PREFACE

Cardiac imaging—advancing and challenging

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Imaging of the heart has advanced massively in the last decade. From the early days of catheter angiography, through the development of ultrasound/echocardiography and subsequently Doppler imaging to functional imaging with nuclear isotopes, we now have available advanced cardiac MRI, electrocardiographic (ECG) gated CT of the heart and positron emission tomography. Each of these modalities has its enthusiastic proponents, or has at one stage been considered to be the best technique. Clarifying the role of each modality, depending on the clinical problem, is the main aim of this special edition of the British Journal of Radiology.

Many of these modalities were initially led and developed by radiologists, with subsequent take-up and further development by clinical colleagues (cardiologists). Cardiac imaging is a multidisciplinary process with input from radiology, nuclear medicine, cardiology, physics and industry. The multidisciplinary nature of the imaging is reflected in the contributors to this issue (albeit under the umbrella of a “radiology” journal).

The complexities of imaging the heart in comparison with other organs are largely a consequence of its perpetual motion in conjunction with the small size of some of the structures being evaluated. This means that there is usually a necessity for ECG gating, breath-holding or respiratory gating, ultrafast image acquisition and high spatial resolution with excellent contrast. Non-conventional imaging axes, function and physiology need to be understood by the radiologist in particular, while cardiologists need to be familiar with commonly coexistent diseases of the vasculature and lungs. Ultrasound has been a real-time technique for decades now but has seen the advent of three-dimensional (3D) technology, leading to an expansion in use for periprocedural guidance. MRI initially required long imaging times and ECG gating; however, with the advent of both balanced steady-state free precession sequences (bSSFP) and real-time cine imaging, these limitations are being progressively removed from the acquisition of high-quality

images. Similarly, ECG gated cardiac CT can be acquired in a breath-hold even from a single cardiac cycle (wide detector panel multidetector technology) or at relatively high heart rates (dual source CT). Cardiac CT was initially a high radiation dose procedure, but as a result of focused attention to dose reduction, particularly by industry, cardiac CT examinations now deliver significantly less dose than those for other body parts.

Cardiac imaging has a vital need to integrate functional with anatomical imaging. Echocardiography and nuclear medicine have led the way here, with MRI now taking an increasing role, although held back by time, skill and availability constraints. There is a need for all involved with functional imaging to become familiar and comfortable with the administration of pharmacological stress agents and the care of patients during such studies. The risks of these procedures is extremely low, if patients are carefully selected, and it has been demonstrated that stress imaging services can be successfully run by both cardiologists and radiologists. Motivated and highly trained radiographers, technicians and nurses are a vital part of the running of a high-quality and efficient cardiac imaging service.

There is increasing recognition of the need for advanced training in cardiac imaging to allow for the expectation of equal value of reports whether delivered by cardiology, radiology or nuclear medicine. To this end, radiologists must recognise that they need to take an active interest in cardiac imaging, through attendance at cardiological multidisciplinary meetings, taking feedback and audit, and familiarisation with imaging often performed by cardiology (e.g. angiography). Radiologists need to consider the physiological consequences as well as the anatomical detail. On the other hand, cardiologists need to ensure that they are up to speed with imaging physics and potential incidentally imaged pathologies beyond the heart. Radiologists and cardiologists need to be aware of the different available techniques to deliver the best in cardiac imaging. There is a debate about the assessment of extracardiac findings and whether or not targeted imaging strategies deliver the best in care for patients. This is particularly important with cardiac CT, but MRI unavoidably shows other areas of the body that may or may not have significant findings. A number of

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centres have responded to this problem by developing dual reporting systems (*i.e.* cardiology plus radiology) which have the byproduct of being an opportunity for mutual education. In times of considerable budget pressure, it is debatable whether this approach is a necessity or a luxury.

The important issue of training and accreditation needs to be addressed. National organisations are setting standards with certification of training and requirements for minimal numbers. There is a continuing argument as to whether or not minimum numbers equate to competence, but numbers are clearly the simplest method of documentation. These standards are not necessarily mandatory but are being developed, applied and accepted, and it is likely that accrediting organisations, or indeed the courts, will be looking for these as evidence of good practice. Such standards are currently being used for trained consultants and senior fellows, but the relevant medical and radiological colleges or specialist organisations need to integrate advanced cardiac imaging training in their curricula and examinations. This is being actively addressed in the UK and no doubt in other countries. Ultimately, there is no substitute for

active benchmarking for any individual against his or her peers and good communication with the referring clinicians.

While the recent advances in cardiac imaging described in this special issue are impressive, the real challenge for cardiac imagers in the future is to prove the value of these (often expensive) tests. Considerable research has shown the accuracy of these tests, but they are of little value if management is not altered. The stacking of tests is a frequent criticism of advancement of imaging, and departments should be cautious of this. There are many areas in which imaging has the potential to have a great impact on the use of stretched resources such as the numerous admissions to hospital with non-specific acute chest pain. More research is needed into how imaging has the potential to identify those who will benefit most from major thoracic surgery or complex percutaneous intervention with the minimum of risk. Considerable strain on healthcare budgets is inevitable for the foreseeable future, so the health economics arguments of more accurate diagnosis, triage and risk/benefit assessment with imaging need to be unequivocally proven.