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Who Should Perform Cardiac Imaging?

Imaging the heart is a crucial component of clinical cardiology that provides invaluable information on structure, function, physiology and sometimes prognosis. In well-funded health systems, it is difficult to envisage managing the majority of patients without some form of cardiac imaging to provide accurate information important to clinical decision making.

Cardiac Imaging different From all Other Imaging

Cardiac imaging is fundamentally different from all other forms of imaging due to the combination of several factors:
1.The heart is the only organ that continues to move while imaged, so moving images or motion correction are required, usually in addition to cardiac (ECG) gating;

2. While anatomy is important, assessing the movement (function) of the cardiac structures (particularly the myocardium and valves) is a very large proportion of the required information; and
3.The orientation of the heart is highly variable, precluding the use of standard imaging planes relative to the body, and requires significant interaction from the operator while imaging to obtain the appropriate image planes.

While other areas of imaging can involve some of these (e.g. operator interaction in abdominal ultrasound, functional assessment in barium swallow), the combination of all three is unique to cardiac imaging and directly relevant when assessing the requirements for performing this. There are many cardiac imaging modalities, including echocardiography, cardiac catheterisation, nuclear cardiac techniques, magnetic resonance imaging (MRI) and computed tomography (CT), though they share many of these requirements.

Who Should Perform Cardiac Imaging?

In assessing who should perform cardiac imaging, it is useful to ask two questions:
1. What is required of the practitioner to assess cardiac imaging optimally?; and
2. What provides the best setup for the patient?

To start with the first aspect, there are three main areas where knowledge and experience is required – the heart, the surrounding thoracic/abdominal regions (for some imaging modalities), and the imaging technique itself. It is clear that a detailed knowledge of cardiac anatomy, both normal and abnormal, is essential. In addition, a good understanding of the normal and abnormal function of all cardiac components is needed, including the motion of the myocardium and valves, flow patterns and differential pressures across valves and other cardiac structures (e.g. septal defects), perfusion of the myocardium by the coronary arteries, and cellular physiology (e.g. for uptake of nuclear isotopes). It is also important to understand the disease processes and patterns of cardiac damage/effects they can induce.

Some imaging modalities, predominantly CT and MRI, involve significant imaging of extra-cardiac structures, and knowledge is also required of the normal and abnormal anatomy of these, or provision made for a review of the images where required (e.g. by a radiologist, if not already involved with reporting the cardiac aspects). Good knowledge of the imaging technique, its optimal use, its limitations and awareness of the various artefacts are additional requirements in order to report appropriately.

Specific Cardiological Knowledge a Must

In addition to these general requirements, optimal cardiac imaging and reporting requires a good knowledge of several areas of clinical cardiology. These can affect both the interpretation of the images, and the assessment of the clinical consequences of the findings. The ability to integrate cardiovascular physiology is important – for example the effect of blood pressure or heart rate on left ventricular outflow tract obstruction, hypertrophic cardiomyopathy and aortic regurgitation are key aspects to take into account in the assessment. Similarly, understanding cardiac and extracardiac shunts is essential to the interpretation of left and right heart catheterisation (including cardiac pressures and oxygen saturations), echocardiography and cardiac MRI. The clinical consequences of a particular finding are also key ingredients of good interpretation – for example, whether the degree of coronary stenoses or valve dysfunction seen are sufficient to cause symptoms or ventricular dysfunction requires clinical knowledge and experience. The best reports use this clinical integration to provide an interpretation of the findings and their consequences in light of the clinical picture, rather than a 'technical' report with only a description of the image findings. This also highlights the last area that a cardiac imaging practitioner requires for good practice – the ability to integrate all cardiac imaging findings – this facilitates an integrated and coherent assessment of the heart, which is invaluable to patient management.

What is Best for the Patient?

The second question, indicated above, addresses the best setup for the patient. There are important safety considerations with cardiac imaging, as there are many aspects of cardiac investigations that carry significant risk. Examples include cardiac catheterisation, dobutamine or adenosine infusions for stress and perfusion studies (with echocardiography, nuclear or MRI), and exercise testing prior to nuclear or echo 'stress' testing (risk of arrhythmia/collapse). It is essential that the practitioner is able to deal with any potential complications of the imaging technique, including arrhythmia, cardiac arrest, hypotension and coronary dissection. In addition, there are significant advantages to the patient in having cardiac imaging provided in the context of a clinical consultation, where an informed discussion about the imaging findings and appropriate clinical management can take place. Not only is this time-efficient, but strengthens the doctor-patient relationship. While there are many areas of medicine (and indeed cardiology) where this isn't feasible, it is a major strength where it can be achieved, though it does limit the imaging to a cardiological setting.

It is clear that performing optimal cardiac imaging has a number of requirements, including a good understanding of the heart (including cardiac anatomy, function, physiology, and disease processes), the clinical context, the imaging techniques, the ability to deal with serious cardiac complications, and a knowledge of extra-cardiac anatomy. This requires specialist training and experience beyond the core aspects of general specialty training programmes. For cardiologists, extra knowledge is required on the imaging techniques and extra-cardiac structures (or integration with radiology for the latter). For radiologists, additional knowledge is required on cardiac anatomy, function and physiology, clinical context and dealing with cardiac complications.

While both specialties have the potential ability to perform cardiac imaging, the degree of additional cardiac knowledge and experience required for radiologists is high, and this puts many off. Coupled with the emphasis on functional imaging and the need for the clinical context, it is often cardiologists who undertake cardiac imaging. Radiologists have been more involved with cardiac CT and MRI, likely due to their excellent knowledge of the non-cardiac uses of these techniques, though additional training and experience are still required to incorporate the requisite cardiac knowledge. These modalities do provide an area for collaboration however between cardiology and radiology, and many centres have forged good links.

Conclusions

In summary, the high degree of specialist cardiac knowledge, skills and experience required for optimal cardiac imaging means that the majority of the time, cardiologists have more of the necessary attributes and are the appropriate specialty to perform this. It is possible for radiologists to perform cardiac imaging, but a high level of additional training and experience is required, and the ability to place the imaging findings in the clinical context is more limited than for cardiologists.

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