Spect imaging

Health & Medicine

Single Photon Emission Computed Tomography Imaging Keiser Michelle Beth SPECT Imaging A Single photon emission computerized tomography (SPECT) allows an examiner to analyze the functions of internal organs of a patient's body. A SPECT scan is similar to X-ray computed tomography or Magnetic Resonance Imaging, but different in a way that it utilizes a radioactive substance to give a description of patient's internal organs.

SPECT scan gives a true image of the working of the organs, unlike X-rays that only depicts the state of the internal organ. Gamma rays are utilized for the purpose that is emitted from radioactive labeled drug. A gamma camera is allows to reconstruct a picture of where these rays are originated. In this way SPECT is able to provide true 3D information. Kuhl and Edwards were the first to produce tomographic images using Anger camera in 1963 (SPECT Tutorial).

A gamma camera consists of a camera collimator, which allows gamma rays to reach the detector only in a specific direction to ensure that the position on the detector accurately depicts the beginning location of the gamma rays. Scintillation detector is there to detect gamma photon and with their interaction electrons are released which in turn produce light. To amplify this small amount of light and convert them into an electrical impulse, photomultiplier tubes with photocathode and anode is present. Position circuitry receives these electrical impulses in Summing matrix circuit and determines where each scintillation event occurred. Finally, this data is converted into a readable image of 3D spatial distribution using a computer processor. With a SPECT camera various acquisitions are possible of which planar is the simplest one. Planar acquisition only requires data from one angle is similar to X-ray radiography. Planar dynamic imaging acquires a

series of planar images over a short interval of time. With this, animation of tracer movement can be seen. If SPECT camera is moved to various angles to get a 3D picture of the body then it will be SPECT imaging. In Gated SPECT imaging, camera is attached to ECG machine so that the resulting SPECT shows the heart as it beats over a time interval (SPECT Tutorial).

SPECT camera creates a series of planar images called projections. Collimator detects only those photons moving perpendicular to the camera. As a result, overlapping of all the tracers emitting organs takes place providing a set of planar images acquired at different angles. All the projections are then sub-divided according to a thin portion of a patient's body, which is then ordered into an image called sinogram. Projection sinogram reconstituted at this point has inherent noise in the data making the images rough due to non- uniformity in spatial resolution (Zeniya, 2006). In SPECT imaging, projection data is transformed into frequency space to efficiently filter the data. After that data are again changed back from frequency domain to spatial domain by dimensional inverse Fourier transform to get the three dimensional information. The main step of reconstruction is back projection. Regions where back projection lines intersect represents the areas with higher radiopharmaceutical concentration.

Applications of SPECT include evaluation of functions heart, kidney, brain, and bone scans. It aids in the treatment of cardiovascular patients and patients at risk of hypoxia, aneurism, stenosis and cardiomyopathy (Freeman & Blaufox, 1991).

References:

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