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Images of the heart

Most heart disorders can be diagnosed from the history and clinical examination. But the severity—and therefore the prognosis and appropriate treatment—cannot always be judged on clinical grounds alone. The size and position of congenital defects, the haemodynamic results of valve lesions, the site of coronary arterial stenoses, and the effect of these disorders on cardiac function are all important for proper management. Of course, an intelligent guess can often be made at the bedside, but nowadays a more accurate assessment can be made with modern techniques of cardiac imaging.

The benefits of any investigation have to be balanced against the risks. The plain chest radiograph remains popular because it is familiar, painless, and practically harmless. It enables us to gauge the overall heart size, presence of valve calcification, left atrial enlargement, and pulmonary congestion. Its chief value is to detect change, especially in heart size. Similar comments apply to cardiac screening, but this does not leave a permanent record and is largely outmoded. The other traditional method of visualising the heart is contrast angiography, which is always combined with the measurement of intracardiac pressures. Cardiac catheterisation is uncomfortable, sometimes distressing, and occasionally hazardous. Its role is changing,[1] but it is still essential when the severity of a lesion is in doubt despite the results of other imaging techniques and when coronary arteriography is required. This latter indication is the more common, so much so that an alternative method of visualising the coronary arteries would put most diagnostic catheter laboratories out of business.

Within the past decade the quality of echocardiographic images has improved from Polaroid photographs of limited value to excellent strip-chart recordings depicting the movement and thickness of the heart valves, the interventricular septum, and the left ventricular posterior wall and the minor diameter of the ventricular cavities. Abnormalities such as pericardial effusion, left atrial myxoma, and vegetations on the valves can be detected, often with ease and always without harm or discomfort to the patient. It is, indeed, the development of this technique that has led to the decline of cardiac catheterisation before valve surgery in some centres.[2] Since by no means everyone can produce such good echocardiographs the chief value of the echocardiogram in other centres will remain confirmation of the presence of a disorder rather than assessment of its severity.[3]

The single piezoelectric crystal of the echocardiographic transducer can be moved through an arc, or multiple crystals can be mounted in the transducer head to give a two-dimensional image of the heart. The information can be recorded on videotape and selected frames photographed. The resultant images have proved so helpful in the diagnosis of congenital defects that nowadays no child should be submitted to cardiac catheterisation without prior two-dimensional echocardiography. In adult practice the place of two-dimensional echocardiography remains to be established, but it will probably have widespread application in the assessment of valve problems and ventricular function.[4 5]

Modern radiographic methods such as computed tomography and digital angiography, radionuclide studies, and nuclear magnetic resonance are all relatively new. Their use in cardiology has tended to lag behind that in other disciplines such as neurology. This is not surprising because the heart keeps moving and it is hidden in the middle of a large bony cage with air on both sides. Nevertheless, with developments such as electrocardiographic gating and faster computer processing these techniques can now be applied to cardiac diagnosis. Computed tomography scanning can depict the thoracic contents and those structures that are relatively immobile such as the aorta and the pericardium, and it can distinguish some disorders of the heart such as tumours and thrombus. The images may be enhanced by an intravenous injection of contrast medium to define the blood pool. Computed tomography scanning may thus become the investigation of choice in clinical problems such as suspected aortic dissection.[6] Digital subtraction of a conventional angiographic image improves the quality so that cardiac angiography and aortography can be performed with peripheral injections of contrast medium. Alternatively, very small amounts (5 ml) can be injected directly into the cardiac chamber, the unpleasant side effects of larger volumes thus being avoided. The processor is small and can be attached to conventional angiographic apparatus, but it is costly and has not yet become established in Britain.

A parallel development is taking place in nuclear cardiology and at the moment is further advanced than computed tomography scanning or digital angiography. Myocardial perfusion may be visualised with radioactive thallium. Defects apparent at rest indicate infarction and defects appearing on exercise indicate reversible ischaemia. This technique has obvious application in the diagnosis and objective assessment of patients with ischaemic heart disease. The sensitivity and specificity

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rates are 82% and 91% respectively.[7] Thallium images are not easy to interpret and the isotope is expensive (about £50 a patient); again, the technique has not caught on widely in Britain. Radionuclide angiography, on the other hand, is proving a useful method of assessing cardiac function. For this purpose the relatively inexpensive isotope technetium-99 (about £5 a patient) is generally used. It may be detected either as it first passes through the heart after an intravenous injection or, more commonly, it can be bound to red cells and allowed to equilibrate in the blood so that an electrocardiographic-gated image can be built up from 100 or more cardiac cycles with 20-50 frames a cycle. The resulting nuclear angiogram may look just like a conventional contrast angiogram but it has the great advantage of being repeatable. Thus global and regional abnormalities of left ventricular function can be detected both at rest and on exercise. An abnormal contraction pattern, or a normal one that becomes abnormal on exercise, may be the best basis for a screening test for suspected cardiac disease. In patients with proved cardiac lesions a nuclear angiogram assesses the functional importance of the lesion, detects change with the passage of time, and monitors the effects of treatment. For example, patients with coronary artery disease and angina show a deterioration in ventricular function on exercise that can be restored to normal with effective medical or surgical treatment.[8]

Nuclear techniques also have an established place in assessing pulmonary perfusion—for example, in suspected pulmonary embolism or congenital heart disease—and in detecting myocardial injury with infarct-avid agents such as technetium-99 pyrophosphate.[9] As a research procedure, positron-emission tomography is providing a measure of regional myocardial blood flow and metabolism; but the specialised equipment necessary for these studies, including a cyclotron, will limit its application. Nevertheless, it should be possible to correlate myocardial perfusion with coronary arterial stenoses in patients and thus to improve our understanding of this common problem. Nuclear magnetic resonance is yet another (totally different) imaging technique that is now being applied in neurology, producing images that can be superior to those of computed tomography.[10] Its role in cardiology is impossible to predict at this stage.

During the past few months the *BMJ* has published several reviews of the newer imaging techniques.[11-13] In the diagnosis of heart disease echocardiography and nuclear angiography are useful now. Both may confirm a clinical diagnosis and provide an estimate of left ventricular function, which is important because the state of the left ventricle is the best predictor of survival in adult heart disease: poor function equals poor prognosis.[14 15] The wider availability of these and other imaging techniques will be determined by their cost and diagnostic value. At present, given that echocardiography is relatively cheap and that nuclear medicine departments are widespread, a reasonable arrangement for the consumer-physician would be as follows. Every doctor should have access to chest radiography. Every district general hospital should have M-mode echocardiography and a physician capable of interpreting the results. Every cardiac centre with a regional responsibility should be able to undertake two-dimensional echocardiography and nuclear studies, certainly blood-pool imaging as a routine with thallium scintigraphy on occasion. Facilities for cardiac catheterisation should usually be confined to one or two such regional centres. Despite doubts about the future of cardiac catheterisation[1] there are strong reasons for believing that it will be with us for years to come,[3] particularly with the advent of interventional cardiac radiology.[16] In the next year or two digital subtraction techniques will become available, and in the more distant future who knows? Three-dimensional echocardiography? Coronary arteriography without catheterisation? One thing seems certain: physicians must continue to work closely with their colleagues in departments of diagnostic imaging so that patients can take advantage of whichever imaging technique gains ascendency in the next decade. Isolated cardiac units are doomed to provide a second-rate diagnostic service.

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Obstructive sleep apnoea syndrome

Obstructive sleep apnoea syndrome is a bizarre disorder first described relatively recently.[1] During sleep the upper airway becomes obstructed, sometimes for well over a minute, despite vigorous attempts by the respiratory muscles to draw in a breath.[2]

The obstruction is probably due to passive collapse of the pharyngeal walls. The muscular activity holding open the pharynx is reduced during sleep[3] and may be unable to overcome the subatmospheric pressures generated in the airway during inspiration.[4 5] Much less commonly laryngeal dysfunction is responsible, as proposed in the Shy-Drager syndrome.[6] Whatever the cause the consequences are hypoxaemia, sometimes incredibly severe, and hypercapnia;