Muse Mistura Omolola

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MLS 314( Medical Physics)

**Question 1**

Radioactive tracers are chemical compounds in which one or more atoms have been replaced by a radioactive so by virtue of its radioactive decay. Radioactive elements or compounds are added to a material to monitor the material's distribution as it progresses through a system. A radioactive tracer can also be used to track the distribution of a substance within a natural system such as a cell or tissue. it can be used to explore the mechanism of chemical reactions by tracing the path that the radioisotope follows from reactants to products. **Radiolabelling** or **radiotracing** is thus the radioactive form of isotopic labelling. Diagnostic techniques in nuclear medicine use radioactive tracers which emit gamma rays from within the body. These tracers are generally short-lived isotopes linked to chemical compounds which permit specific physiological processes to be scrutinized. Exposure to radiation generally is considered harmful to the human body, but radioisotopes are highly valuable in medicine, particularly in the diagnosis and treatment of disease. They can be given by injection, inhalation, or orally. Radioactive tracers form the basis of a variety of imaging systems, such as, PET Scans, SPECT Scans and technetium scans.

**Question 2**

Nuclear medicine uses radioactive isotopes in a variety of ways. One of the more common uses is as a tracer in which a radioisotope, such as technetium-99m, is taken orally or is injected or is inhaled into the body. The radioisotope then circulates through the body or is taken up only by certain tissues. Its distribution can be tracked according to the radiation it gives off. The emitted radiation can be captured by various imaging techniques, such as single photon emission computed tomography (SPECT) or positron emission tomography (PET), depending on the radioisotope used. Through such imaging, physicians are able to examine blood flow to specific organs and assess organ function or bone growth. Radioisotopes typically have short half-lives and typically decay before their emitted radioactivity can cause damage to the patient’s body.

**Single Photon Emission Computed Tomography (SPECT)**

Single-photon emission computed tomography is applied in nuclear medicine tomographic imaging technique using gamma rays. It is very similar to conventional nuclear medicine planar imaging using a gamma camera (that is, scintigraphy), but is able to provide through 3D information. This information is typically presented as cross-sectional slices through the patient, but can be freely reformatted or manipulated as required. The technique needs delivery of a gamma-emitting radioisotopes (a radionuclide) into the patient, normally through injection into the bloodstream. On occasion, the radioisotope is a simple soluble dissolved ion, such as an isotope of gallium (III). Most of the time, though, a marker radioisotope is attached to a specific ligand to create a radioligand, whose properties bind it to certain types of tissues. This marriage allows the combination of ligand and radiopharmaceutical to be carried and bound to a place of interest in the body, where the ligand concentration is seen by a gamma camera.

SPECT can be used to complement any gamma imaging study, where a true 3D representation can be helpful, such as tumor imaging, infection (leukocyte) imaging, thyroid imaging or bone scintigraphy.

Because SPECT permits accurate localisation in 3D space, it can be used to provide information about localised function in internal organs, such as functional cardiac or brain imaging.