CARDIOLOGY

Scans: PET vs SPECT

What is the difference between a cardiac PET scan and a cardiac SPECT scan? This article compares and contrasts these two cardiac imaging techniques.

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Cardiovascular disease is the single largest cause of death in the world. There has been a striking increase in the prevalence of obesity and type 2 diabetes mellitus in Asia. In particular, patients with type 2 diabetes mellitus exhibit accelerated progression of coronary artery disease (CAD), which may account for the increased signs, symptoms and death rates in these patients.

Another area of concern is the expected increase in the longevity of post-menopausal women. Pre-menopausal women benefit from oestrogen, which protects them against atherosclerosis and heart diseases. Post-menopausal women have low oestrogen levels, which increases their cardiovascular risk profile.

Hence, it is important to detect heart problems effectively so that treatment can be instituted and lifestyle changes enforced. Among the more advanced technologies for this is the cardiac PET (cardiac positron emission tomography) scan.

What is a cardiac PET scan?

PET is a nuclear medicine imaging technique that produces a 3D image of the functional processes in the body by detecting pairs of gamma rays emitted indirectly by a positron-emitting radiotracer. This non-invasive imaging technique evaluates blood flow to the heart muscle.

When blood flow to the heart is reduced in the narrowed/diseased coronary arteries, the reduction in oxygen supply to the involved heart muscle produces symptoms such as chest discomfort or shortness of breath.

The cardiac PET scan is a functional test that assesses the patient's heart function as well as blood flow in coronary arteries; this helps clinicians to risk-stratify their patients.

A small amount of radiotracer, Rubidium-82 (Rb-82), is administered intravenously during the test. The amount of radiation exposure is extremely low compared to the quality of information gained from the PET scan. The uptake of Rb-82 by the heart muscle is related to blood flow — areas of the heart with adequate blood flow would have more Rb-82.

A PET scanning camera takes 3D images of the Rb-82 uptake by the heart when it is at rest and when it is stressed. This is done with the help of pharmaceutical agents that dilate the blood vessels. The reason why doctors want to observe a stressed heart is to see if there is adequate blood flow to the heart when it has an increased workload. Further analysis of these images helps to identify the location, severity and extent of reduced blood flow to the heart muscle (ischaemia).

What is a cardiac SPECT scan?

Another functional test commonly used is the SPECT (single photon emission computerised tomography) myocardial perfusion scan.

SPECT is similar to PET in its use of radioactive tracer material and detection of gamma rays. However, the tracers used in SPECT emit gamma radiation that is measured directly; PET tracers emit positrons (particles with the same mass as electrons but bearing an opposite charge) that neutralise electrons with the emission of gamma photons (electromagnetic radiation), which are what the PET scanner detects.

SPECT imaging performed after stress reveals the distribution of the radiopharmaceutical and therefore the relative blood flow to the different regions in the myocardium. Diagnosis is made by comparing images of the heart when stressed to a set of images of the heart at rest. In both PET and SPECT studies, the stress test uses each individual patient as its own control.

Cardiac SPECT vs PET

Increasingly, cardiologists prefer cardiac PET scans to SPECT scans for the following reasons:

- PET scans offer a higher spatial resolution and accuracy than SPECT scans. Diagnostic accuracy in identifying cardiac coronary artery disease for PET and SPECT is 95% and 83% respectively.
- A SPECT scan may not detect vascular disease at the micro-circulatory level of the coronary circulation, or early stages of coronary artery disease when there are no symptoms. A PET scan can detect early functional abnormalities of the coronary circulation, which may be a precursor of ensuing coronary artery disease.
- Exposure to radiation is much lower for the PET scan compared to the SPECT scan due to the short half-life of Rb-82 (75 seconds).
- A PET scan lasts 30–40 minutes; a SPECT scan takes at least 6–8 hours to complete.

Doctors often also use the non-invasive coronary CT angiogram to visualise the coronary arteries, especially for evidence of atherosclerosis. This may be indicated by calcification with mild to moderate blockages, although the patient may have no symptoms and end up confused. But physiology trumps anatomy: if a patient has a partial blockage, but a functional test shows no evidence of reduced blood flow, then coronary intervention procedure may not be necessary and avoided.