LETTER TO THE EDITOR

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Stress echocardiography in the age of multi-detector computed tomography

The introduction of 64-slice multi-detector computed tomography (CT) in 2005 made the non-invasive imaging of coronary arteries relatively easy to perform. Computed tomography coronary angiography (CTCA) has been shown to be highly accurate at detecting coronary artery disease (CAD), when compared with invasive X-ray coronary angiography and, in particular, has an excellent negative predictive value (NPV). There are also prognostic data confirming very low risk for patients with normal CTCA. One of the limitations of multidetector CT and despite very good temporal resolution of 150 ms, with half scan reconstruction, is the need for beta-blockers to slow the heart rate to 65 bpm, for retrospective, and 60 bpm, for the low radiation dose, prospective gated acquisitions. This is to minimize coronary motion particularly of the right coronary artery. Dual-source CT, with twice the temporal resolution, can cope with faster heart rates, whereas the 320-slice CT can image the heart in one heart beat. The UK national institute of clinical excellence (NICE) have recently produced guidelines on the management of patients with chest pain of recent onset, endorsing the use of CTCA in their investigational algorithm. We discuss the radiation dose associated with this strategy and how the guidelines should increase the demand for stress echocardiography.

Up till now patients with chest pain in the UK were investigated with functional tests to demonstrate myocardial ischaemia, using the exercise tolerance test (ETT), stress echocardiography, single photon emission computed tomography (SPECT), and cardiac magnetic resonance (CMR) perfusion. This is likely to change in the light of the new NICE guidelines, which recommend that the ETT is no longer used in patients without known CAD because of its limited sensitivity and specificity. For patients with stable cardiac sounding chest pain of recent onset and an estimated likelihood of CAD of 10–29%, the guidelines recommend CT calcium score followed by CTCA, if the calcium score is above zero. This reflects the extensive data confirming excellent prognosis, in mostly asymptomatic populations, with a zero calcium score and the excellent NPV for CTCA (97–99%).

For patients with stable cardiac sounding chest pain of recent onset and 30–60% likelihood of CAD, functional testing is recommended with any of the three imaging modalities as they have broadly similar diagnostic accuracy and are all superior to the ETT. Stress echocardiography is the most economical although somewhat labour intensive, whereas SPECT is more expensive, exposes patients to 8–10 mSv of radiation, but has extensive evidence base and is less labour intensive. CMR perfusion does not involve radiation and may in time be proved to be superior to SPECT, because of the higher spatial resolution, but is expensive and not yet widely available. For patients with stable cardiac sounding chest pain of recent onset and 61–90% likelihood of CAD, invasive coronary angiography is recommended.

The guidelines acknowledge the limitations of the ETT and the excellent NPV of CTCA in patients with low likelihood of CAD disease. Furthermore, functional testing in a population with higher likelihood of disease should reduce the false-positive rate for the functional tests and hence normal invasive coronary angiograms, which was 39% in a recent ACC National Cardiovascular Data Registry. This should reduce vascular risk and cost. However, the radiation exposure is an important consideration particularly in the light of the recent data from the USA highlighting the high cumulative radiation dose from medical imaging, particularly in women who receive a higher effective dose because of the breast tissue. One study calculated the cumulative effective radiation dose in nearly 1 million adults between January 2005 and December 2007 and estimated it to exceed 20 mSv per year in 4 million Americans. SPECT represented 22% of the total radiation dose of 15.6 mSv per scan. Another study estimated that 72 million CT scans were performed in 2007 with a projected 29 000 excess cancers in 20–30 years time. A further study found the median radiation dose for CTCA to be 22 mSv and estimated the risk of future cancer from CTCA to be 1 in every 270 in 40-year-old women undergoing the test. As a result the US Food and Drug Administration (FDA) has recently launched an initiative to increase patients’ and physicians’ awareness and encourage the recording of imaging history. However, it is possible to half the radiation dose from CTCA to 10 mSv by using various dose reduction techniques. Furthermore, with the introduction of prospective gating, where the acquisition is limited to 10% of the cardiac cycle at end-diastole, it is possible to reduce the dose to 2 mSv, in patients with a regular rhythm of 60 bpm.

CTCA is likely to become the test of choice in patients with low likelihood of CAD in view of the excellent NPV. However, it is important to use all the dose reduction techniques in those patients as they are likely to be relatively young and/or female, with good prognosis and while ruling out CAD is important, every effort must be made to minimise their exposure to radiation. Patients in whom it is difficult to control the heart rate will have suboptimal image quality on CTCA and will receive a higher radiation dose. A functional test should be considered instead. Furthermore, as the use of CTCA increases, which is likely considering its ease of use, the fast acquisition time and potentially low cost, it will unearth more anatomical evidence of moderate or severe CAD and the need for functional testing, to evaluate for the presence of associated ischaemia will also increase. As doctors and patients become more aware of the cumulative radiation dose from cardiac imaging and with the recurrent nature of CAD, there will be a stronger need for non-radiation-based functional tests, particularly for younger patients.

In most hospitals and for most patients, this is likely to be an echocardiography-based functional test.

References

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