Single-Photon Emission Computed Tomography

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Editorial

Single-photon emission computed tomography (SPECT, or less commonly, SPET) is a nuclear medicine tomographic imaging technique using gamma rays. It is very similar to conventional nuclear medicine planar imaging using a gamma camera, but is able to provide true 3D information. This information is typically presented as cross-sectional slices through the patient, but can be freely reformatted or manipulated as required.

The technique needs delivery of a gamma-emitting radioisotope (a radionuclide) into the patient, normally through injection into the bloodstream. On occasion, the radioisotope is a simple soluble dissolved ion, such as an isotope of gallium (III). Most of the time, though, a marker radioisotope is attached to a specific ligand to create a radio ligand, whose properties bind it to certain types of tissues. This marriage allows the combination of ligand and radiopharmaceutical to be carried and bound to a place of interest in the body, where the ligand concentration is seen by a gamma camera.

SPECT can be used to complement any gamma imaging study, where a true 3D representation can be helpful, such as tumor imaging, infection (leukocyte) imaging, thyroid imaging orbonescintigraphy.
Because SPECT permits accurate localization in 3D space, it can be used to provide information about localized function in internal organs, such as functional cardiac or brain imaging.
Functional brain imaging
Usually, the gamma-emitting tracer used in functional brain imaging is Technetium (99mTc) exametazime. 99mTc is a metastable nuclear isomer that emits gamma rays detectable by a gamma camera. Alleviate, rehabilitate or catch up on disabilities or injuries. One example is that the evolution of hearing aids to mitigate deafness through sound amplification.

SPECT scans use radioactive material called tracers. The tracers mix with your blood and are taken up by living heart muscle.

A special "gamma" camera picks up signals from the tracer as it moves around your chest. The tracer's signals are converted into images by a computer. A SPECT scan can be used to examine blood flow in your heart at rest and during exercise (called a nuclear stress test). If you can't exercise, you'll get a medicine to increase the blood flow in your heart as if you were exercising (called a chemical or pharmacologic stress).
SPECT scans can also give information about how well your heart is pumping. Single photon emission computed tomography is a medical imaging technique that is based on conventional nuclear medicine imaging and tomographic reconstruction methods.

The images reflect functional information about patients similar to that obtained with positron emission tomography (PET). Both SPECT and PET give information based on the spatial concentration of injected radiopharmaceuticals, in contrast to the other medical imaging modalities used for clinical diagnostic purposes.

Methods of compensating for scatter can be grouped into two general approaches. In the first approach, scattered photons are considered to carry no useful imaging information. The compensation techniques involve estimating the scatter component and subtracting it from the measured data or from the reconstructed images to obtain scatter-free reconstructed images. Various techniques have been developed, including those using two or more energy windows during acquisition. The compensation methods based on subtraction of scattered photons provide SPECT images with increased contrast and improved quantitation. However, the methods tend to increase noise in the subtracted images. When conventional reconstruction techniques (e.g., x-ray CT algorithms) are used in SPECT, the reconstructed images are severely affected by statistical noise fluctuations, poor spatial resolution, low-contrast, and inaccurate quantitative information.

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