Coronary artery disease, or CAD, is the single greatest cause of death in both men and women of several countries. This has spurred a great interest within the medical community in identifying patients who can benefit most from preventive and therapeutic strategies, of which stress myocardial perfusion imaging (MPI) has emerged as one of the most important non-invasive means of evaluating patients suspected of having, or who are at a high risk of developing, CAD.

Thanks to modern advances in nuclear cardiology, doctors can now use a stepwise approach to test for heart disease: first through non-invasive testing, followed by coronary angiography in appropriate patients. This has shown to be one of the most cost effective modes of treatment and has shown itself to be clinically useful in identifying high-risk patients.

Nuclear cardiology encompasses a wide range of imaging techniques that are both qualitative and quantitative. What all these techniques have in common is their use of radiopharmaceuticals as a photon source. As such, tests may include radionuclide angiograms (MUGA scans), thallium scans, technetium scans and positron emission tomography scans (PET scans).

Due to their nature, most nuclear cardiography tests are non-invasive and allow for effective assessment of the patient's heart function as well as any underlying myocardial ischemia and risk stratification. SPECT, for instance, or single photon emission computed tomography, is now routinely used for myocardial perfusion imaging. Through the use of a rotating Gamma-camera head which moves around the chest, the machine is able to acquire multiple projections that are then fed into the computer to generate a three-dimensional image of the heart.

PET, on the other hand, has been recently introduced for the use of myocardial perfusion imaging. By offering a higher spatial resolution, and accuracy than SPECT, the use of PET has advanced the field of cardiology significantly over the past few years.

In contrast to conventional CT. SPECT and PET cardiac imaging allows the estimation of regional myocardial blood flow capacity by examining the relative distribution of radiopharmaceutical substances in the blood both after stress and at rest. During stress, coronary territories with significant flow limiting blockages will receive less blood, thus causing the troubled areas to show up during the scan. By comparing the results of both the heart at rest as well as the heart under stress, MPI can uncover areas of infarction or ischemia.

It should be noted that when used in this particular context, stress usually takes the form of an exercise machine, typically a treadmill. The patient is first put on the treadmill, and the radiopharmaceutical agents then injected when the body is at peak stress. Once done, the patient is then imaged under a rotating gamma camera to reveal myocardial perfusion.

However, the use of a treadmill may not be suitable for every patient. Older Patients with medical illnesses such as diabetes or chronic kidney disease may not be able to use the exercise treadmill, in which case a pharmaceutical drug to dilate the blood vessels of the patient (such as adenosine, dipyridamole or dobutamine) is used instead.

One of the greatest advantages of the highly accurate measurements of heart size and function acquired from nuclear cardiology tests is the sheer amount of information it provides the cardiologist with. Aside from allowing the doctor to better prescribe medicine and select further testing, it also helps the doctor decide if bypass surgery is required or if certain devices may be used to optimise treatment outcomes.

With the growing number of patients with chronic coronary artery or multivessel disease, molecular cardiac imaging with SPECT and PET will play an important role in preventing unnecessary revascularization which could theorectically offset the cost of advanced systems like PET.

DR ERIC HONG

CARDIOLOGIST & DIRECTOR OF EH HEART SPECIALIST