SNS COLLEGE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION)

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Department of Biomedical Engineering

Course Name: RADIOLOGICAL EQUIPEMNT

III Year : VI Semester

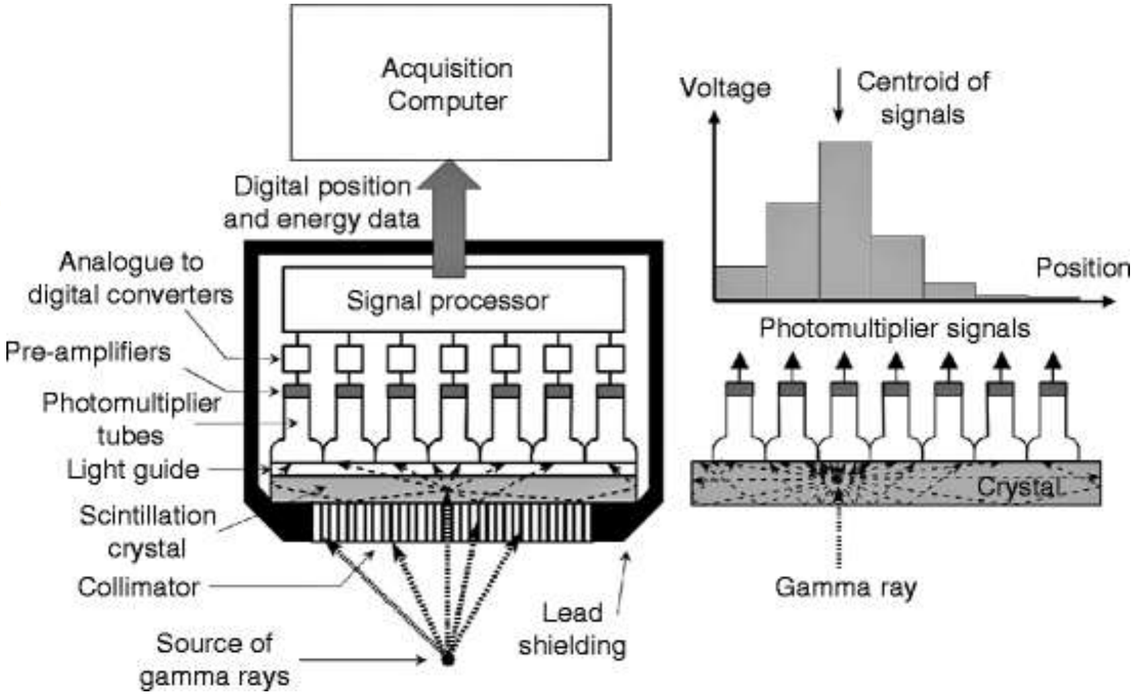
TITLE: PRINCIPLES OF SPECT

SPECT

- A single-photon emission computerized tomography (SPECT) scan lets your doctor analyze your body's organs, tissue and bones.
- A SPECT scan is a type of nuclear imaging test, which means it uses a radioactive substance and a special camera to create 3D pictures.

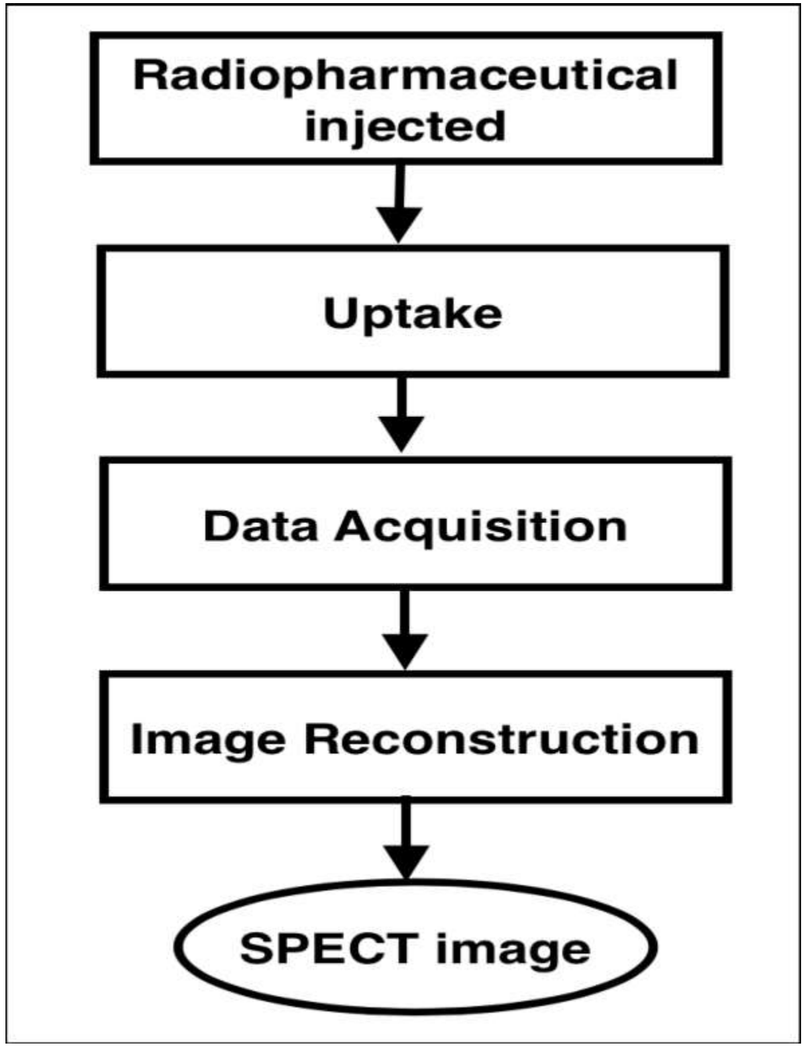
WORKING OF SPECT

- A radiopharmaceutical is injected into the patients body.
- It travel into the blood stream and concentrates in the region of interest.
- There, it decays emitting gamma rays.
- The gamma rays travel out the patients body and are detected by the gamma camera head of the SPECT machine .
- The gamma ray is collimate by the collimators to minimize scatter and improve image quality.



WORKING OF SPECT

- The collimated gamma rays hit the crystal detector usually sodium iodine crystals doped with Thallium [Nal (Tl)], which converts the energy of the gamma rays to visible light .
- As visible light travel through the photo multiplier tubes(PMT), they absorb the light and emit electrons.
- The electron emitted are used for image formation.
- They are detected by a positioning and summing circuit which decode the body position of the original photon.
- A pulse height analyzer decodes the energy of the emitted photons and finally the information is passed to the digital circuit on a computer



PRINCIPLE OF SPECT

1. GAMMA RAY DETECTION:

Gamma-ray detection is a crucial component of SPECT imaging. A gamma camera equipped with a scintillation crystal and a photomultiplier tube is used to detect the emitted gamma rays from the patient. The scintillation crystal converts gamma rays into visible light, which is then amplified and converted into electrical signals by the photomultiplier tube. These signals are further processed to create the SPECT images.

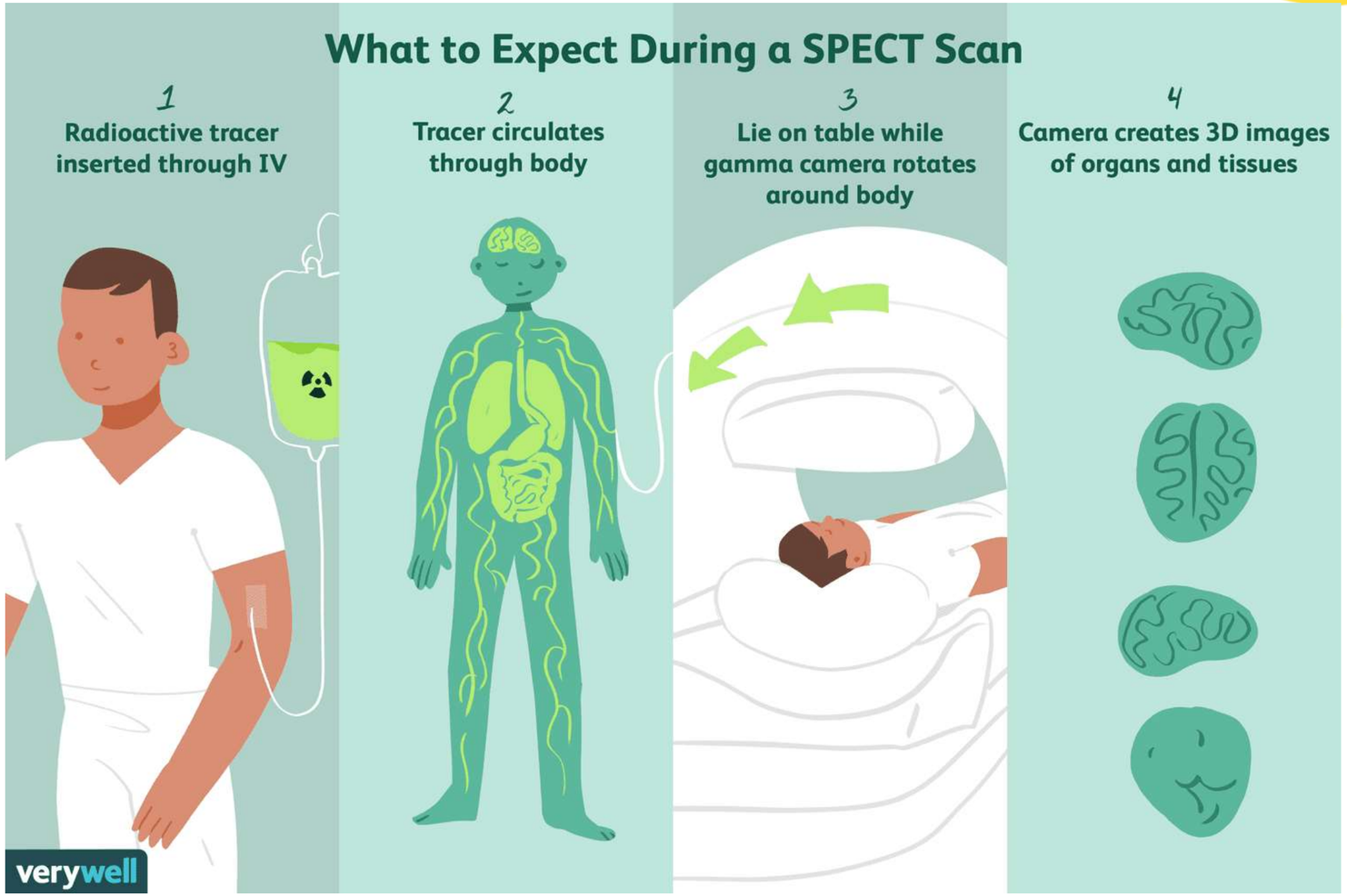
2.COLLIMATION IN SPECT:

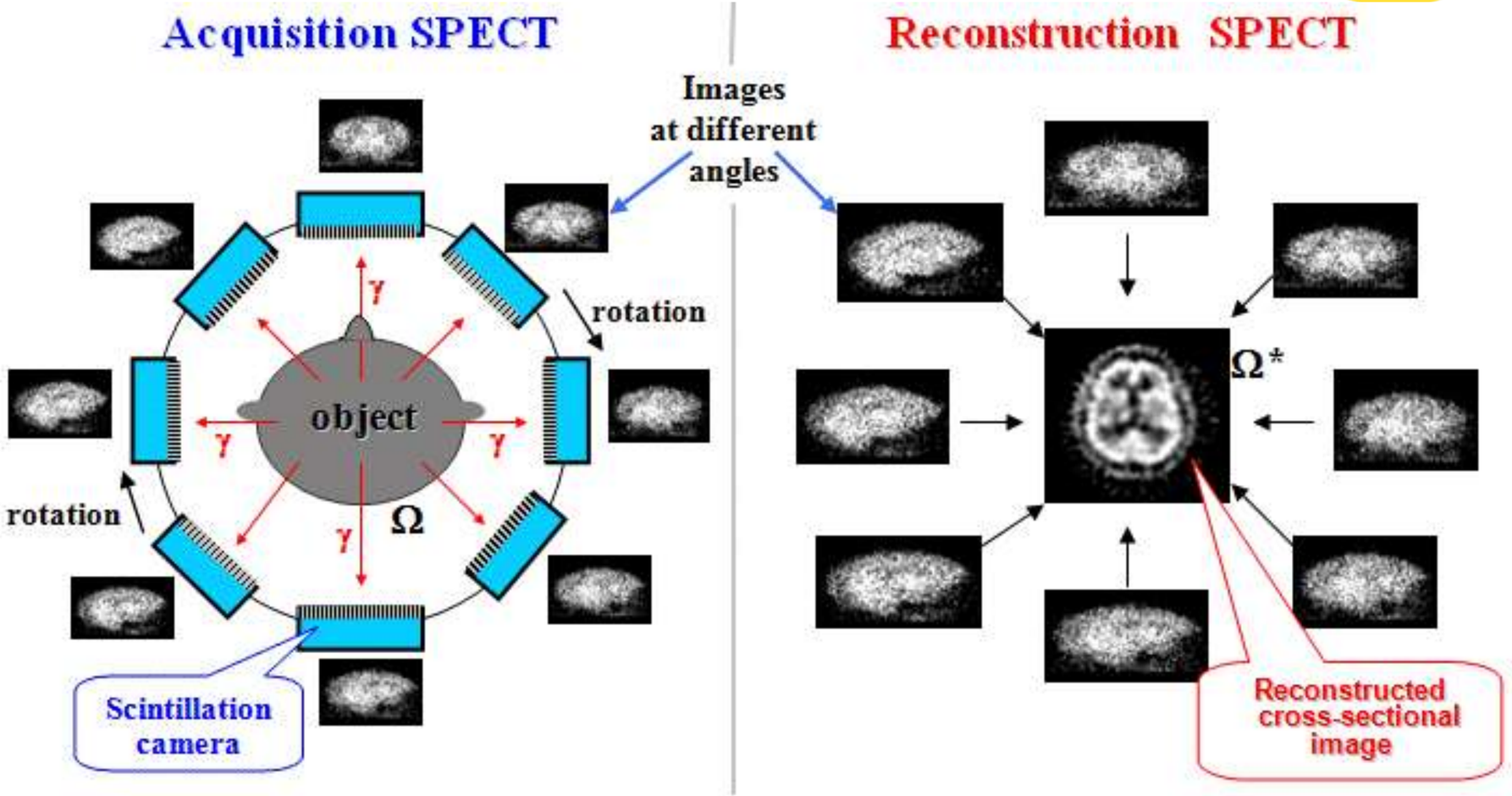
Collimation is an essential technique in SPECT imaging. It involves the use of a collimator, which is a lead or tungsten plate with an array of tiny holes. The collimator allows only the gamma rays emitted in specific directions to reach the scintillation crystal of the gamma camera. This helps in reducing scattered gamma rays and improving the spatial resolution of the SPECT images

PRINCIPLE OF SPECT

3. IMAGE RECONSTRUCTION IN SPECT:

Image reconstruction is the process of converting the acquired projection data into a three-dimensional image. Various algorithms, such as filtered back projection and iterative reconstruction, are used for SPECT image reconstruction. These algorithms account for factors like attenuation and scatter to generate accurate and high-quality images. The reconstructed images provide valuable information about the functional and anatomical aspects of the imaged organ or tissue.


What to Expect During a SPECT Scan
1
Radioactive tracer inserted through IV
2
Tracer circulates through body
3
Lie on table while gamma camera rotates around body
4
Camera creates 3D images of organs and tissues
verywell


Acquisition SPECT
Reconstruction SPECT
Images at different angles
rotation
rotation
object
Ω
γ
γ
γ
γ
Scintillation camera
Ω*
Reconstructed cross-sectional image

Why SPECT is done?

Some of the most common uses of SPECT are to help diagnose or monitor brain disorders, heart problems and bone disorders.

BRAIN DISORDERS:

A SPECT test creates a detailed, 3D map of the blood flow activity in your brain, which can be helpful in determining which parts of the brain are being affected by:

- Clogged blood vessels
- Seizure disorders.
- Parkinson's disease.

HEART PROBLEMS:

Because the radioactive tracer highlights areas of blood flow, SPECT can check for:

- Clogged coronary arteries.
- Reduced pumping efficiency

BONE DISORDERS:

Areas of bone healing or cancer progression usually light up on SPECT scans, so this type of test is being used more frequently to help diagnose hidden bone fractures.

APPLICATIONS OF SPECT

SPECT imaging finds wide applications in medical diagnostics. It is commonly used in:

- cardiology for assessing myocardial perfusion and function,
- neurology for studying brain disorders,
- and oncology for tumor detection and staging.
- SPECT also plays a crucial role in theranostics, where it combines both diagnostic imaging and targeted therapy using radiopharmaceuticals.

ADVANTAGES OF SPECT

SPECT imaging offers several advantages in medical diagnostics:

- It provides functional information about the imaged organ or tissue, allowing for better disease characterization.
- SPECT is non-invasive, relatively cost-effective, and widely available in medical facilities.
- It also has the capability to perform quantitative analysis of radiotracer uptake, aiding in treatment planning and monitoring. These advantages make SPECT a valuable imaging modality in clinical practice

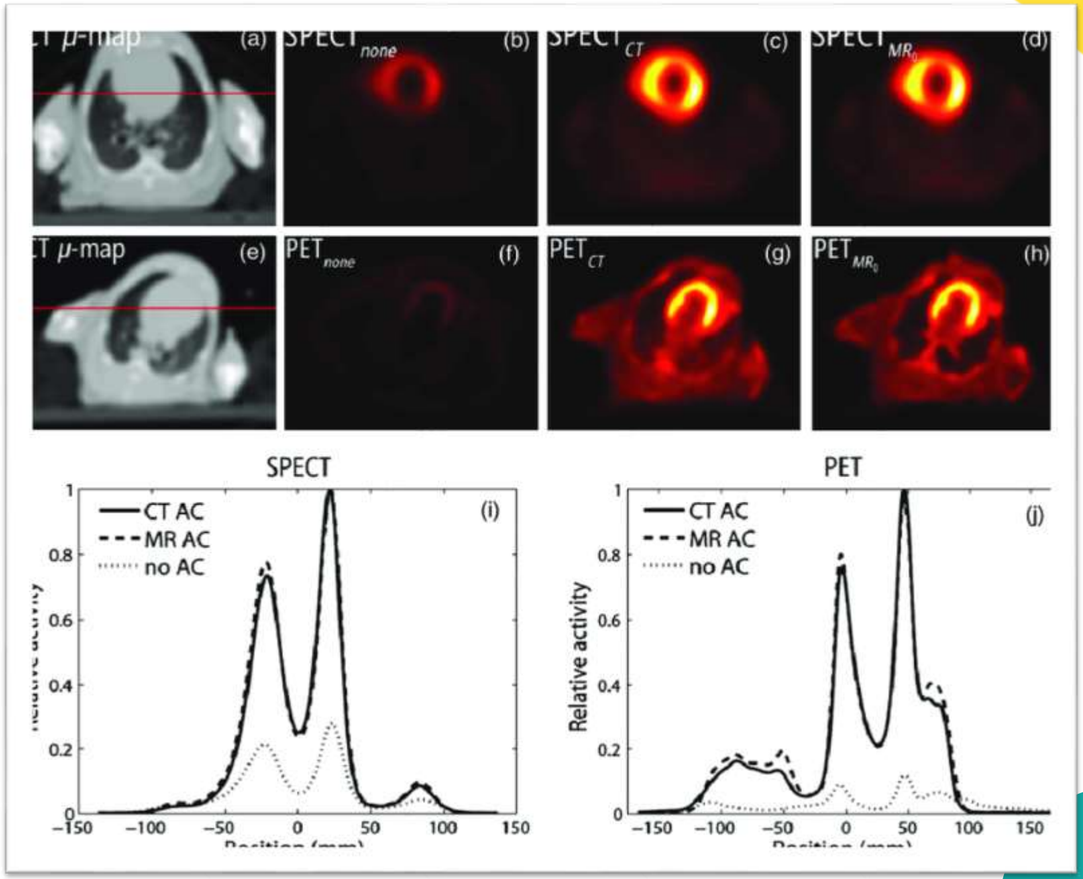
RISKS OF SPECT

- SPECT scans are generally a very safe procedure and do not trigger any harmful side-effects.
- Minor bleeding, pain or swelling post the intravenous injection in the region where the needle was inserted in the arm can occur, which diminishes on its own within a day or two.
- in rare instances, the patient may be allergic to the radioactive dye.

DIFFERENCE BETWEEN PET AND SPECT

PET vs SPECT Imaging

PET	SPECT
Resolution range of clinical devices: 2–6 mm ✔	Resolution range of clinical devices: 7–15 mm
Excellent quantitative ability ✔	Usually lower quantitative ability compared to PET
only a single radiotracer can be applied	several radiotracers can be applied at one time (multi-tracer imaging) ✔
Short acquisition time – dynamic imaging/kinetic modeling is efficient ✔	Long acquisition time – dynamic imaging/kinetic modeling is impractical
Cyclotron production of the most commonly used radioisotopes (including ^{18}F-FDG) limit the availability	Generator production of the most commonly used radioisotope (^{99m}Tc) make them widely available ✔



Vision Tit 2

Vision Title 3

THANK YOU!!!