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1. What are radioactive tracers?

2. Discuss explicitly one application of tracers in medicine

Answers

1. Radioactive tracers is a chemical compound in which one or more atoms have been replaced by a radionuclide (this is an atom that has excess nuclear energy, making it unstable) so by virtue of its radioactive decay (this is the process by which an unstable atomic nucleus loses energy by radiation) it can be used to explore the mechanism of chemical reactions by tracing the path that the radioisotope follows from reactants to production. Radiotracing is thus the radioactive form of isotopic labelling (this is a technique used to track the passage of an isotope through a reaction, metabolic pathway or cell).

Radioisotopes of hydrogen, carbon, phosphorus, sulphur, and iodine have been used extensively to trace the path of biochemical reactions. A radioactive tracer can also be used to track the distribution of a substance within a natural system such as a cell or tissue, or as a flow tracer to track fluid flow. Radioactive tracers are also used to determine the location of fractures created by hydraulic fracturing in natural gas production. Radioactive tracers form the basis of a variety of imaging system, such as PET scan, SPECT scan and technetium scans.

2. Application of tracers in medicine:

In medicine tracers are applied in a number of tests such as 99mTc in autoradiography and nuclear medicine, including single photon emission computed tomography (SPECT), positron emission tomography (PET) and scintigraphy.

**Scintigraphy (as an application of tracers in medicine)**

This is a gamma camera also called a scintillation camera or anger camera that is used to image gamma radiation emitting radioisotope, a technique known as scintigraphy. The application of scintigraphy include early drug development and nuclear medical imaging to view and analyse images of the human body or the distribution of medically injected, inhaled, or ingested radionuclides emitting gamma rays.

Scintigraphy is the use of gamma cameras to capture emitted radiation from internal radioisotope to create two-dimensional images.

Construction:

A gamma camera consists of one or more flat crystal planes optically coupled to an array of photomultiplier tube in an assembly known as a head, mounted on a gantry. The gantry is connected to a computer system that both controls the operation of the camera and acquires and stores images. The construction of a gamma camera is sometimes known as a compartmental radiation construction.

The system accumulates events, or counts, of gamma photos that are absorbed by the crystal in the camera. Usually a large flat crystal of sodium iodide with thallium doping in a light-sealed housing is used.

The crystal scintillates is response to incident gamma radiation. When a gamma photon leaves the patient who has been injected with a radioactive pharmaceutical, it knocks an electron loose from an iodine atom in the crystal, and a faint flash of light is produced when the dislocated electron again finds a minimal energy state. After the flash light is produced, it is detected. A Photomultiplier tube behind the crystal detects the fluorescent flashes and a computer sums the counts. The computer reconstructs and displays a two dimensional image of the relative spatial count density on a monitor. This reconstructed image reflects the distribution and relative concentration of radioactive tracer elements present in the organ and tissue image.