Al-Mustaqbal University Colleg
Medical Physics Department

Medical Imaging

Lecture 8

Nuclear imaging

Second Stage

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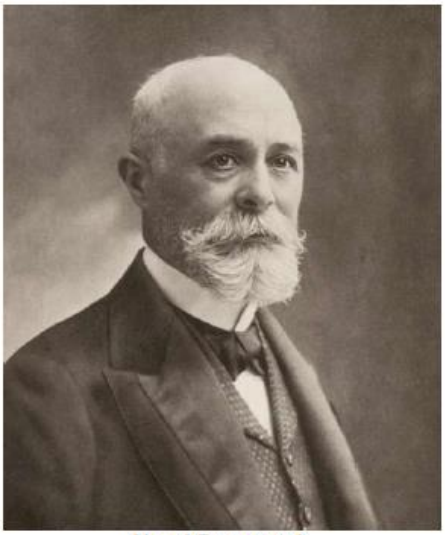
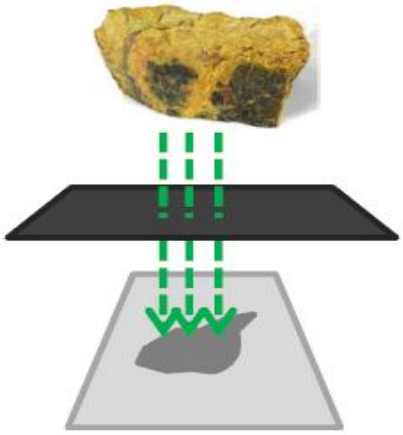
Nuclear medicine imaging: is a method of producing images by detecting radiation from different parts of the body after a radioactive tracer is given to the patient.

History of nuclear medicine imaging

- Following the discovery of x-rays in 1895 by Roentgen, ***Becquerel*** had the idea, mistakenly, that minerals that were made phosphorescent by visible light might emit x-rays.
- ***Phosphorescence*** is the ability of a crystal to absorb light and re-emit light sometime after the exciting light has been removed.



Henri Becquerel



Radioactivity blackens a photographic plate even through a layer of black paper

- Becquerel had a large collection of minerals, many of which exhibited phosphorescence. He experimented by wrapping a photographic plate in black paper (to protect it from direct light), placing a phosphorescent uranium mineral on it and exposing it to bright sunlight.
- When developed the plate bore a clear image of the uranium mineral. Initially, he thought of this as confirmation of his theory.

- After several days he developed the plate expecting a weak image from the small amount of phosphorescence that had not yet decayed away.
- In the 1950's nuclear medicine started to utilized as a way to diagnose pathology in the body. In these tests, the source of the X-rays is not an X-ray tube but rather radioactive compounds, which typically emit gamma rays as they decay. They are combined with other compounds that are taken up as part of the disease process to study a particular problem.
- The most exciting test in nuclear medicine today is "***positron emission tomography"*** or "PET" scanning.

SPECT (single photon emission computed tomography) scan

- A single photon emission computed tomography (SPECT) scan is an imaging test that shows how blood flows to tissues and organs.
- It may be used to help diagnose seizures, stroke, stress fractures, infections, and tumors in the spine.

How does a SPECT scan work?

- SPECT is a nuclear imaging scan that integrates computed tomography (CT) and a radioactive tracer. The tracer is what allows doctors to see how blood flows to tissues and organs.
- Before the SPECT scan, a tracer is injected into your bloodstream. The tracer is radiolabeled, meaning it emits gamma rays that can be detected by the CT scanner. The computer collects the information emitted by the gamma rays and displays it on the CT cross-sections. These cross-sections can be added back together to form a 3D image of your brain.
- The radioisotopes typically used in SPECT to label tracers are iodine-123, technetium-99m, xenon-133, thallium-201, and fluorine-18. These radioactive

forms of natural elements will pass through your body and be detected by the scanner. Various drugs and other chemicals can be labeled with these isotopes.

- The type of tracer used depends on what your doctor wants to measure. For example, if your doctor is looking at a tumor, he or she might use radiolabeled glucose (FDG) and watch how it is metabolized by the tumor.
- The test differs from a PET scan in that the tracer stays in your blood stream rather than being absorbed by surrounding tissues, thereby limiting the images to areas where blood flows. SPECT scans are cheaper and more readily available than higher resolution PET scans.