

# Risk Matters



Dear Reader,

*The gold standard investigation for coronary artery disease remains the coronary angiogram an invasive test requiring a catheter to be passed into the coronary arteries, which supply blood to the heart. Using non-invasive tests for easy and accurate identification of insurance applicants with asymptomatic coronary artery disease would be a major advance in risk stratification and underwriting assessment.*

*Techniques that both provide enhanced images and cause less inconvenience to the patient represent attractive alternatives to either angiography or tests that reveal the extent of concomitant disease processes in the heart, including valvular dysfunction, and could be valuable to underwriters.*

*This article discusses the options available, including Cardiovascular Magnetic Resonance, Cardiac Computerised Tomography and 3D Echo, and the various advantages and limitations of less invasive cardiac tests.*

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## Cardiac Imaging

There are three alternative cardiac tests to angiography that are widespread and in common use. These are Transthoracic Echocardiography (TTE), Transoesophageal Echocardiography (TOE or TEE in the U.S.) and Nuclear Cardiology (also called perfusion imaging or “Thallium” scanning).

Echocardiography directs high frequency sound waves at the heart to produce moving images. Both TOE and TTE can be used to assess the valves of the heart, the degree of left ventricular hypertrophy as well as detecting any defect between the heart chambers. The function of the left ventricle can also be estimated by determining the ejection fraction, a measure of the proportion of blood that is pumped out of the left ventricle during each contraction. For TTE the probe is placed on the chest wall, and for TOE the probe is inserted into the oesophagus so it produces clearer images because the probe can be sited closer to the heart. In both techniques there are restrictions on the angles at which the probe can be placed that reduce the information available.

Nuclear Cardiology introduces a radioactive tracer into the bloodstream and a camera measures how quickly it enters various areas of the heart. It is known as nuclear imaging, myocardial perfusion imaging or Single Positron Emission Computed Tomography (SPECT). The test is commonly performed once during exercise (stress) and then again at rest. Areas of the heart where the tracer failed to enter, or entered more slowly during stress, may correspond to areas of myocardial ischaemia where there is insufficient blood supply to part of the heart. The images that are produced by this technique can be of variable quality depending on the exact tracers used and the compliance of the patient and his or her body build. This can sometimes make accurate and reliable interpretation challenging.

## Cardiovascular Magnetic Resonance (CMR)

CMR uses the same technological principles as Magnetic Resonance Imaging (MRI) scans and relies on the principle that body tissues with varying amounts of water content react differently to strong magnetic fields. In the past CMR has produced less accurate images of other organs than MRI due to the artefacts produced by the cardiac contraction and respiratory movements. However, modern techniques now include gating, where the recording of the image is coordinated to the cardiac cycle, and rapid analysers that allow recording within a single breath-hold and have helped to address these limitations. The latest scanners are much faster and have dramatically improved image quality.

CMR can be used to assess ventricular function and provides clear images of all chambers due to its high resolution and the stark contrast between blood and heart muscle. The clarity of the images also makes for easier and more accurate interpretation. CMR is fast and reproducible. This means results can be easily measured and compared time after time. CMR does not use any form of ionising radiation (e.g., x-rays or radioactive tracer) and therefore presents minimal risk to the patient.

Unlike echo, CMR images can be taken in any plane or angle that may increase the amount of information available for interpretation. In fact CMR employs several different scanning techniques at once. Moving images are used to assess function and calculate ejection fraction. Late Gadolinium Enhancement (LGE) requires dye to be introduced that sticks to damaged or scarred heart tissue. Any damage that is present is revealed in scans as white, in contrast to the normal undamaged, black myocardium. The most common cause of scarring of the heart is previous myocardial infarction or heart attack. Importantly, this helps assess viability by looking at parts of the heart muscle that are damaged and allowing an assessment of the potential to improve perfusion and contractility of these damaged areas of myocardium by intervention such as bypass grafting or percutaneous coronary intervention. Correct interpretation of the images can assist with specific decisions on treatment options.

CMR may be used to check for the presence of ischaemia, to assess other heart disease (e.g., cardiomyopathies) and congenital heart defects. Distinct patterns of myocardial scarring can also be visualised in a wide variety of different conditions that affect the heart (e.g., sarcoid, amyloid and myocarditis). Because CMR combines several techniques within one 30-minute test, the relatively high costs (£1,500 variable) may be offset by the potential of enhanced diagnostic benefit. Recent data suggests that if used correctly in the majority of cases, CMR may be the only imaging test required.<sup>1</sup>

## Cardiac Computerised Tomography (CCT)

CCT scanning uses x-rays to produce a three-dimensional image of the heart and is used to assess the condition of the coronary arteries. CCT demonstrates coronary artery calcification extremely well. Almost all long-term atheroma contain calcium and the amount of calcium gives an

indication of the amount of plaque in the coronary arterial tree. Use of an injected contrast material allows for clear images of the coronary artery lumen, and tests last only 10 minutes. CCT scanning is best thought of as a “rule out” test. This means that if the test shows there is no narrowing of the coronary arteries, this is highly likely to be the reality. However, if this test does demonstrate some narrowing of the coronary arteries, often further imaging of some form will be needed to determine the significance of these narrowings.

One advantage, however, is that CCT is less expensive than CMR, but it is really only used to look at the coronary arteries. CCT is also more widely available and the machines themselves produce less claustrophobia in patients. This test can even be performed on patients with pacemakers, but it does involve a radiation dose. This can be similar to that of a full coronary angiogram, but the dose size has been reducing consistently in recent years with improvements in technology. In the future CCT can be used to look at scarring, LV function and even perfusion, but at present these are all research techniques and are not widely available.

## 3-D Echocardiogram

Two-dimensional echocardiography has been used for many years, but improved technology has allowed for the creation of 3-D images in real-time. The resulting colour images are very detailed and are useful in looking at the condition of heart valves. 3-D echo allows for a very good assessment of valvular damage to be made. This is especially true of the mitral valve, which sits on top of the left ventricle controlling the flow of oxygenated blood from the left atrium into the left ventricle. 3-D echocardiography also allows assessment of ventricular function, but in general CMR is seen as the most accurate assessment of ventricular function.

## Potential Impact on Risk Assessment

Traditional cardiac tests, such as an Exercise Electrocardiogram (Ex ECG), are known to have poor sensitivity and specificity with limitations on their interpretation due to age, gender and pre-test probability, and are being used less and less in clinical cardiology. As a consequence, underwriters increasingly question the value of using this test in any but those applications with larger face amounts. The Ex ECG has been in common use by underwriters for decades. These form part of the screening evidence we obtain as routine in many situations. The test is relatively cheap and the machines to perform them are plentiful. Also, before we move to abandon the Ex ECG as an underwriting tool, it is worth remembering that completion of a treadmill test may be viewed not simply as brief cardiac screen but a proxy for generally good health in an applicant. A positive test found at underwriting stage is still worthy of further investigation, but it may be conceded that the role of the Ex ECG in determining further management of patients is becoming increasingly limited as alternatives offer physicians so much more.

CMR and CCT scanning are quite new and as their use becomes more common, we will probably uncover more of the various types of heart diseases. The increased resolution of the images enables doctors to pick up small tissue abnormalities that previous scanning techniques were unable to show. A CMR scan is able to detect very low levels of tissue damage, down to 1 gram (0.5% of the total muscle in the heart), and the estimate ejection fraction is accurate to 2%.

It may even be possible in certain cases to obtain some information about the timing of events, such as a recent heart attack, by looking at the pattern of scarring, the thickness of the heart muscle or any residual swelling. However, these abnormal patterns are not absolute and will not persist for months after an infarct. The effect of these findings may be more an issue for claims as an individual may be told that there are signs of a recent infarct, yet there has been no ECG or troponin levels recorded.

The increased resolution of images will portray minor degrees of abnormality with increased frequency, but it remains important to look at the pre-test likelihood of cardiac disease being present and how much an abnormal test alters that assessment of risk. In the future it is possible that claimants with CI policies will hold diagnostic detail that could not have been imagined at the time the product was designed, priced and underwritten. The revolution in cardiac imaging promises improvements to patient diagnoses similar to the impact felt from Troponin. CI definitions of the future may need to refer to these new diagnostic tests. We can forecast an increase in cardiac-related claims as these scanning techniques become more widespread.

#### Endnote

- 1 Bruder O., Schneider S., Nothnagel D., Dill T., Hombach V., Schulz-Menger J., Nagel E., Lombardi M., van Rossum A. C., Wagner A., Schwitter J., Senges J., Sabin G. V., Sechtem U., Mahrholdt H. EuroCMR (European Cardiovascular Magnetic Resonance) registry: results of the German pilot phase. *J Am Coll Cardiol.* 2009 Oct 6;54(15):1457-66.



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