

PHARMACEUTICAL APPLICATIONS OF RADIOACTIVE PHARMACEUTICALS

Radioisotopes find use in medicine in four different ways. They are:

1. Radiation source in therapy
2. Radioactive traces for diagnostic purpose
3. Research
4. Sterilization.

1. Radioisotopes in therapeutics:

- Gold (^{198}Au) finds use in treatment of abdominal and pleural effusions associated with malignant tumors. It is given in the form of colloidal gold suspension.
- ^{198}Au used in treatment of carcinoma of uterus and urinary bladder.
- Sodium phosphate (^{32}P) used in therapy of polycythemia vera to decrease the rate of formation of erythrocytes leukemia.
- Cobalt labeled cyanocobalamin (vitamin B_{12}) used in the diagnosis of pernicious anemia. The labeled isotopes of cobalt have been Co-57, Co-58 and Co-60
- Sodium iodide (^{131}I) used in the treatment of thyroid disorders.

2. Radioisotopes in Diagnosis:

- Labeled cyanocobalamin is used in the measurement of glomerular filtration rate.
- Ferric citrate (^{59}Fe) injection is used for diagnosis of hematological disorders.
- Colloidal gold (^{198}Au) injection is used in diagnostically study of blood circulation in liver.
- Sodium iodide (^{131}I) is used in the diagnosis of thyroid gland functioning.
- Iodinated (^{131}I) human serum albumin injection is used to investigate the cardiovascular functions.
- Sodium rose Bengal I -131 injections is used as diagnostic agent to study renal functions.

3. Research:

- $^{14}\text{C}_6$, $^3\text{H}_1$ are most commonly used nuclides for the research purpose.

4. Sterilization:

- Radiations that is constantly available from strong radiation sources for sterilizing pharmaceuticals in their final packed containers and surgical instruments in hospitals.
- The radiation does not destroy or harm most of the pharmaceuticals.
- $^{60}\text{Co}_{27}$ or Cesium -137 are used for sterilizing surgical instruments.
- No heat or chemicals get involved.

- Thermolabile substances such as vitamins, hormones, antibiotics etc, can be safely sterilized.

Some of the applications of specific radio isotopes are as follows:

1. **Calcium (Ca-44 and Ca-45):** the radioactive calcium is used to study bone structure and in treatment of carcinoma of bone.
2. **Strontium -90:** It is one of the most dangerous isotopes formed during the fission of uranium in atomic bomb blasts, due to its long half-life of 28 years. It is a pure beta emitter. Used for radio therapy of superficial carcinomas.
3. **Cobalt -60:** gamma radiations of Co -60 are being used in the sterilization of heat labile medicinal substances and food products.
4. **Calcium -47:** its half-life is 4.7 day. In the form of its chloride, it is used in calcium absorption studies.
5. **Cynacobalamin (Co-57):** the radioactive half life of Co-57 is 270 days. It is used in the diagnosis of pernicious anemia.
6. **Gold (Au-198):** This solution is cherry red, colloidal solution of radioactive gold which is sterilized by autoclaving. It emits beta particles (0.96 MeV) and gamma rays (0.41 MeV) and having a half-life of 2.7 days. It is used as a neoplastic suppressant. Also used in estimation of reticuloendothelial activity.
7. **Hydrogen (H-2 & H-3):** The deuterium (H-2) and tritium (H-3) are the isotopes of hydrogen useful to determine total body water.
8. **Iron (Fe-59):** It emits beta particles and high energy gamma rays. The half-life of Fe-59 is 45 days and is used in research studies about utilization and absorption of iron salts. It is also used in the investigation of iron metabolism and to measure red cell life span.
9. **Nitrogen (N-13 & N-15):** Used in the investigations of amino acids and protein metabolism and also in studies of nitrogen fixation by plants.
10. **Oxygen (O-17 & O-18):** Used in the studies of organic reactions and photosynthesis etc.,
11. **Sodium (N-22 & N-24):** Used in the estimation of extracellular fluid, blood circulation rate, studies in cell permeability, excretion and distribution of water etc.,
12. **Sodium chromate (Cr-51) solution:** Used to study red cell volume and survival time.