Name- Onyekwena Jennifer Nneoma

Matric number- 17/MHS05/017

Level- 300

Course- Medical Physics

Assignment

1.What are radioactive tracers?

2. Discuss explicitly one application of tracer in Medicine.

Radioactive tracer

1.A radioactive tracer also called a radiotracer, or radioactive label, is a chemical compound in which one or more atoms have been replaced by a radionuclide so by virtue of its radioactive decay it can be used to explore the mechanism of chemical reactions by tracing the path that the radioisotope follows from reactants to products.

Radiolabeling or radiotracing is thus the radioactive form of isotopic labeling.

2.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.

Radioactive tracers form the basis of a variety of imaging systems, such as, PET scans, SPECT scans and technetium scans. Radioisotopes of hydrogen, carbon, phosphorus, sulfur, and iodine have been used extensively to trace the path of biochemical reactions.

Application of positron emission tomography (PET)

Positron emission tomography (PET) is an imaging technique that uses radioactive substances to visualize and measure metabolic processes in the body. PET is mainly used in the area of medical imaging for detecting or measuring changes in physiological activities like metabolism, blood flow, regional chemical composition, and absorption, and therefore, also called a functional imaging technique.

It uses radioactive materials for imaging, it is generally categorized within the field of nuclear medicine.

Mechanism

A tracer is injected into the body, which gets trapped within the tissues of interest. The unstable nucleus of radio-ligand emits 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 detectors 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.

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, [18F]FDG is commonly used to detect cancer, [18F]NaF is widely used for detecting bone formation, and 15OH2O is used to measure blood flow.

Tracer molecule used

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

(i) Explore the possibility of cancer spreading to other body sites (cancer metastasis).

(ii) Diagnose types of dementia.

(iii) Image the tissue concentration of different kinds of molecules of interest inside the body.

Uses of PET scan

(i) PET is both a medical and research tool used in pre-clinical and clinical settings.

(ii) It is used heavily in the imaging of tumours and the search for metastases within the field of clinical oncology.

(iii) For clinical diagnosis of certain diffuse brain diseases such as those causing various types of dementias.

(iv) It enhances our knowledge of the normal human brain, heart function, and support drug development.

(v) PET can provide molecular-level information much before any anatomic changes are visible.

Safety

PET scanning is non-invasive, but it does involve exposure to ionizing radiation.

18F-FDG, which is now the standard radiotracer used for PET neuroimaging and cancer patient management, has an effective radiation dose of 14 mSv.

For PET-CT scanning, the radiation exposure may be substantial—around 23–26 mSv (for a 70 kg person—dose is likely to be higher for higher body weights).

Limitation

(i) Limitations to the widespread use of PET arise from the high costs of cyclotrons needed to produce the short-lived radionuclides for PET scanning and the need for specially adapted on-site chemical synthesis apparatus to produce the radiopharmaceuticals after radioisotope preparation.

(ii) Because the half-life of fluorine-18 is about two hours, the prepared dose of a radiopharmaceutical bearing this radionuclide will undergo multiple half-lives of decay during the working day. This necessitates frequent recalibration of the remaining dose (determination of activity per unit volume) and careful planning with respect to patient scheduling.