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ASSIGNMENT 1

MEDICAL PHYSICS (MLS 314)

1. A radioactive tracer is a radioactive element or compound added to a material to monitor the material's distribution as it progresses through a system. The use of a radioactive tracer is called radiolabeling, which is one form of isotopic labelling. Radioactive tracers form the basis of some medical imaging systems, such as PET scans. Radiolabelling is used in research to trace the path of elements in biochemical reactions and cells. Radioisotopes are also used to track the flow of fluids, particularly in the petroleum and natural gas industry. Examples of commonly used radioactive tracers include tritium, carbon-11, carbon-14, oxygen-15, fluorine-18, phosphorus-32, sulfur-35, technetium-99, iodine-123, and gallium-67.

2. Application of Radioactive Tracers in Medicine

PET technique uses radioactive materials (also known as a tracer or radio-tracer) for imaging, it is generally categorized within the field of nuclear medicine . A tracer is injected into the body, which gets trapped within the tissues of interest. The unstable nucleus of radio-ligand emit positrons, which combine with neighbouring electrons to produce gamma rays in the opposite direction at 180 degrees to each other. These gamma rays are detected by the ring of detector placed within the donut-shaped body of the scanner. The energy and location of these gamma rays are recorded and used by a computer program to reconstruct three-dimensional (3D) images of tracer concentration within the body.

In modern PET computed tomography scanners, PET images are often reconstructed with the aid of a computed tomography X-ray scan performed on the patient during the same session, in the same machine. Different tracers are used for various imaging purposes, depending on the target process within the body. For example, FDG is commonly used to detect cancer, NaF is widely used for detecting bone formation, and 15 OH 2 O is used to measure blood flow.

Fluorodeoxyglucose (FDG) is an analogue of glucose and the most commonly used tracer molecule for PET. The concentrations of imaged FDG tracer indicate tissue metabolic activity as it corresponds to the regional glucose uptake. Metabolic trapping of the radioactive glucose molecule allows the PET scan to be utilized. FDG is used to explore the possibility of cancer spreading to other body sites (cancer metastasis). These FDG-PET scans for detecting cancer metastasis are the most common in standard medical care (representing 90% of current scans).

The same tracer may also be used for the diagnosis of types of dementia. Less often, other radioactive tracers, usually but not always labelled with fluorine-18, are used to image the tissue concentration of different kinds of molecules of interest inside the body.

One of the disadvantages of PET scanners is its operating cost.