aortitis in 19, arteriosclerosis in 6, and infection in 6. Follow-up of patients for periods of 6 months to 5 years has shown maintenance of the good initial haemodynamic results.

**Non-invasive assessment of left ventricular function before and after aortic valve replacement for severe aortic reflux**

M. G. St. John Sutton, A. Venco, D. G. Gibson, and D. J. Brown
Cardiac Department, Brompton Hospital, London

In 20 patients who underwent aortic valve replacement for severe aortic reflux, simultaneous apex cardiograms and left ventricular endocardial echo-cardiograms were recorded before operation, and repeated in the 4 weeks after surgery. The left ventricular echoes and apex cardiograms were digitized so that instantaneous left ventricular dimension, rate of change, and velocity of circumferential fibre shortening could be derived, and a loop describing the time relation between change in left ventricular dimension and apex cardiogram plotted. Incoordinate contraction and relaxation were recognizable by changes in shape of this loop. These parameters were used to study the effects of surgery on left ventricular function.

After aortic valve replacement, there was an early reduction in end-diastolic dimension from 7.0 ± 0.8 cm to 5.7 ± 1.0 cm (P < 0.001) and no significant change in end-systolic dimension, while peak VEF fell from 1.9 ± 0.6 to 1.4 ± 0.4 s⁻¹ (P < 0.01), and was unchanged subsequently. In the early post-operative period there were distinct abnormalities of isovolumic contraction and to a less extent of isovolumic relaxation which resolved in the first week except in 2 patients who developed protracted low output states.

After aortic valve replacement there is an early reduction in diastolic dimension, deterioration in peak VEF, and a variable period of incoordinate contraction and relaxation.

**Early closure of ventricular septal defect complicating myocardial infarction**

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In an 18-month period 6 patients were submitted to operation for ventricular septal rupture which had occurred within one week of acute myocardial infarction. All had sudden occurrence of a harsh systolic murmur and rapidly developed gross cardiac failure. Two were in cardiogenic shock by the time of operation. Complete preoperative investigation included right and left heart catheterization with biplane left ventricular cineangiography and coronary arteriography.

Four patients required operation 8 to 25 days after infarction and the other 2 were operated on after 4 and 7 months. The principal of 'total correction' of all cardiac pathology was applied so that in addition to closure of the septal defect, each patient had additional operative procedures—resection of left ventricular infarct or aneurysm (all patients), mitral valve replacement (1 patient) or coronary artery vein bypass grafts (5 patients). All 6 patients survived operation, with immediate improvement in their haemodynamic state so that none required mechanical assistance postoperatively. One patient died 4 weeks postoperatively from perforation of an acute peptic ulcer and 1 required reclusion of the defect which recurred on the second postoperative day. The 5 surviving patients remain very well at follow-up.

It is recommended that such patients should have early complete investigation and immediate surgical correction when medical treatment proves inadequate.

Comparison of measurement of ejection fraction by radioisotope techniques and by cineangiography

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Until recently the measurement of ejection fraction has relied on data from cardiac catheterization, but radioisotope techniques offer a promising, non-invasive alternative.

We have measured the ejection fraction in 20 patients with ischaemic heart disease using two different radioisotope techniques, either by following the rapid fluctuations in count-rate after the injection of a bolus of 10 mCi of Technecium99m in its passage through the left ventricle, or by using our own modification of an accumulative method proposed by Zaret and colleagues (1971). Our own technique uses a simple gated electronic circuit which allows analysis of the change in ventricular volume throughout the cardiac cycle and makes no assumptions with regard to ventricular geometry. We have compared the ejection fraction measured by these radioisotope methods with the ejection fraction measured by cineangiography.

We have obtained a good correlation between these two isotope methods (r=0.91) and between ejection fraction measured by these methods and by cineangiography (r=0.87). The gated isotope technique which allows measurement of very low ejection fractions and also allows analysis of the rate of volume change, offers a valuable non-invasive means of investigating left ventricular function.

Reference


Initial clinical experience with stented porcine aortic valve xenograft

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In recent years the gluteraldehyde preserved porcine xenograft mounted on a flexible stent (Hancock Laboratories) has been increasingly used for human heart valve replacement. These valves were first used in Edinburgh in November 1973, and our 2-year experience with them is presented. Seventy-six Hancock valves were inserted in 66 patients, 33 male and 33 female. Their average age was 55 years (range 14–68 years). The indication for operation was rheumatic heart disease (38 patients), papillary muscle dysfunction (8 patients), prosthetic valve dysfunction (8 patients), congenital abnormality (4 patients), degenerative valve disease (4 patients), SBE (3 patients), and luetic disease (1 patient).

Forty-six valves were placed in the mitral, 28 in the aortic, and 2 in the tricuspid position; 10 patients required double valve replacement. Additional operative procedures included coronary artery vein bypass grafts (12 patients), tricuspid annuloplasty (6 patients), open mitral valvotomy (3 patients), left ventricular aneurysmectomy (2 patients), and replacement of the ascending aorta (1 patient). There were 2 hospital deaths (3%).
Oral anticoagulation was continued for approximately 6 weeks postoperatively when it was discontinued in all but 8 patients.

In the follow-up period (3 to 26 months) there were 3 late deaths, 2 of which were sudden. There was no documented episode of thromboembolism or valve degeneration. All except 2 patients were clinically improved from N.Y.H.A. class III or IV preoperatively to class I or II postoperatively.

Initial results with Hancock valves are satisfactory but further follow-up is required to determine their long-term durability.

Pregnancy after valve replacement

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A questionnaire sent to cardiologists in the U.K. yielded details of 25 pregnancies in 22 patients to which were added 5 personal cases.

Eighteen pregnancies in 15 women who were not given anticoagulants produced 17 healthy babies and 1 spontaneous abortion. This group included 8 patients with tissue mitral valve replacements, 5 of whom were in atrial fibrillation, as well as 6 who had free aortic homografts. There were no maternal complications.

Thirteen pregnancies in 12 women who received anticoagulants gave rise to 5 healthy babies. This group included 11 patients with mitral valve prostheses, 9 of whom were in atrial fibrillation. There were no thromboembolic complications in patients taking oral anticoagulants.

In 3 additional patients the valve replacement was carried out during pregnancy.

Most women with valve replacements tolerate the haemodynamic load of pregnancy easily and without personal hazard. A high fetal wastage in women taking oral anticoagulants with transfer to heparin before term is largely attributable to haemorrhage in utero but partly to malformation. The withholding of anticoagulants would usually be undesirable in patients with prosthetic valves but warfarin should be avoided in pregnancy because of teratogenicity.

The advantages of biological valves in young women were apparent in this series.

Myocardial lactate metabolism and coronary venous phosphate in cyanotic congenital heart disease

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To define the myocardial metabolic adaptation to cyanotic heart disease, coronary arteriovenous metabolic differences were measured at rest and after atrial pacing. During atrial pacing (150–180 min) for 5–10 min, lactate extraction in 7 non-cyanotic controls decreased from 27 ± 5 to 16 ± 4 per cent (P < 0.05). Cyanotic patients fell into 2 groups: 9 patients (group I) showed a drop in arterial O₂ saturation (SaO₂) with atrial pacing, from 76 ± 3 per cent to 55 ± 5 per cent; their lactate extraction fell sharply from 29 ± 2 to 3 ± 6 per cent (P < 0.001). Five cyanotic patients (group II) showed no fall in SaO₂ with atrial pacing, and lactate extraction remained stable (27 ± 2%). Inorganic phosphate extraction was noted in all patients at rest; this disappeared with atrial pacing in controls and cyanotic group I, but not in group II. No potassium changes were seen in any patients. The combination of the release of lactate and phosphate during pacing in group I cyanotics showed breakdown of high energy phosphate compounds and activation of anaerobic glycolysis in the myocardium. The absence of such changes in group II cyanotic patients indicates adaptation which allows the stress of pacing to be withstood more satisfactorily than in controls.

Assessment of subendocardial ischaemia during open heart surgery using intramyocardial oxygen and electrocardiographic electrodes

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Recent animal studies have shown that the low cardiac output syndromes seen in the post-cardiopulmonary bypass period may be secondary to ischaemic haemorrhagic necrosis of the subendocardial portion of the left ventricle.

The occurrence of subendocardial ischaemia in patients during cardiotomy bypass was assessed on a minute-to-minute basis using ST segment elevations in unipolar intramyocardial electrograms and intramyocardial oxygen tensions measured in the subendocardium and subepicardium. Fifteen point platinum plunge electrodes...
were constructed in 22-gauge stainless steel needles and placed in the anterior right and left ventricular walls in patients during surgery. Changes in ST elevation and myocardial oxygen tension were correlated with ischaemic and reperfusion times on cardiopulmonary bypass. In no patient was elevated ST segment seen before bypass or during perfusion before aortic cross-clamping. Simultaneous intramyocardial oxygen tension during these periods was \( \text{PO}_2 = 19.1 \pm 3.1 \). Four patients developed a very depressed mechanical function in the postoperative period and also showed a distinct increase in preferential subendocardial extracellular ST elevation. Seven patients had a significant increase in the subendocardial ST elevation at the termination of bypass when the beating non-working heart was separated from bypass and converted to a beating, working heart, and 3 of these patients required isoprenaline support. Elevations of ST segment were noted only in the subendocardium in these patients, showing that intraoperative intramyocardial \( \text{PO}_2 \) and electrograms allowed a minute-to-minute evaluation of regional oxygen supply/demand ratio in patients undergoing cardiopulmonary bypass.

**Emergency treatment of certain cyanotic heart defects with prostaglandin \( E_2 \)**

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Newborn infants with pulmonary atresia are almost entirely dependent on continuing patency of the ductus arteriosus for their pulmonary blood flow. When the ductus constricts they develop severe hypoxia, metabolic acidosis, and without intervention usually die. Our demonstration that \( E \)-type prostaglandins conspicuously relax the ductus smooth muscle in fetal lambs suggested a new approach to the emergency management of patients with pulmonary atresia and similar lesions. During diagnostic catheterization we have infused Prostin \( E_2 \) (Prostaglandin \( E_2 \) Upjohn) 0.1 mg/kg per min into 5 neonates with various cyanotic cardiac malformations and ductus dependent pulmonary blood flow. Two further hypoxic patients, one with transposition and a failed balloon septostomy and the other with critical pulmonary stenosis in whom surgery had been unsuccessful, were also treated with a similar infusion. \( \text{PaO}_2 \) was measured before and after a 10-min test infusion and rose significantly in every patient. The mean increase in \( \text{PaO}_2 \) was 14 mmHg (1.9 kPa) and in arterial oxygen saturation the mean rise was 25 per cent. Apart from a slight fall in systemic blood pressure no untoward effects were observed during the test infusion. Based on this favourable response the infusion was continued in these 7 patients until emergency surgery a maximum of 15 hours later. At operation the ductus was found to be widely patent in 6 of the 7, no problems were encountered with bleeding, and 6 of the 7 patients survived surgery and have done well to date. Initial experience with this new approach to the immediate management of this type of malformation is encouraging.

**Pulmonary atresia: assessment by lung imaging of pulmonary perfusion before and after operation**

Susan L. Lipscombe, K. E. Britton, and Jane Somerville
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The surgical management of complex pulmonary atresia poses difficulties because of the presence of large systemic collaterals and small underdeveloped pulmonary arteries. In order to investigate the changing pulmonary blood flow after staged and radical surgical procedures, conventional lung imaging with \( ^{99m}\text{Tc} \) labelled albumin microspheres was used in 23 patients.

Using the visual display processor of the Elscint dual-headed scanner, venous admixture shunt was measured as the difference between the summed lung activity and the total torso activity and expressed as a percentage of the total. The change in pulmonary perfusion distribution was scored for each lung using the quantitative colour display.

In patients having Blalock operations, improved lung perfusion scores on the side of the operation occurred with little alteration of the venous admixture shunt. Those undergoing radical correction where collaterals were also ligated showed distinct perfusion changes to each lung, while the venous admixture shunt fell on average from 23 per cent to 8 per cent—probably normal for the microsphere technique in this context.

This pilot study showed that routine lung imaging before and after operation for complex pulmonary atresia provides an early non-invasive means of assessment of its effect on pulmonary perfusion.
Echocardiographic diagnosis of corrected transposition

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Corrected transposition can best be defined as transposition with atrioventricular discordance. It is often difficult to diagnose, even with angiography, since the diagnosis depends upon accurate identification of ventricular chambers. Studies on the conducting tissue in corrected transposition have shown that precise diagnosis is essential for safe surgical repair of associated anomalies. The anatomical arrangement of the heart suggests that echocardiography could play a vital role in precise diagnosis. Thus in the situs solitus individual the right-sided anterior (morphologically mitral) valve is in fibrous continuity with the pulmonary valve. The left-sided posterior (morphologically tricuspid) valve is discontinuous from the aortic valve which is usually anterior and left sided. The interventricular septum is in the anteroposterior position.

Echocardiography performed in 7 patients with corrected transposition confirmed these features. The anterior atrioventricular valve exhibited excursion of both anterior and posterior cusps, features typical of a mitral valve. It was 'continuous' with the posterior semilunar valve. The interventricular septum was sagittally orientated. The posterior atrioventricular valve was frequently dysplastic and was discontinuous from the anterior semilunar valve. The only other condition that could give this anatomical arrangement is the exceedingly rare anatomically corrected malposition with absorption of the subaortic conus.

Transposition of great arteries, ventricular septal defect, and left ventricular outflow tract obstruction: results of 23 Rastelli operations

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Twenty-three patients with transposition of the great arteries (TGA), ventricular septal defect (VSD), and left ventricular outflow tract obstruction (LVOTO) had Rastelli operations between July 1971 and December 1975. Age at operation ranged between 2 and 14 years. Associated lesions included:

- atrial septal defect (10), patient foramen ovale (7),
- left superior vena cava (4), abnormal attachment of tricuspid and mitral valve (3), other (3). Previous operations included: Blalock-Taussig shunt (19), Waterston shunt (1), Blalock-Hanlon procedure (6), banding of the pulmonary artery (2), and Mustard operation (1).

Rastelli operations were performed on cardiopulmonary bypass with moderate hypothermia and intermittent cross-clamping of the aorta. The left ventricle was connected to the aorta through the VSD, which was enlarged in 15 patients. Continuity between the right ventricle and the pulmonary artery was established with a 'dacron' conduit containing an aortic homograft (10) or a porcine heterograft (13). There were 2 hospital deaths (8%). The first patient died in low cardiac output, the second died during reoperation for severe tricuspid incompetence and residual VSD. Two patients (8) died suddenly after 5 and 13 months, respectively. The cause of death was not explained at necropsy in the latter one.

Anatomical correction of transposition of great arteries and ventricular septal defect

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Mustard's operation of inflow correction has been accepted as the method of choice for treating patients with transposition of the great arteries (TGA): this however does not constitute total correction. The ideal operation for TGA should consist of transecting the aorta and pulmonary arteries and reattaching them to the appropriate ventricles; this should include the origin of the coronary arteries. Two patients with TGA and ventricular septal defect (VSD) were treated by this method. The VSD was closed through a transverse ventriculotomy using a 'dacron' patch. The ages at the time of operation were 8 weeks and 5 years. The younger child was operated on as an emergency because of cyanosis and severe heart failure resistant to intensive medical therapy. The older child had had previous banding of the pulmonary artery at the age of 1 year. In both patients pulmonary artery pressure dropped to below half systemic immediately after the operation. Postoperative progress has been satisfactory with relief of cyanosis and heart failure.

It is concluded that early anatomical correction of TGA and VSD should play an important role in the management of these patients.
Correction of total anomalous pulmonary venous drainage in infancy

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Between May 1971 and December 1975, 39 infants underwent correction of total anomalous pulmonary venous drainage (TAPVD) in this Unit. Fourteen of the 39 patients were under 1 month of age at the time of operation. Twenty-four out of 39 had supracardiac type, 7 had intracardiac type, 6 had infracardiac type, and 2 had mixed type TAPVD. The overall hospital mortality was 36 per cent compared with 68 per cent for 47 patients operated between 1963 and 1970. There were no late deaths. The improvement in survival rate in this series was attributed to: (a) earlier recognition and prompt referral, (b) an aggressive approach to diagnosis involving complete cardiac catheterization and angiocardiography to show the exact site of drainage of all pulmonary veins and to exclude any additional cardiac lesions, (c) vigorous preoperative care, (d) early complete correction, including construction of a large anastomosis and enlargement of the left atrium when indicated, (e) intensive post-operative management, paying particular attention to fluid balance, acid base status, and treatment of pulmonary complications. Mortality related to age, type of lesion, and presence of pulmonary hypertension or pulmonary venous obstruction is discussed.

Evaluation of early primary repair of ventricular septal defect in first year of life

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It has been our policy to perform primary repair of ventricular septal defect in all patients requiring operation. Indications for operation have been severe intractable cardiac failure or persistent pulmonary hypertension to systemic level in infants approaching the age of 1 year in an attempt to prevent permanent pulmonary vascular disease. Fifteen infants between the age of 1 month and 1 year underwent operation. Their weights were between 2-1 and 11 kg. All patients preoperatively had pulmonary artery pressures at or within 10 mmHg (1-3 kPa) of systemic level. All patients had the defect patched with 'dacron' through a transverse ventriculotomy. There was an immediate fall in pulmonary artery pressure to less than half systemic pressure in all patients. There was no late death and no late deaths. The remaining patients are asymptomatic and not requiring antifailure treatment. Late cardiac catheterization was performed 1 to 3 years after operation in 8 patients and showed normal pulmonary artery pressures and normal response to exercise. It is concluded that early repair of ventricular septal defect gives satisfactory results and appears to prevent pulmonary vascular disease.

Anatomy of ventricular pre-excitation

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Ventricular pre-excitation results from short-circuiting of the normal atrioventricular delay induced by the atrioventricular node. Theoretically this bypass can result through accessory atrioventricular, node-ventricular, fasciculo-ventricular, or atrio-fascicular connexions, or through intranodal bypass tracts. We examined 53 normal hearts and 8 hearts with ventricular pre-excitation of Wolff-Parkinson-White variety. The morphology of the atrioventricular fibrous anuli and their relation to the conducting tissues and pre-excitation were examined. In the normal hearts the fibrous anuli were not of uniform morphology. In places the atrial and ventricular myocardium on the right side was separated only by sulcus tissue but atrioventricular muscular connexions were not identified. Accessory atrioventricular conducting tissue was identified in atrial myocardium at the tricuspid orifice in over 20 per cent of hearts, but again did not make atrioventricular connexions. Accessory atrioventricular connexions were identified in 6 of the 8 hearts with pre-excitation. Seven connexions were identified. Four were discrete bundles which skirted the mitral anulus without perforating it. One was a right septal connexion and another perforated the tricuspid anulus. The final connexion originated from the anterior segment of the accessory atrioventricular ring conducting tissue.

What is role of clinical electrophysiology in evaluation of patients with sinoatrial disease?

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Clinical recognition of sinoatrial (SA) disease
currently depends on the demonstration of transient sinus bradycardia, sinoatrial block, or supraventricular tachyarrhythmias. The value of clinic electrophysiological assessment in these patients is not clear. Using intracardiac electrophysiological recordings and programmed stimulation we have evaluated 22 patients with sinoatrial disease and 12 control patients undergoing investigation for chest pain.

Intracardiac conduction times (AH and HV intervals) were normal in all patients. Effective atrial refractory periods and sinus node recovery times were not significantly different in the two groups of patients.

Two populations of sinoatrial conduction time were identified (with or without rate correction) but the mean values of 128 ±27 ms in patients and 112 ±30 ms in controls were not significantly different and major overlap rendered this measurement clinically valueless.

Sinus node or atrial re-entry was observed in 15 of 22 patients with SA disease (68%) and consisted of single or multiple re-entry beats and sustained tachycardias. Only 2 of 12 control patients showed re-entry phenomena.

It is concluded that no current electrophysiological measurement has diagnostic value in patients with sinoatrial disease. Re-entry activity can be shown in 68 per cent of patients with sinoatrial disease.

**Role of autoregulation in transmural distribution of coronary flow in canine left ventricular wall**

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The distribution of blood to deep and superficial layers of the left ventricular wall is approximately equal in spite of a systolic pressure gradient favouring the superficial layers. It is believed that this homogeneity is achieved by autoregulation; relative ischaemia of deep layers causing vasodilatation such that any systolic flow deficit is made up in diastole. We tested this hypothesis in a canine preparation in which coronary flow could be varied independently of aortic pressure. Flow distribution to the left ventricular wall was measured by the microsphere technique. We found that partial or complete abolition of autoregulation by ischaemia, dipyridamole or adenosine had no effect on transmural flow distribution. This suggests that coronary flow must be virtually arrested in systole and be confined to diastole when pressure conditions favour equal distribution. As previously reported, a rise in ventricular diastolic pressure is associated with reduction of subendocardial flow. At low left atrial pressures, flow distribution is determined by the ratio of coronary diastolic pressure to ventricular systolic pressure. A fall in this ratio, however caused, results in relative underperfusion of deep muscle layers.

**125I—Labelled fibrinogen, autoradiography, and sterearteriography in identification of coronary thrombotic occlusion in fatal myocardial infarction**

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The classical concept that acute coronary thrombotic occlusion is causally related to acute myocardial infarction has been challenged by recent observations. The evidence that thrombosis, when present, is commonly a sequel to infarction lacks validation.

In a prospective research programme, clinical data are correlated with evidence obtained from postmortem sterearteriography of the heart and of excised coronary arteries and from serially mounted 2 mm transverse sections of the coronary arteries. Each patient had received 100 μCi 125I-labelled radiofibrinogen IV shortly after the onset of the acute ischaemic illness. Incorporation of radioactivity in thrombi was studied by autoradiography of the 2 mm serial sections. The technique is described, observations illustrated, and problems in interpretation discussed.

By December 1975, 25 cases were examined and preliminary results are reported. In nearly all acute regional infarcts, thrombus was found in the subtending artery. The portion of thrombus evidently causing occlusion was characteristically radionegative, suggesting formation before radiofibrinogen administration. Radiopositive thrombus was common at either end of the occlusive thrombus, in keeping with the thrombus formation after infarction. Occasionally, however, occlusive thrombus was radiopositive throughout.

The results mainly support a causal role for coronary occlusive thrombus in the pathogenesis of myocardial infarction.
Unusual electrocardiographic response to exercise in patients with mitral leaflet prolapse

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Patients with mitral leaflet prolapse (MLP) often experience chest pain. Their investigation may include exercise testing to establish whether coronary artery disease (CAD) is present.

The response to electrocardiographically monitored submaximal exercise stress testing has been studied in 44 patients with MLP. With exercise ventricular ectopies occurred in 7, ventricular tachycardia in 1, and atrial fibrillation in 1. Exercise was terminated short of target heart rate in 18, because of chest pain (5), fatigue (7), ventricular arrhythmia (4), dizziness (1), or ST depression (1). Twenty-three patients developed post-exercise ST abnormalities, of whom 5 had ‘ischaemic’ patterns and angiographically proven CAD; among the 18 others, the ST segments were depressed and minimally downsloping in 2, slowly ascending from depressed J point in 3, horizontal for >80 ms with J depression of <1 mm in 12, and cupped in 1. In those without CAD the ST abnormality was either evanescent (not seen beyond 2 min post-exercise, 8 cases) or long-lasting (present at >8 min post-exercise, 10 cases).

Post-exercise ST abnormalities occur in patients with MLP without coexisting CAD (18/39, 46%) and have features which should be helpful in distinguishing from the progressively resolving ST deviation characteristic of CAD with angina.

Natural history of ventricular arrhythmias during acute myocardial infarction

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The variability and paroxysmal nature of ventricular arrhythmias during acute myocardial infarction makes their prevalence and prognostic significance difficult to assess.

Continuous electromagnetic tape recording of the electrocardiogram was started within 12 hours of the onset of symptoms in 28 patients with acute myocardial infarction and continued for 60 hours. A special hybrid computer was subsequently used to locate all ventricular premature beats (VPB) and to subdivide these into R on T ectopic beats and R on apex T ectopic beats. Slow and fast ventricular tachycardias were also differentiated by the computer. Antiarrhythmic drugs were not given to the patients.

The incidence and time of occurrence of the following ventricular arrhythmias have been precisely determined: (1) ventricular tachycardia, (2) R on T VPB on a preceding sinusal beat, (3) R on T VPB on a preceding VPB, (4) R on apex T of a sinusal beat or VPB.

An independent retrospective study of 3410 patients admitted to the Coronary Care Unit with myocardial infarction identified 81 with primary ventricular fibrillation (VF). The distribution of ventricular fibrillation by time is also described.

Primary VF is rare beyond four hours after the onset of symptoms, while the so-called ‘serious’ ventricular arrhythmias, outlined above, are common and persist for many hours. The apparent independence of VF from these other arrhythmias raises questions concerning the indications and effectiveness of antiarrhythmic drugs in the management of myocardial infarction.

Effects of tachycardia and isoprenaline on coronary blood flow: observations on pathogenesis of myocardial infarction

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Five anaesthetised open-chested mongrel dogs have been studied by measuring left anterior descending (LAD) coronary blood flow, left ventricular and aortic pressure with catheter-tip manometers, and epicardial electrograms.

After control measurements of pressures, LAD blood flow, and electrograms, the dogs were paced to a heart rate of 300 per minute, and then after termination of pacing were infused with isoprenaline until a similar heart rate was reached. The LAD was then stenosed in order to reduce the hypertensive response from the resting value of 3:3:1 to a value of 1:5:1 and then the study was repeated.

During the control situation LAD flow was shown to increase with the increase in heart rate when either pacing or isoprenaline was used as the stress. Though the partial occlusion did not reduce resting coronary flow, this fell under stress conditions to 65 per cent of the control resting values. The importance of this observation is that though one
might expect flow in a stenosed vessel to increase to a maximum limited by the stenosis, this in fact does not happen. It appears that with increasing stress, local ischaemia produces a rise in coronary resistance which reduces available flow below resting values. Such a mechanism may explain the occurrence of myocardial infarction without proximal occlusion of coronary vessels and may explain the discrepancy between the time course of myocardial infarction as seen after experimental coronary ligation and that seen in man.

Rhythm of normal human heart

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The 24-hour cardiac rhythm was studied in 86 subjects (41 male and 45 female) aged 16 to 65 years, from a total of 101 volunteers from the employees of the company, after excluding the 16 with abnormalities in the medical history, physical examination, electrocardiogram, and biochemical and haematological screening. Each subject's electrocardiogram was recorded continuously for two 24-hour periods with a Holter recorder, and the tapes analysed using the Avionics Electrocadioscanner. The accuracy of the scanning procedure was established by visual inspection of a 60-minute sample in each of 21 representative subjects.

In this apparently normal population over a third showed abnormalities of rhythm, including many thought to be of serious prognostic significance, such as junctional rhythm, second degree heart block, frequent ventricular ectopic beats, R-on-T and multifocal ventricular ectopic beats, bigeminy and ventricular tachycardia. Brady- and tachyarrhythmias and conduction disturbances occurred similarly in waking hours and during sleep. Abnormalities were not confined to the older age groups. Heart rates were significantly higher in smokers and at expected times of activity during the day.

Data on normal variation are important in evaluating the significance of arrhythmia and drug treatment in coronary heart disease and the prevention of sudden death.

Significance of cycle length alternation during drug treatment of supraventricular tachycardia

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Cycle length alternation (CLA) is commonly seen during an otherwise regular supraventricular tachycardia (SVT) before termination of attacks by drugs like verapamil which act mainly on the atrioventricular (AV) node. Characteristically, anterograde conduction time (P'Q or A'H) lengthens variably, usually progressively on alternate cycles, while retrograde times (QP' or VA') remain almost constant throughout; rarely is the converse seen.

Intracardiac studies in 16 patients with CLA invariably revealed a re-entry AV tachycardia involving either two intranodal pathways (one case) or one intranodal path with a partial (four) or complete (eleven) AV nodal bypass. There were pronounced differences in functional properties (conduction time, functional refractoriness [particularly in SVT] and paced second degree AV or VA block) between the pathways, especially in sensitivity to cycle length change and to verapamil (0-145 mg/kg iv), thus providing a mechanism whereby CLA can occur. This has been confirmed in normal subjects using a new technique; simulated AV re-entry tachycardia.

When CLA that varies is seen on the electrocardiogram during SVT, this strongly suggests a re-entry mechanism and, where atrial (P) and ventricular (QRS) events are clear, permits useful qualitative assessment of pathway properties.