

Module 10

Medical Imaging

- X-rays
- Computed Tomography (CT)
- Positron Emission Tomography (PET)
- Single Photon Emission Computed Tomography (SPECT)

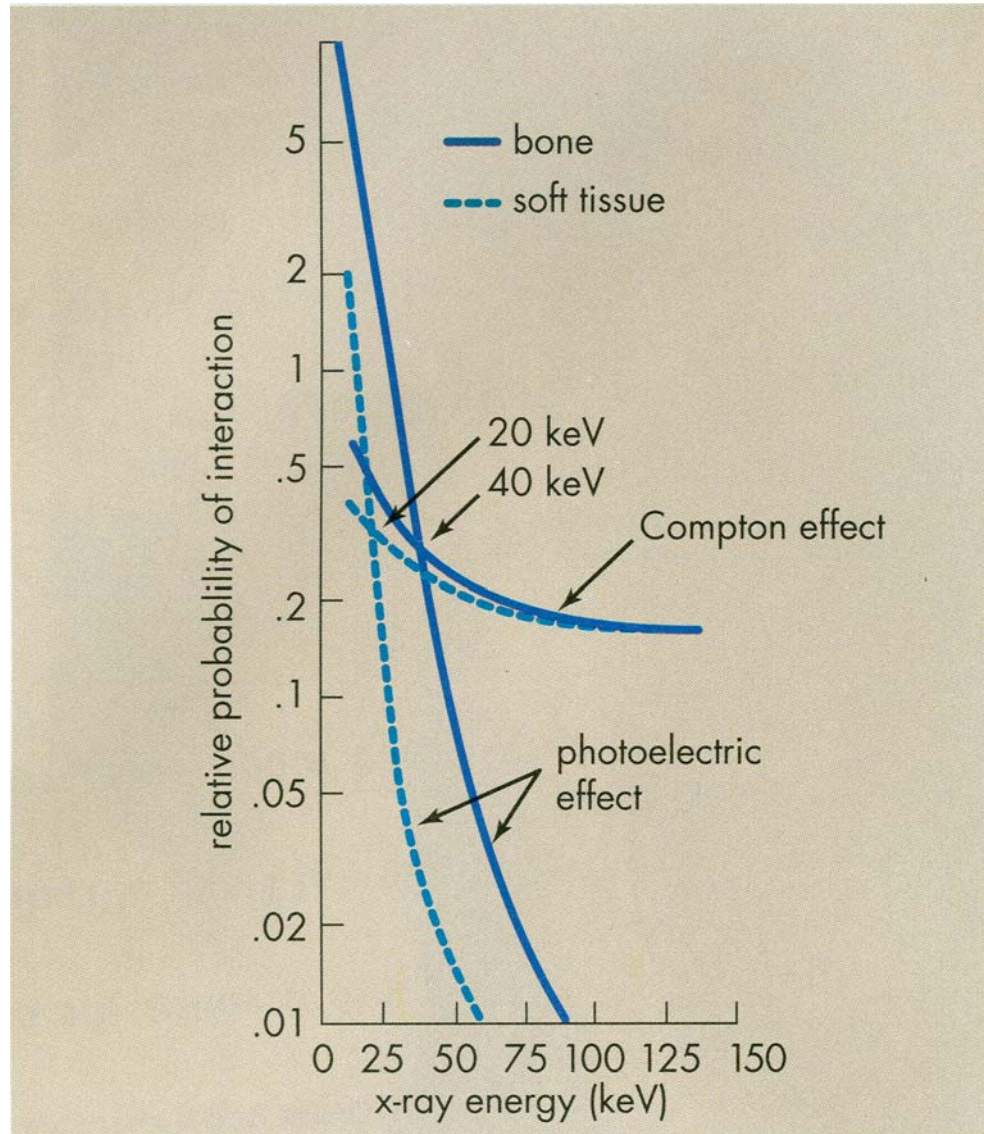
Early Radiograph



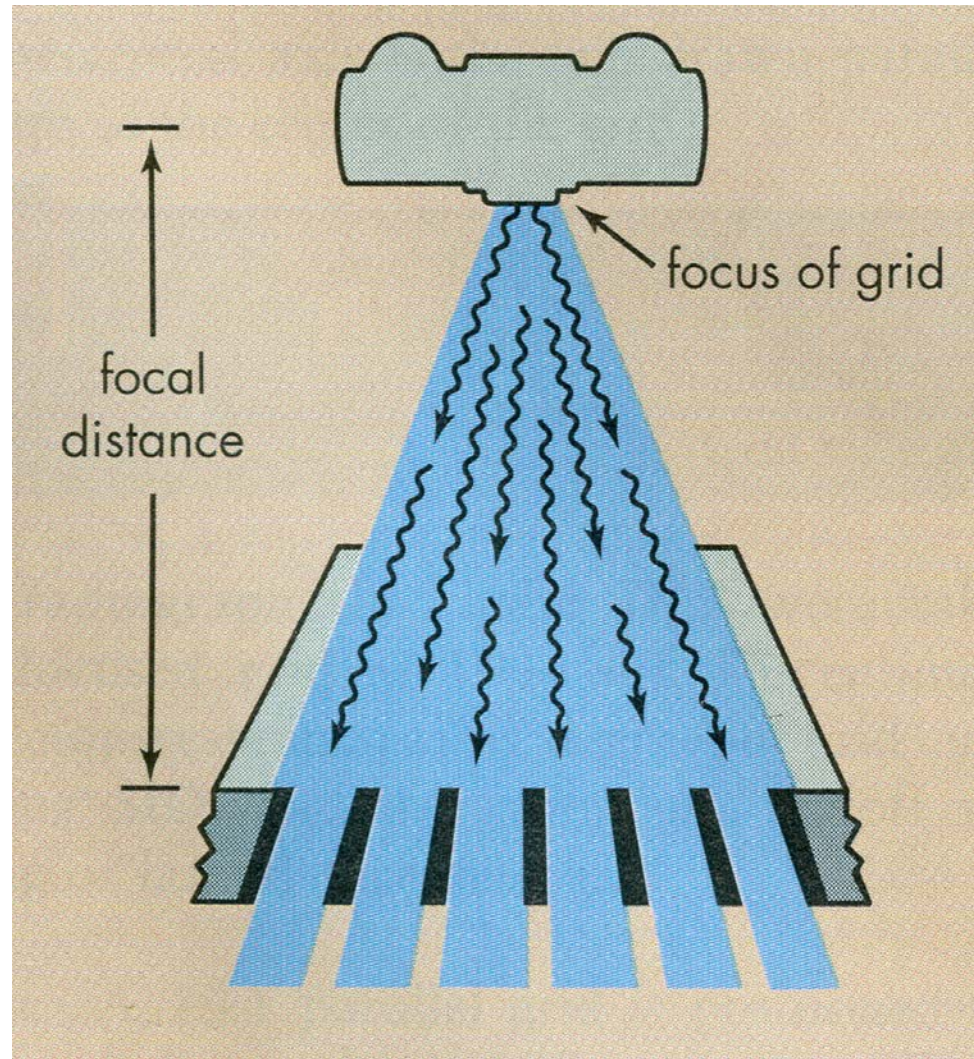
Modern Refinements

- Adjustable X-Ray spectrum
- Grids to enhance contrast reduce effect of scattered X-Rays
- Tomography (linear and angular)
- Digital detectors
- Computer Enhancement

Compton Fogging of X-Rays



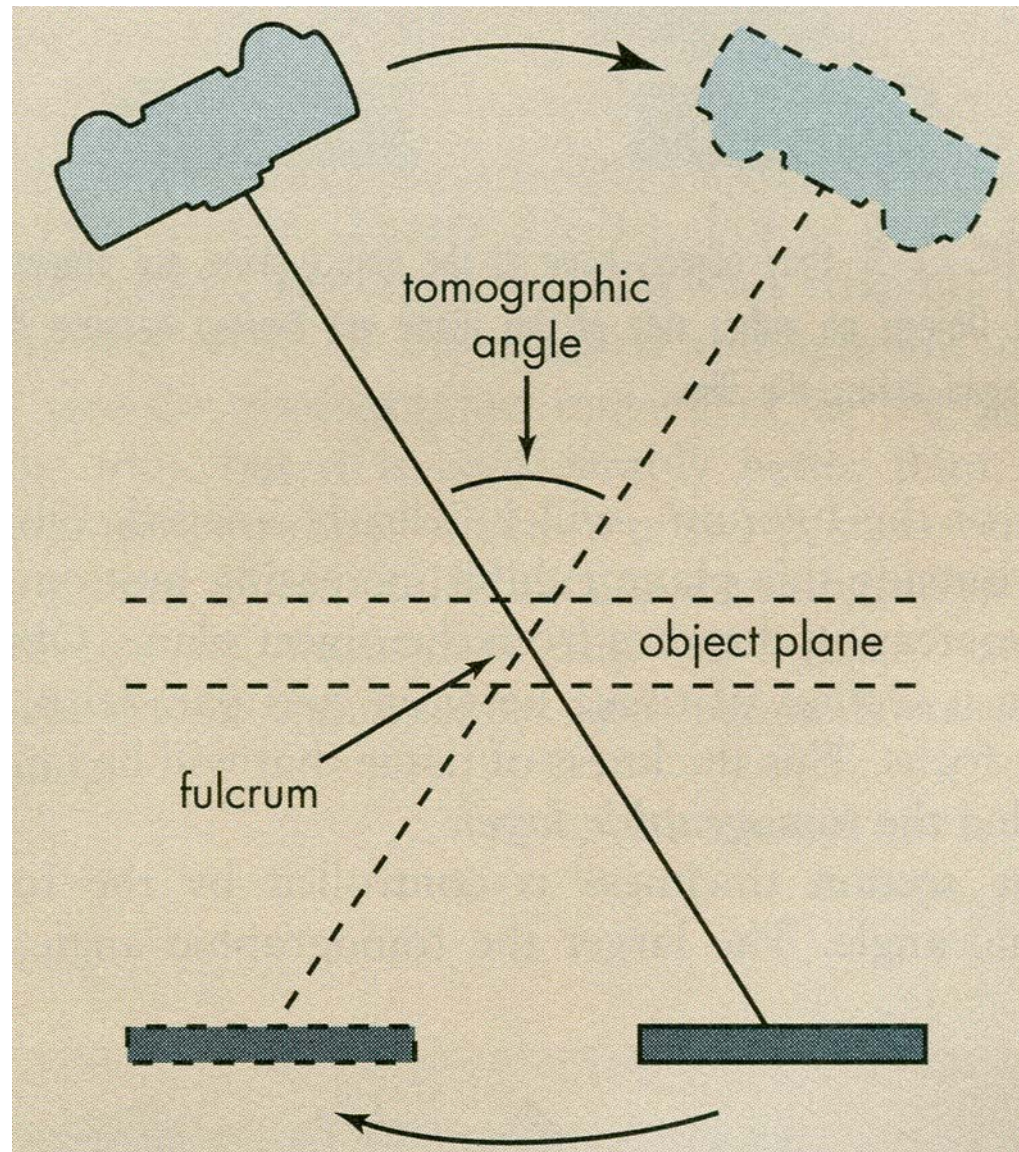
Grid to remove Compton Scattering



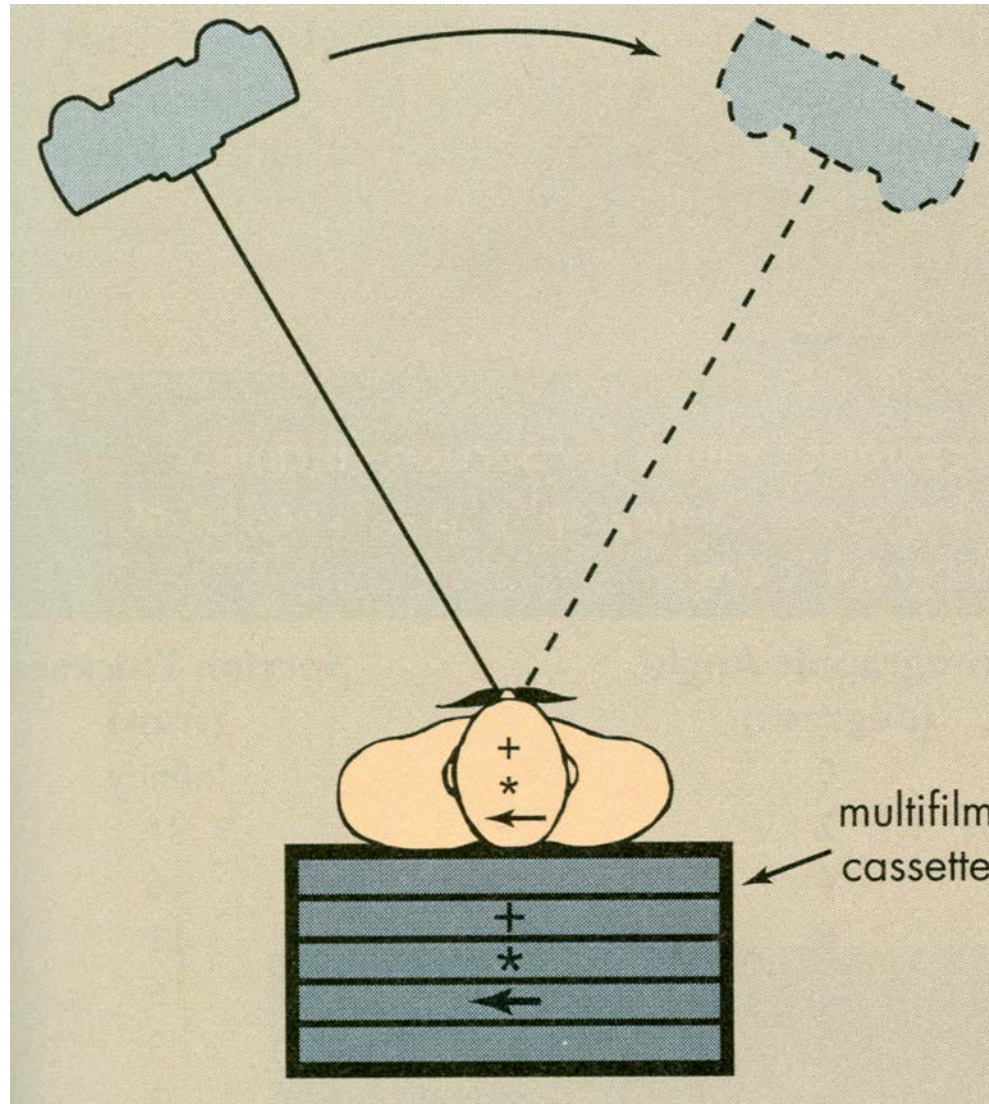
Tomography

- Any of several techniques for making detailed x-rays of a predetermined plane section of a solid object while blurring out the images of other planes.

Basic Tomography



Multi-level Tomography



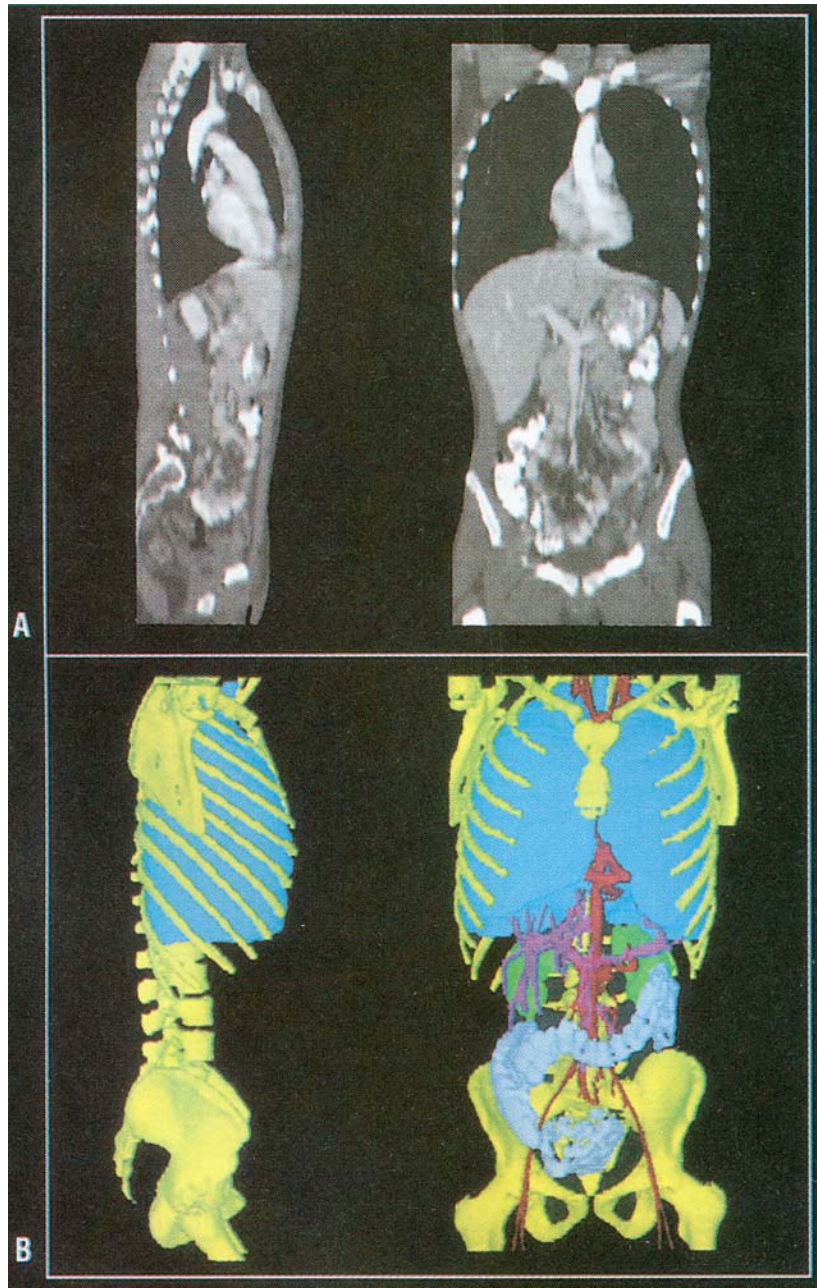
Parallel Versus Perpendicular



Computed Tomography

- Using a series of 2 dimensional data to reconstruct a 3 dimensional image by analogue or digital methods.
- Higher doses (> 200 mRem) are common for this procedure.
- Newer techniques such as spiral scan can minimize the dose needed.
- Need to solve linear equation for each pixel. Most scanners now have over 250,000 pixels!

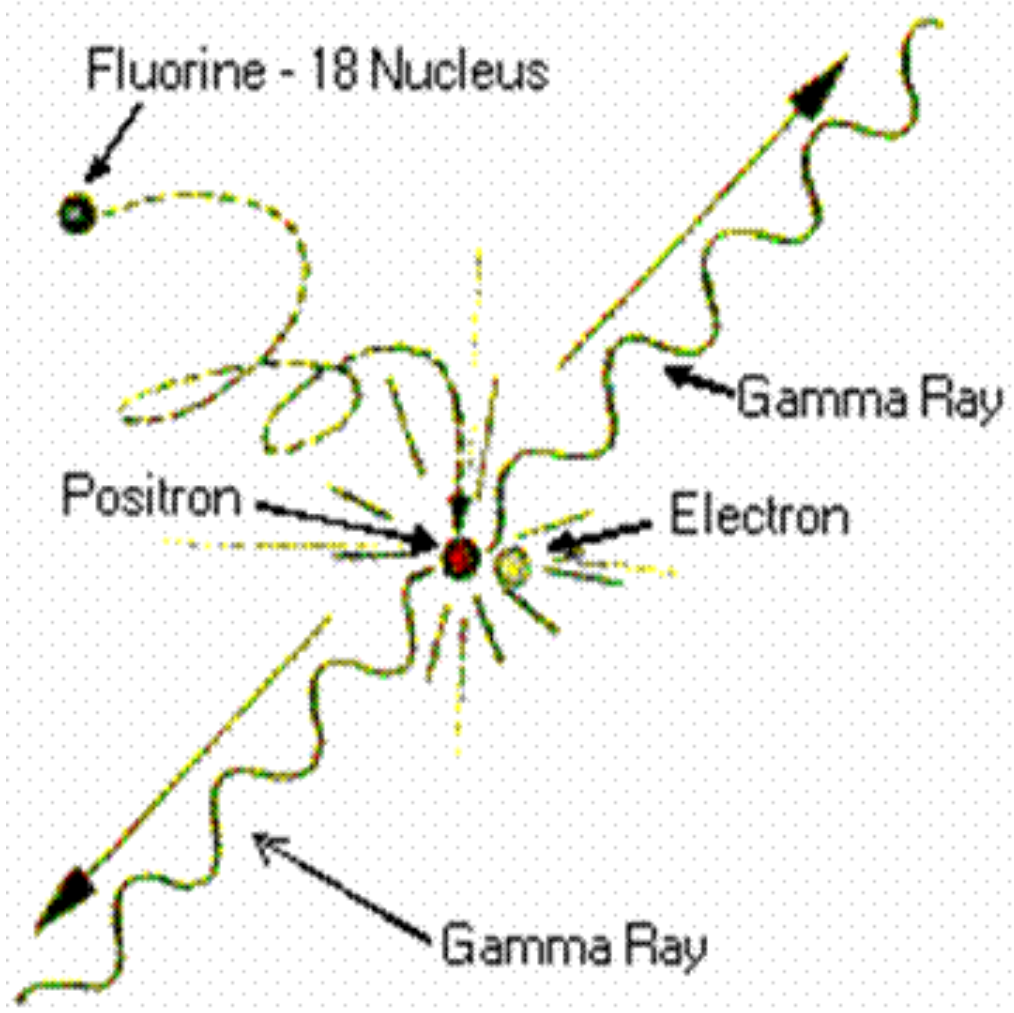
Standard CT

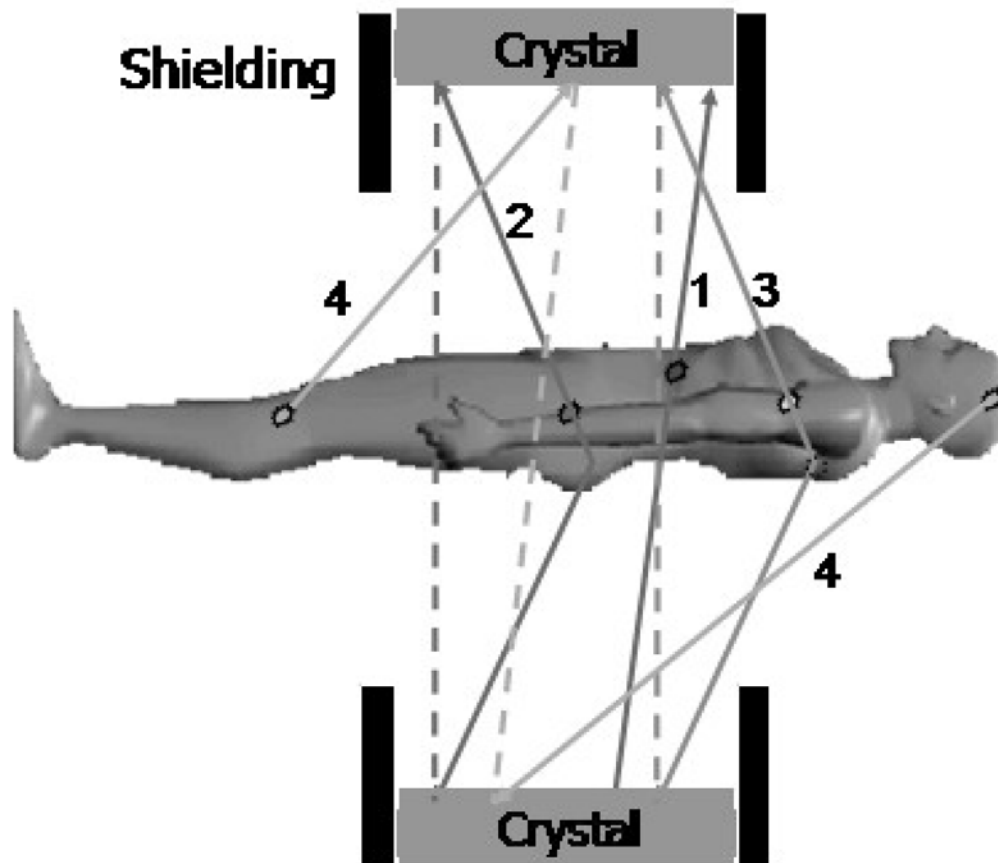


With
Surface
Shading

Modern
Example
of CT
Scan with
the
addition
of Surface
Shading

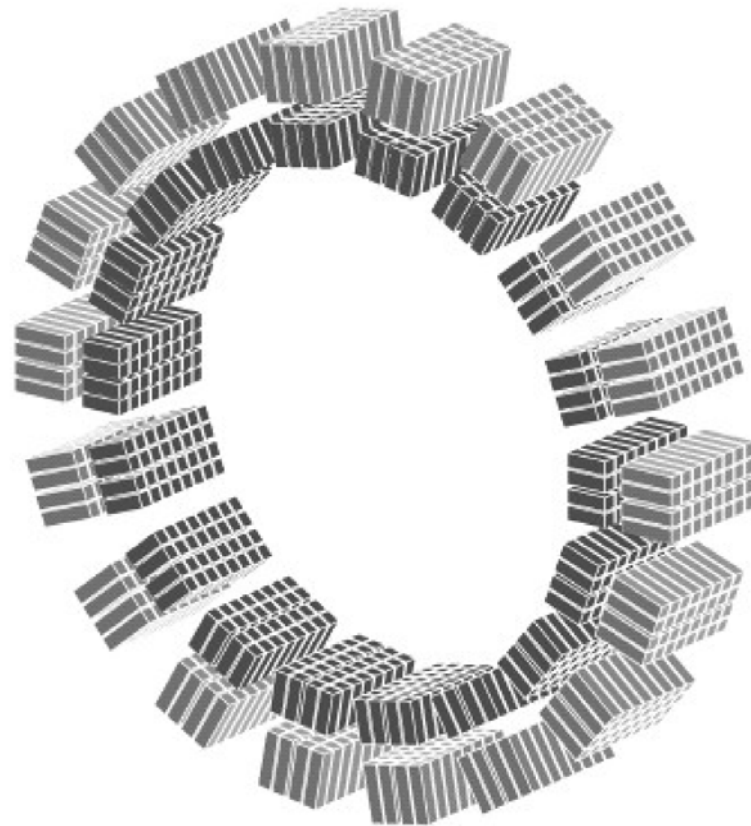
Positron Emission Tomography



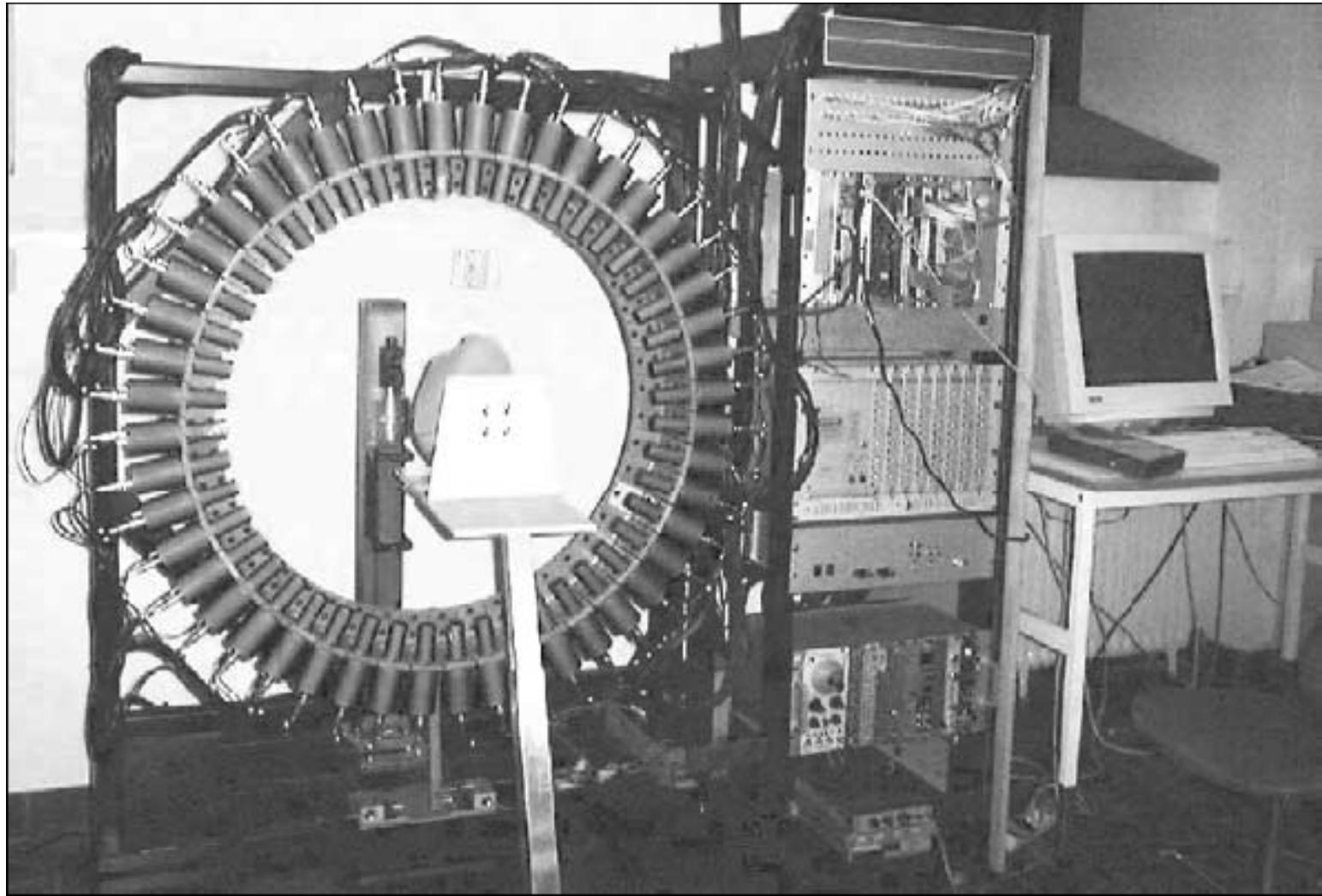


1. True Coincidence
2. Scatter Inside FOV
3. Scattered Outside FOV
4. Random coincidence

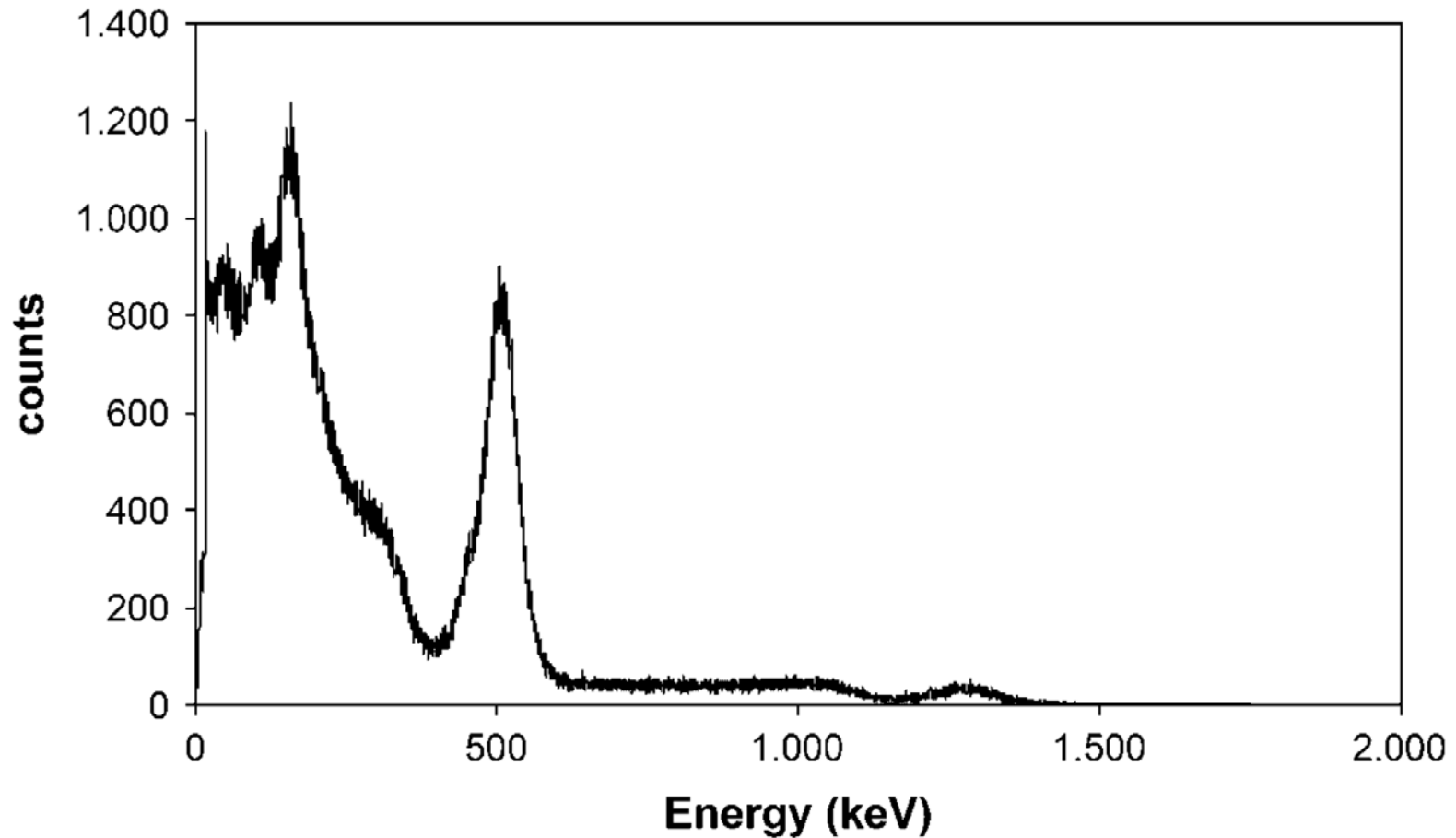
LSO-APD Array Schematic



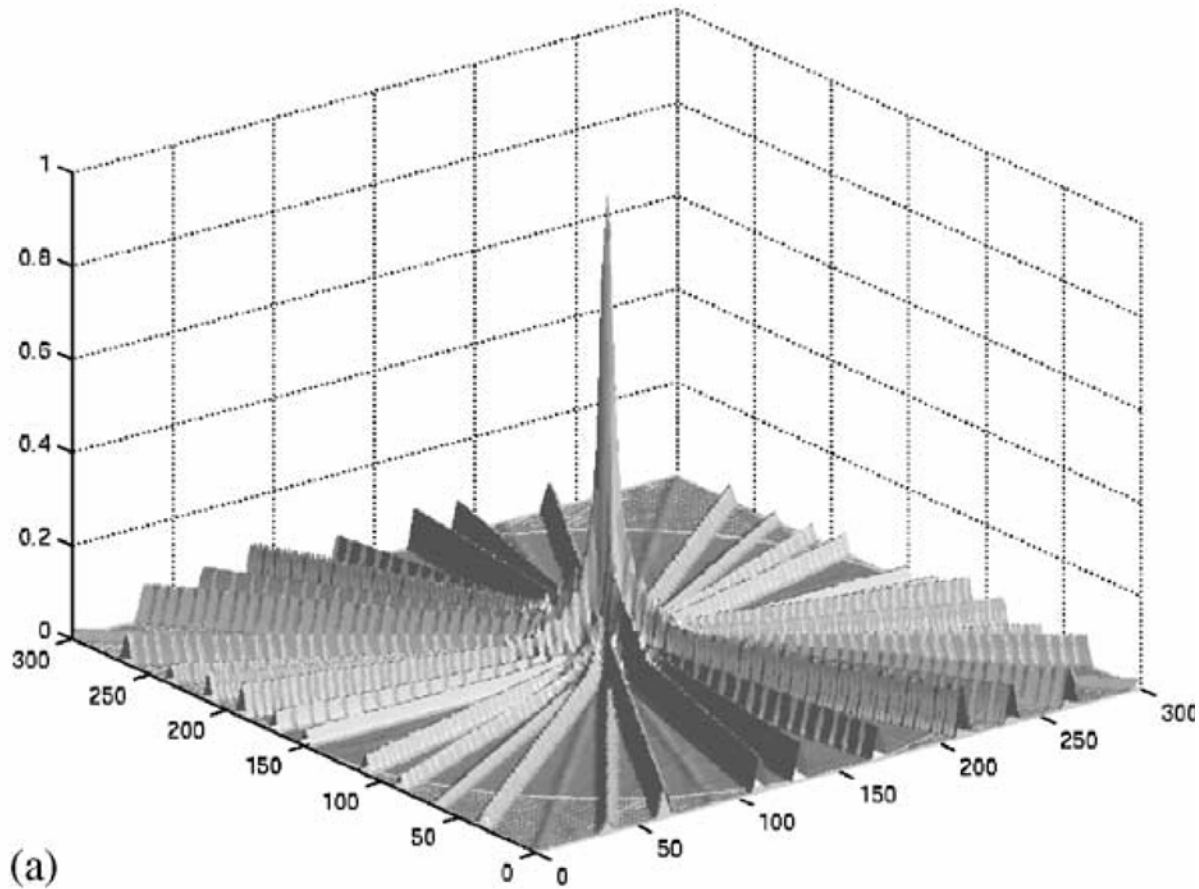
Time-of-Flight PET



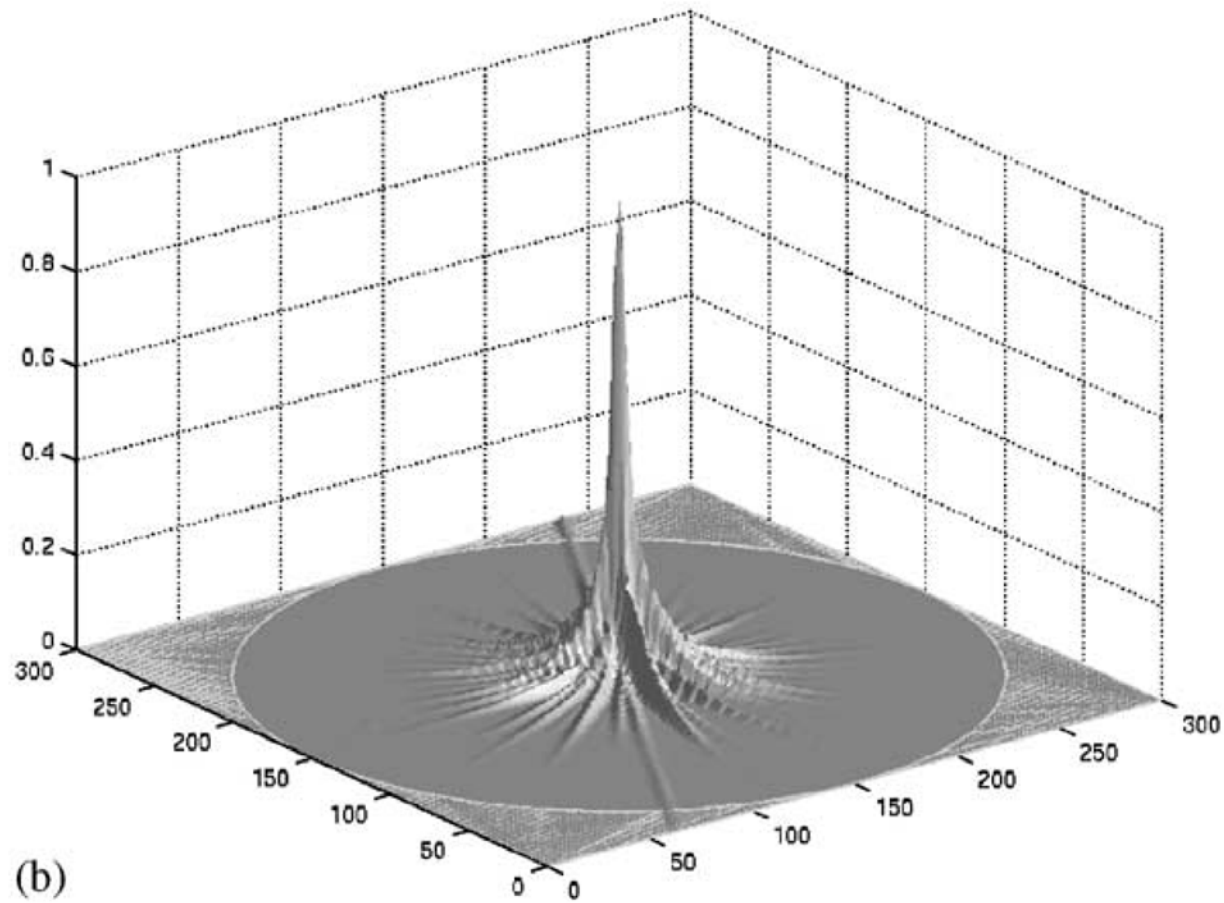
Energy Spectrum with Lutetium oxyorthosilicate (LSO)-APD Array



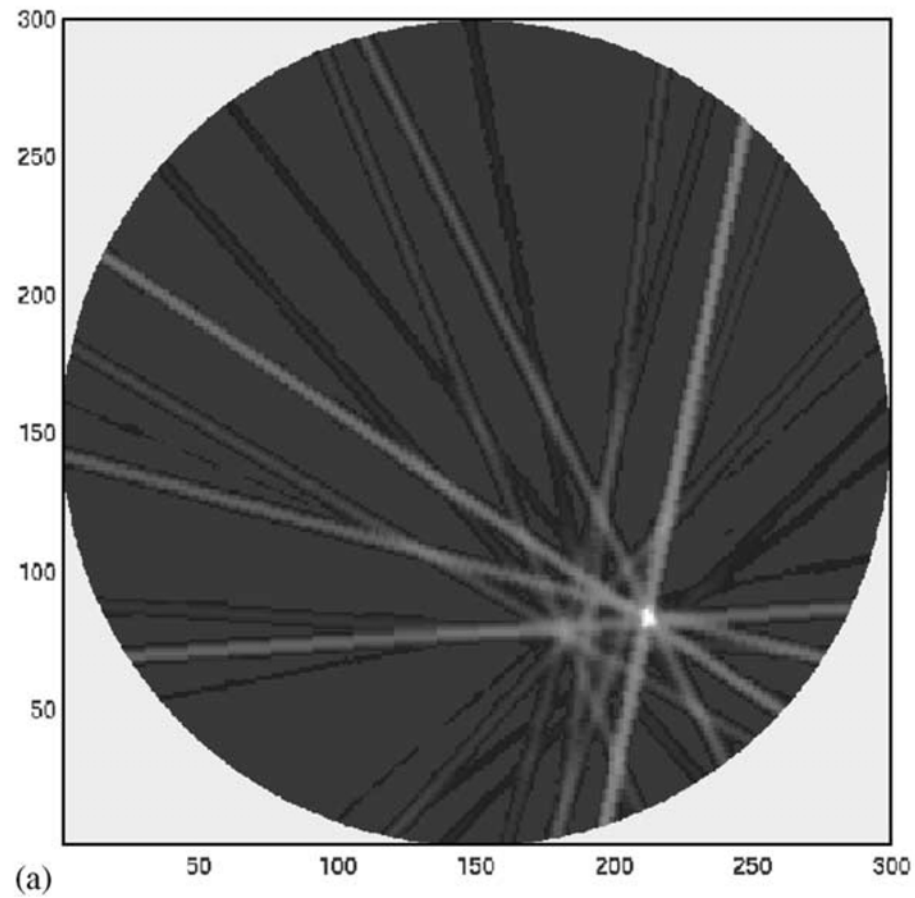
Single Source PET only



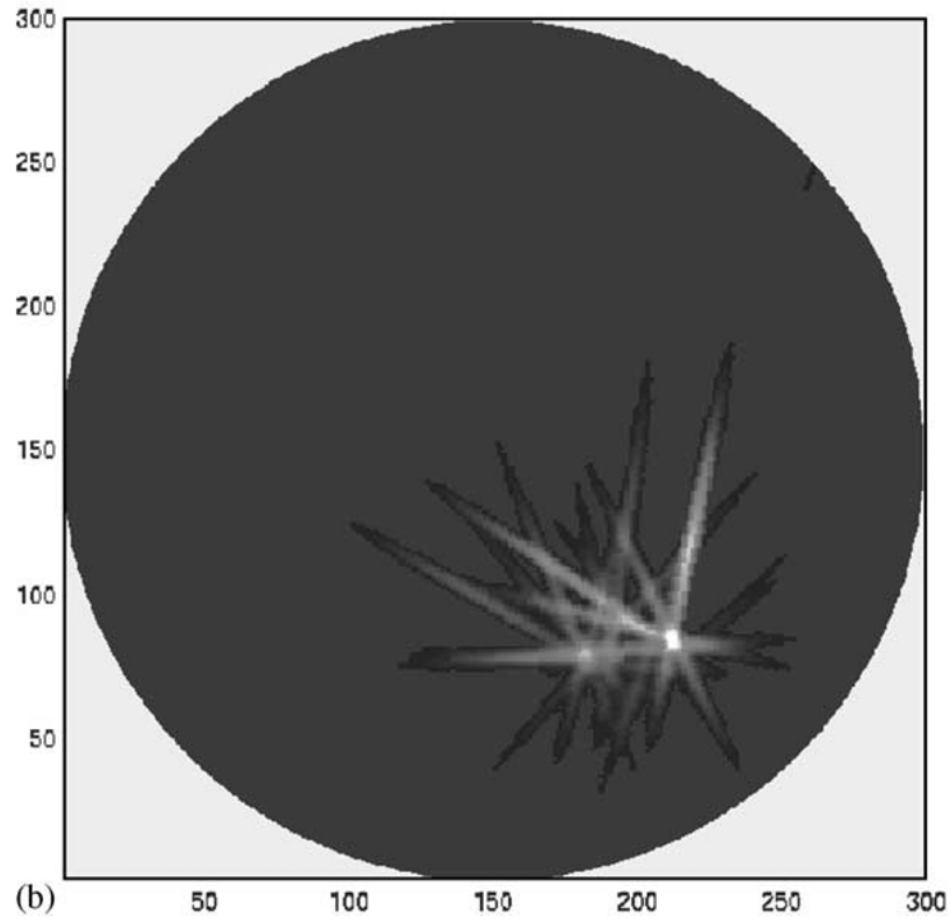
Single Source Pet-TOF



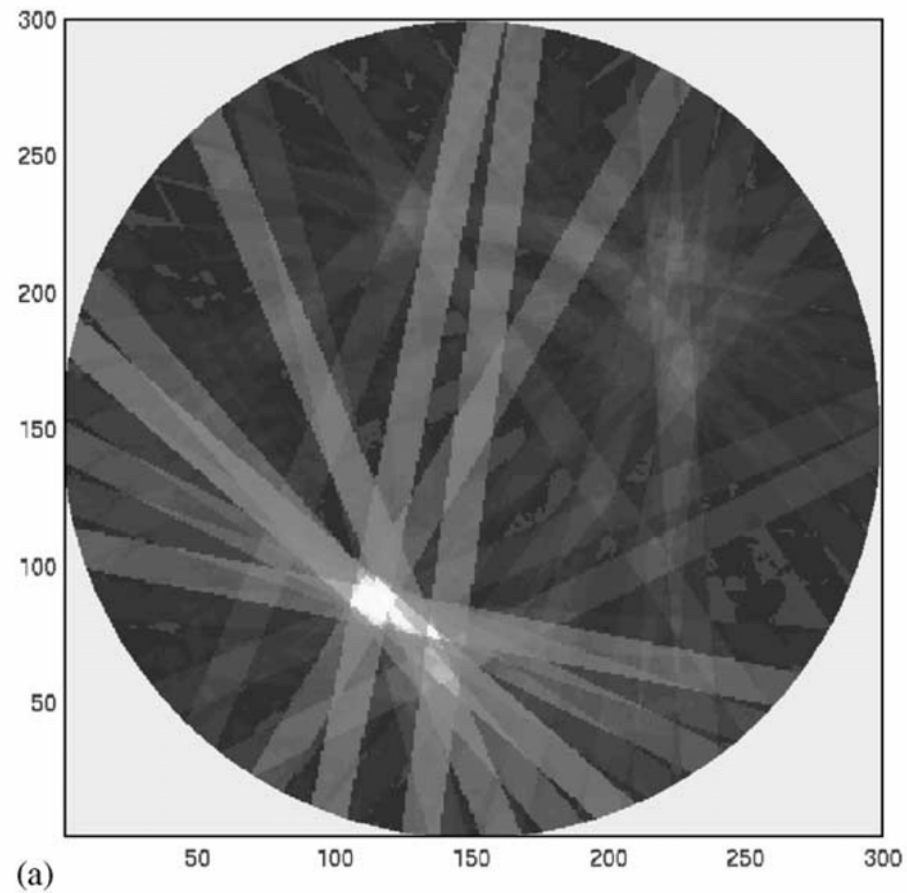
Two Sources PET



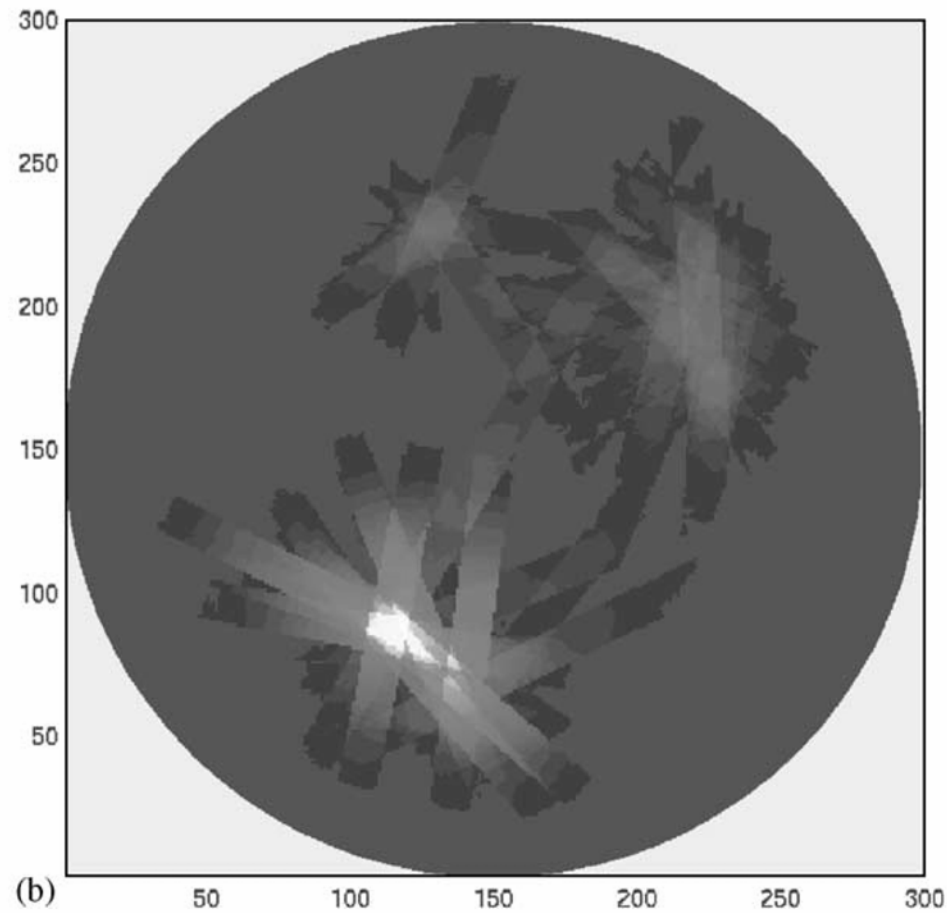
Two Sources PET-TOF

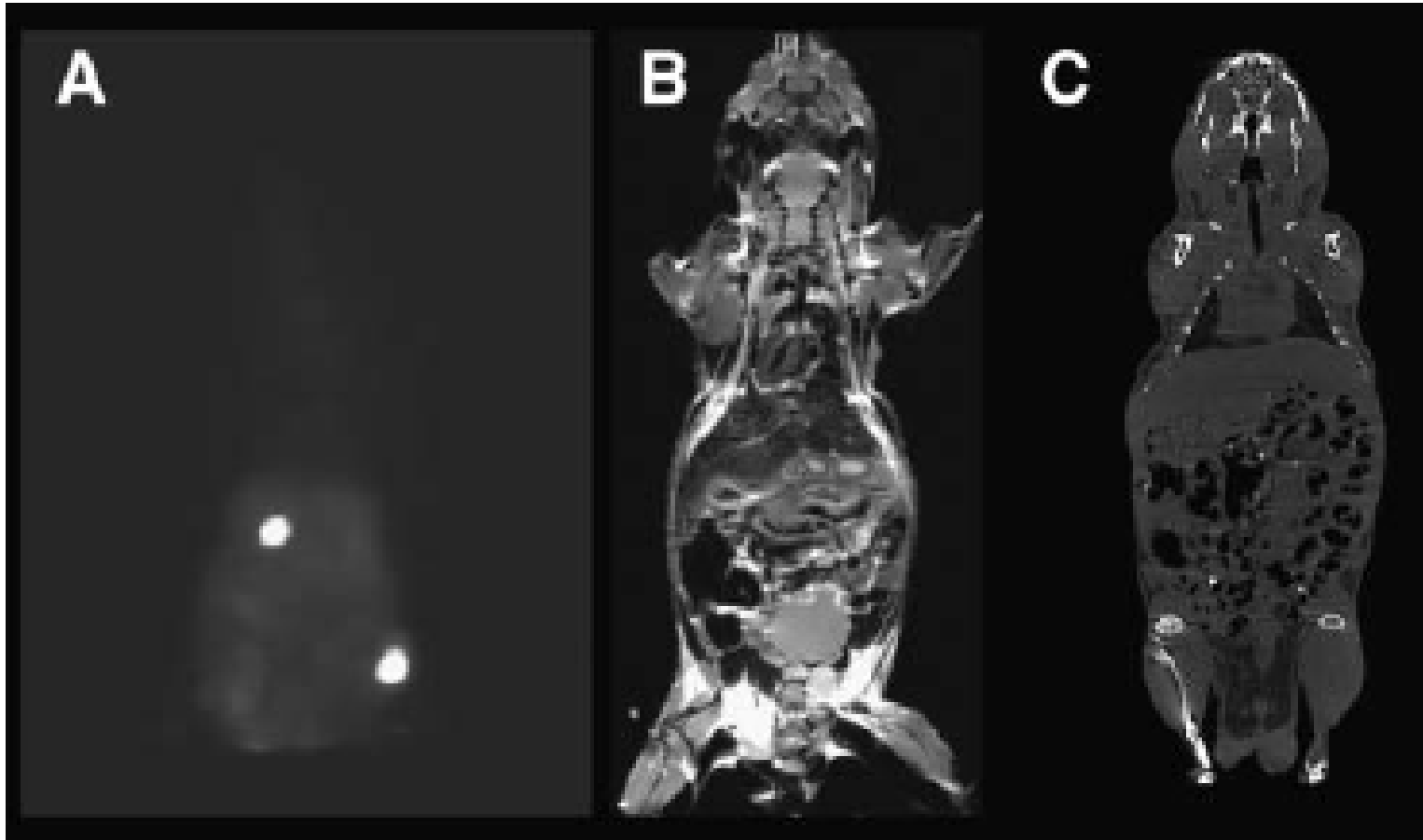


Four Sources PET



Four Sources PET-TOF



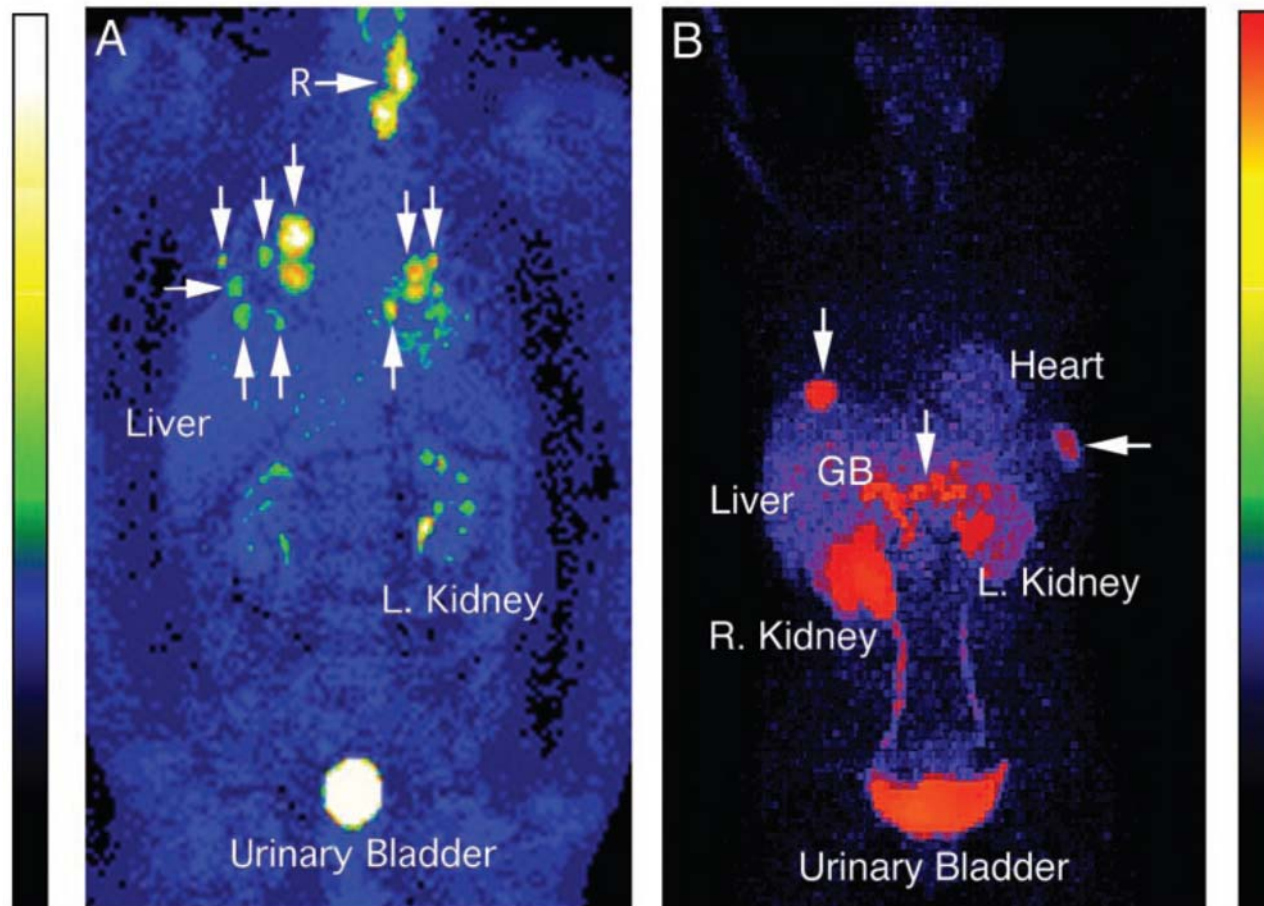


PET Scan

MRI

CT scan

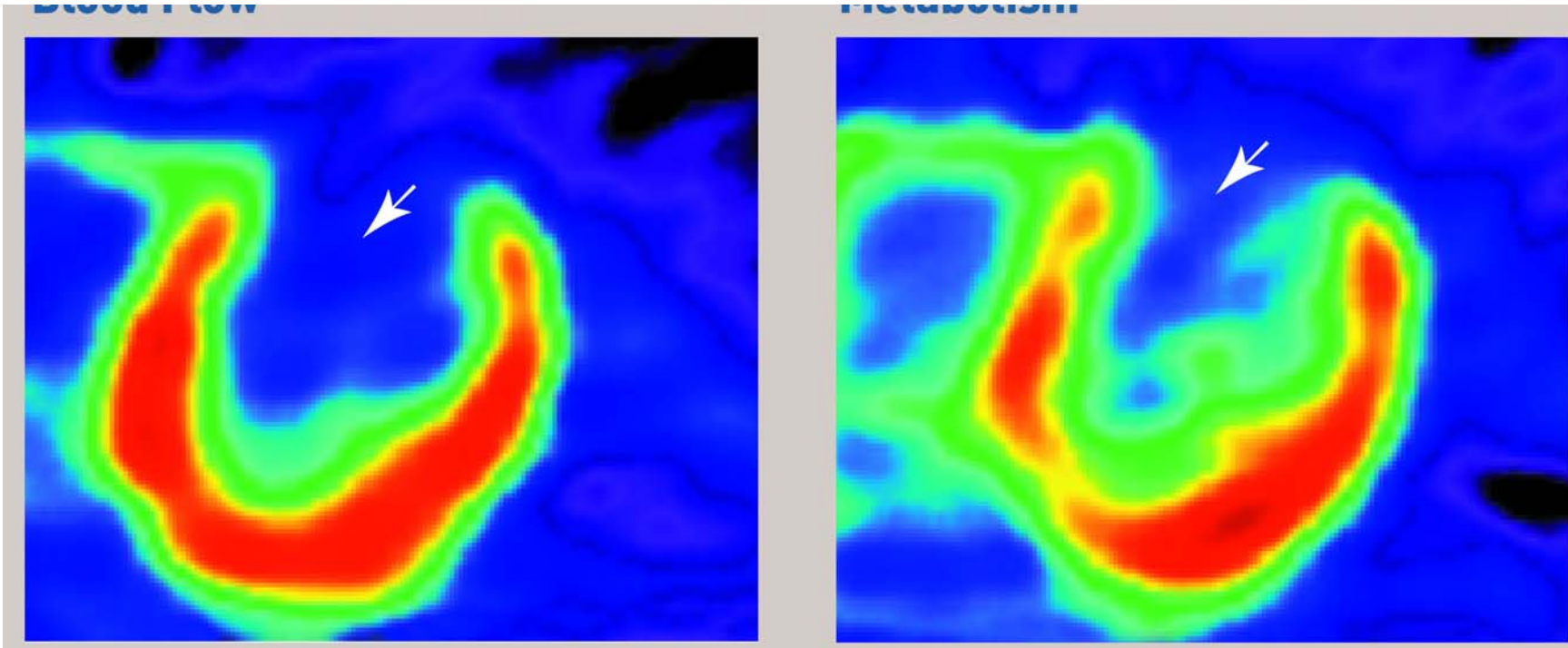
Endocrine Gland Cancers



metastatic thyroid cancer

metastatic pheochromocytoma

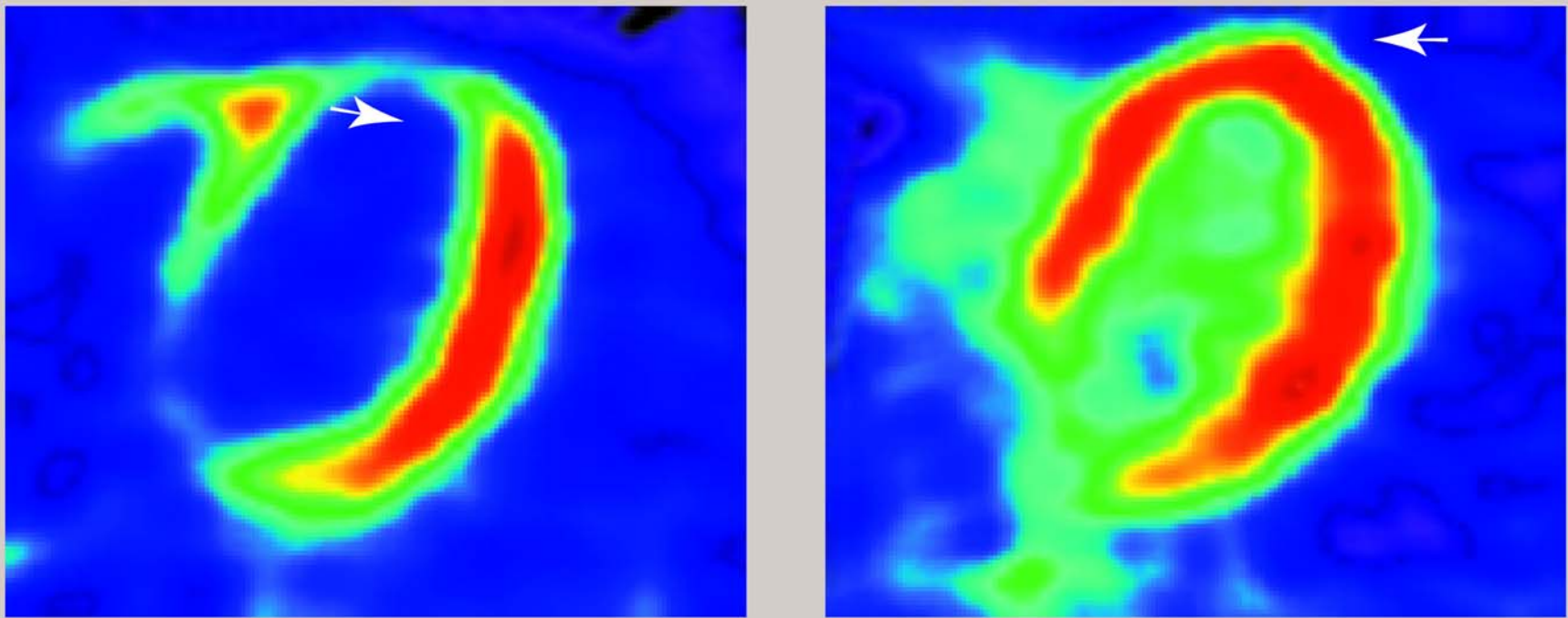
Blockage of a heart vessel.



Blood Flow

Metabolism

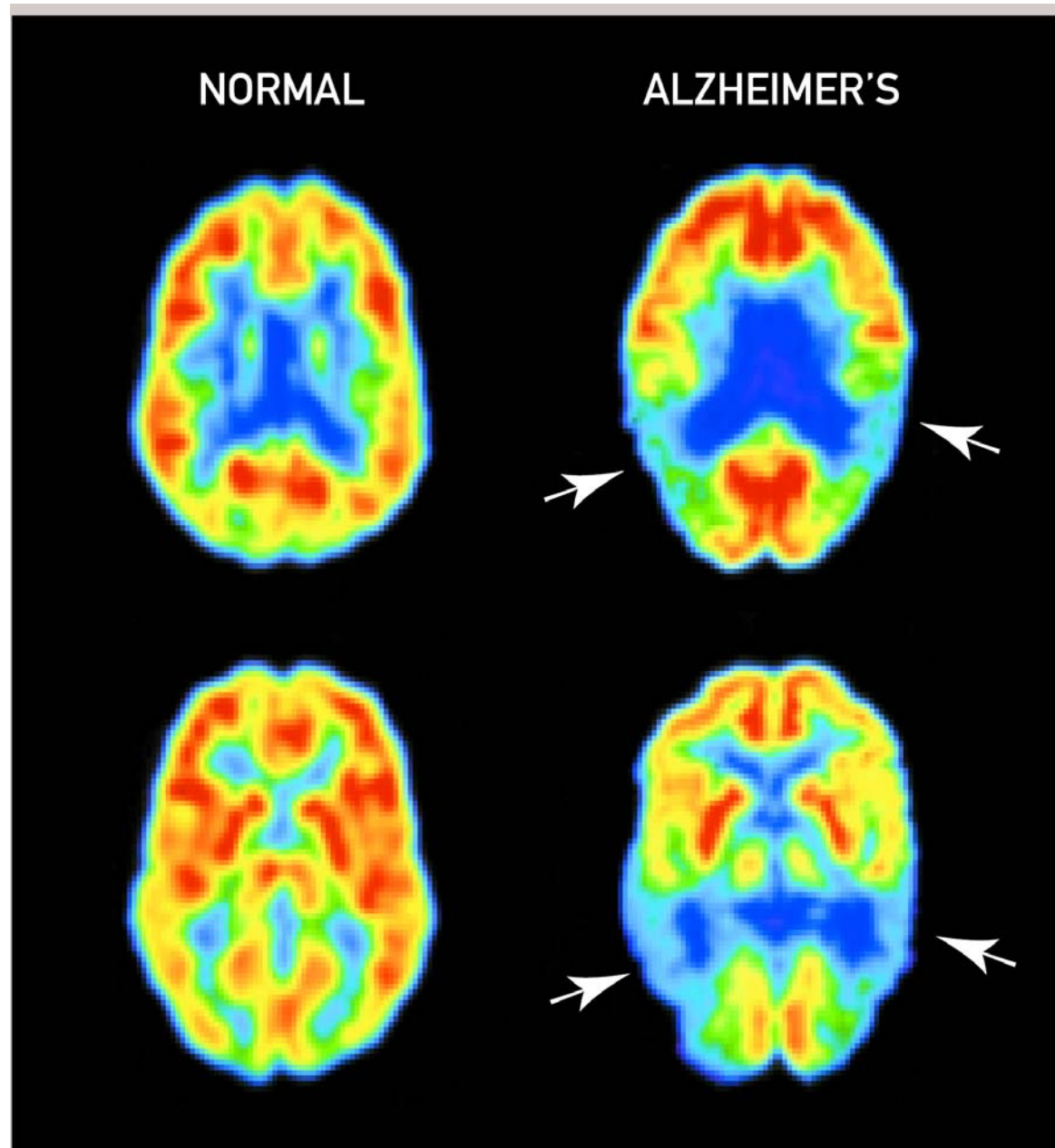
Heart blockage but healthy metabolism



Blood Flow

Metabolism

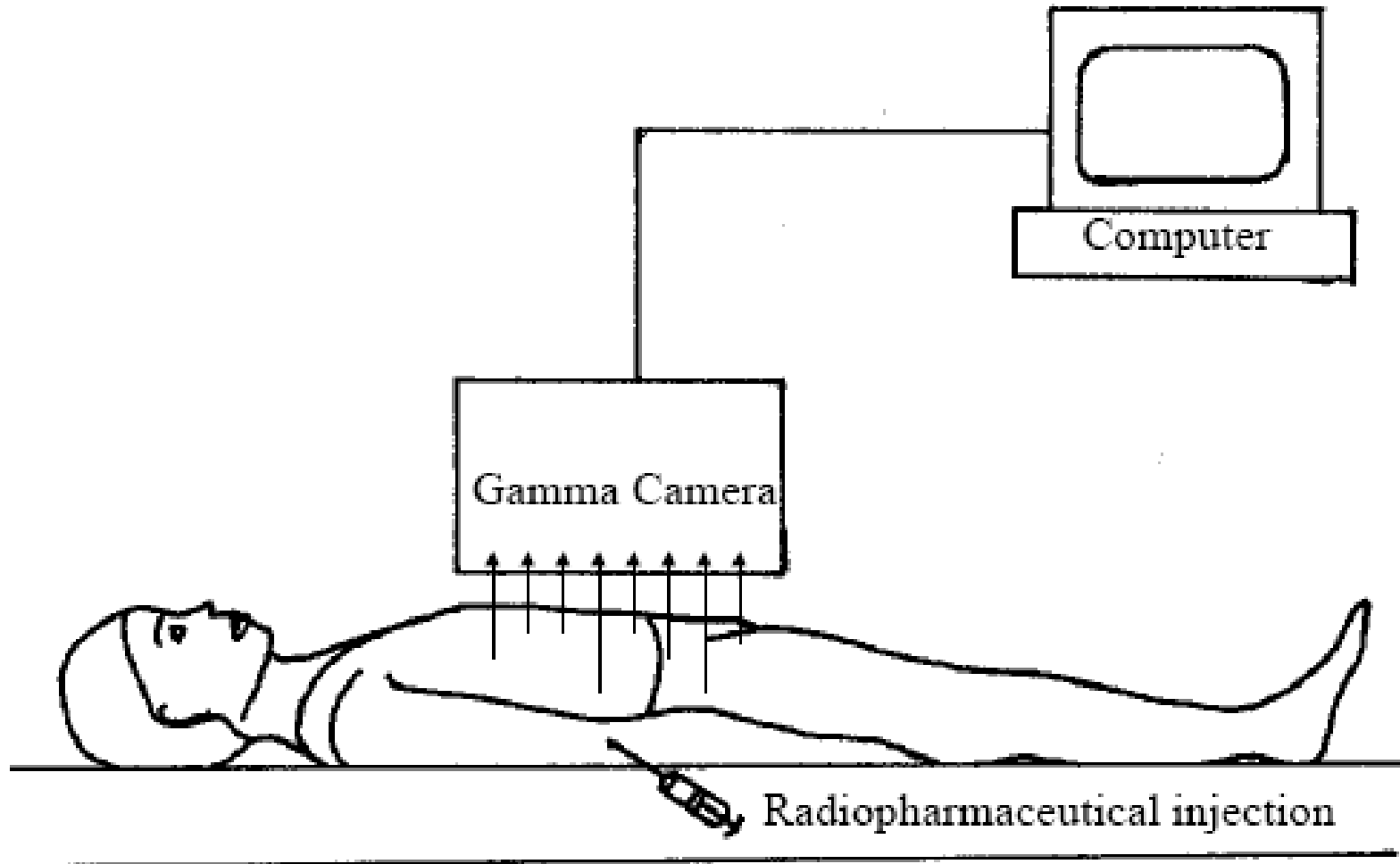
Brain Function



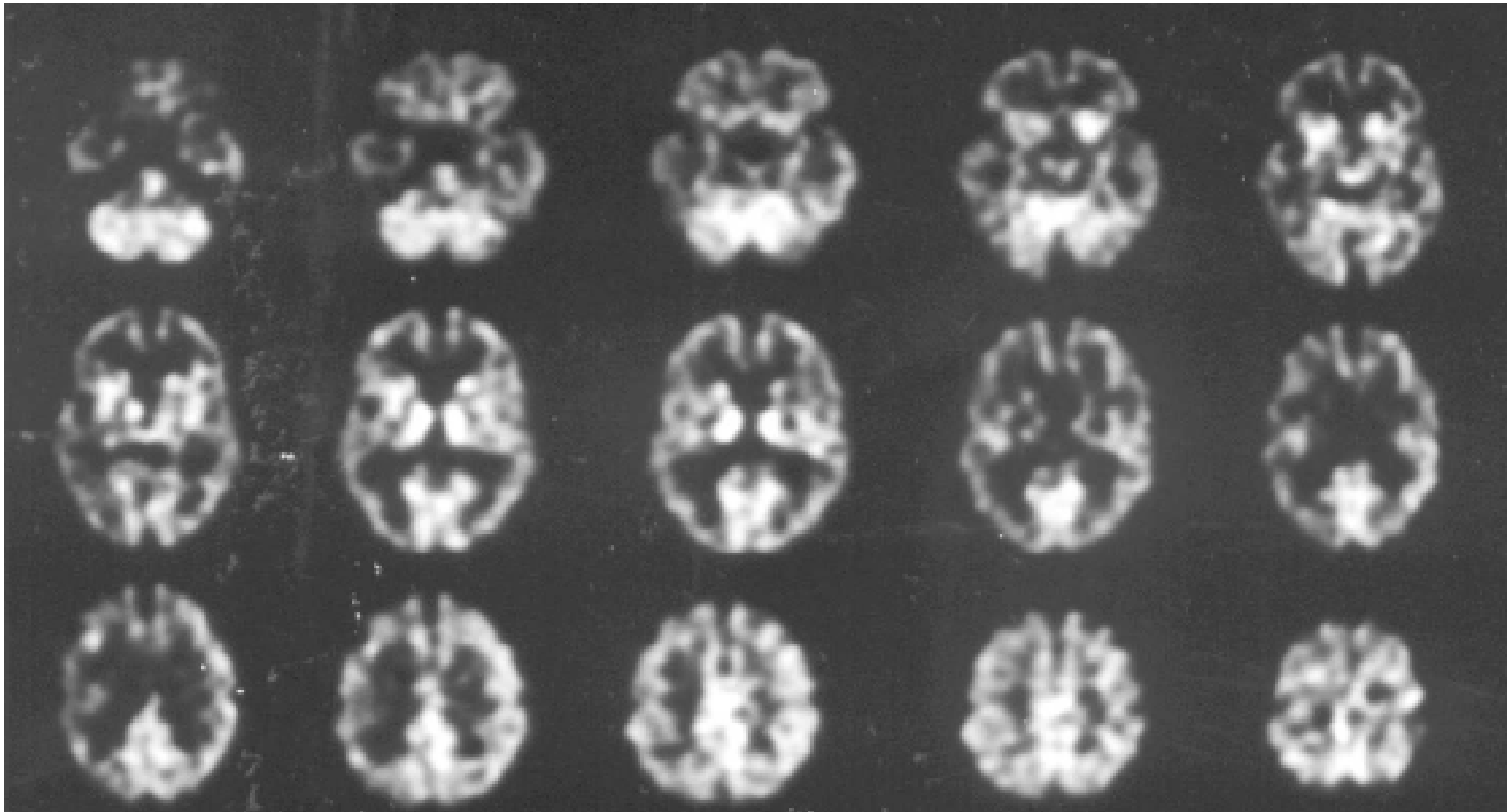
Basic SPECT



Basic Diagram



Brain Scans

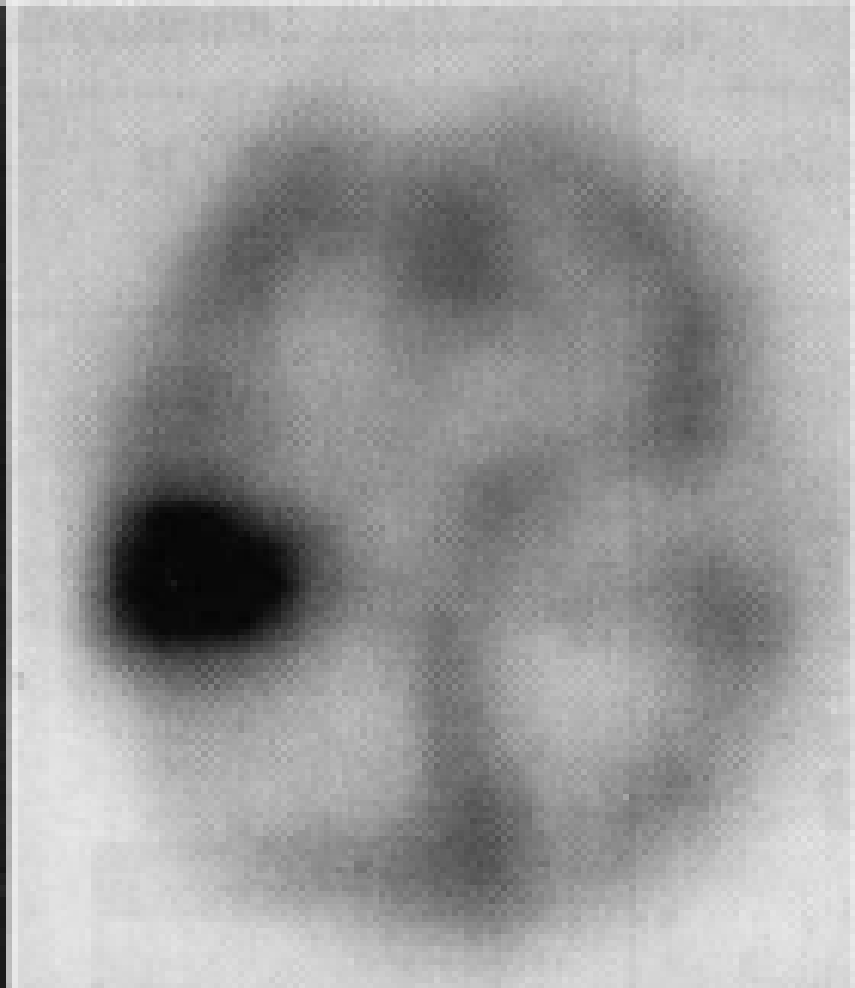


Glioma

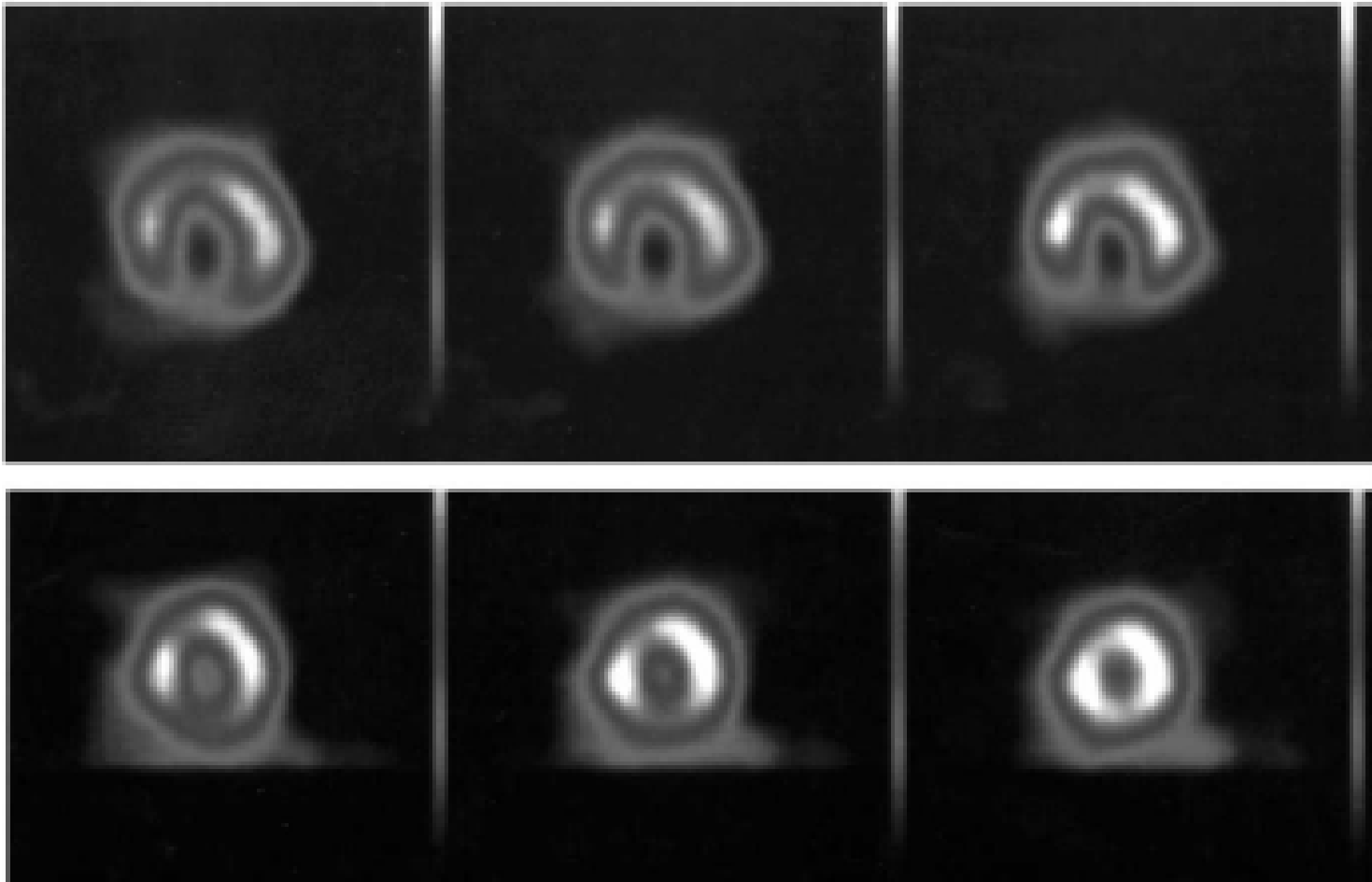
CT



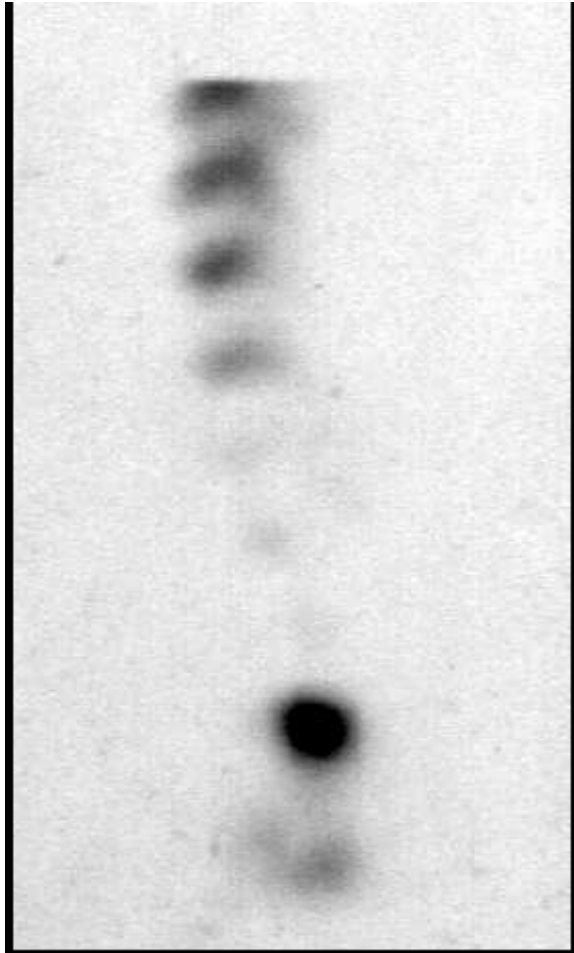
SPEC



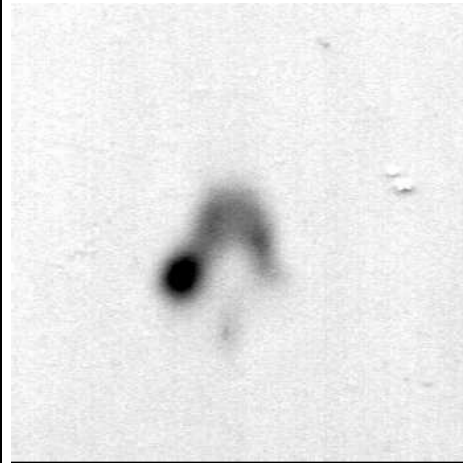
Perfusion of the left ventricle of a heart (top), normal (bottom)



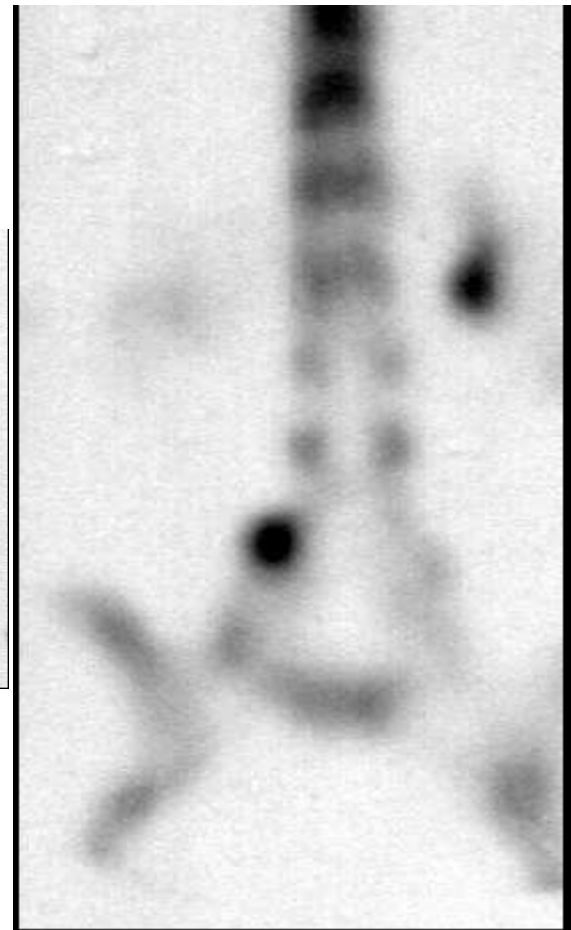
Stress Fracture of the Spine



Sagittal



transaxial



coronal