

UNIT 4: NUCLEAR IMAGING

4.2 Radio pharmaceuticals

Radiopharmaceuticals are a group of medicinal formulations containing radioactive isotopes that are used in nuclear medicine for diagnosis, therapy, or research. These compounds combine a radioactive element (radionuclide) with a biologically active molecule, allowing them to target specific tissues, organs, or cellular processes.

Types of Radiopharmaceuticals

1. Diagnostic Radiopharmaceuticals

- Used to image organs or detect abnormalities.
- Examples:
 - **Technetium-99m (Tc-99m):** Commonly used in imaging the heart, bones, or kidneys.
 - **Fluorine-18 (F-18):** Found in FDG (fluorodeoxyglucose) for PET scans to image metabolic activity.
 - **Iodine-123 (I-123):** Used for thyroid imaging.

2. Therapeutic Radiopharmaceuticals

- Used to treat diseases like cancer by delivering targeted radiation.
- Examples:
 - **Iodine-131 (I-131):** Treats hyperthyroidism and thyroid cancer.
 - **Lutetium-177 (Lu-177):** Targets neuroendocrine tumors or prostate cancer.
 - **Radium-223 (Ra-223):** Treats metastatic bone cancer.

Key Features

- **Target Specificity:** Radiopharmaceuticals are designed to bind to specific receptors or biological pathways, ensuring targeted delivery.
- **Short Half-life:** Many radiopharmaceuticals are designed with short half-lives to minimize radiation exposure to the patient.
- **Multimodal Use:** They can be used in combination with imaging techniques (like PET or SPECT) for real-time tracking of biological processes.

Production

Radiopharmaceuticals are typically produced in nuclear reactors or cyclotrons, depending on the radionuclide. They must be handled under stringent safety and regulatory protocols due to their radioactive nature.

Applications

1. **Oncology:** Imaging and treatment of cancers, such as neuroendocrine tumors and prostate cancer.
2. **Cardiology:** Imaging blood flow and heart function.
3. **Neurology:** Studying brain activity and diagnosing conditions like Alzheimer's disease.
4. **Endocrinology:** Diagnosing and treating thyroid disorders.

