Radiopharmaceuticals: Cancer Therapy

Pushkin Rathore 18111043

Week 5

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AIM

The aim of this is paper is to make aware the reader about the technologies that exists that make the treatment of certain diseases such as cancer to be more efficient by the use of different approaches. In this particular case, we'll look into the dealings in regards to the radioactive substances and the science behind them that is being applied to treat diseases such as cancer. Radiopharmaceuticals, or medicinal radio compounds, are a group of pharmaceutical drugs containing radioactive isotopes. Radiopharmaceuticals can be used as diagnostic and therapeutic agents. Radiopharmaceuticals emit radiation themselves, which is different from contrast media which absorb or alter external electromagnetism or ultrasound. Radiopharmacology is the branch of pharmacology that specializes in these agents. The main group of these compounds are the radiotracers used to diagnose dysfunction in body tissues. While not all medical isotopes are radioactive, radiopharmaceuticals are the oldest and still most common such drugs. Radiation therapy was first used to treat cancer more than 100 years ago. About half of all cancer patients still receive it at some point during their treatment. And until recently, most radiation therapy was given much as it was 100 years ago, by delivering beams of radiation from outside the body to kill tumors inside the body.

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One of the hallmarks of RPT is its ability to deliver highly potent forms of radiation directly to tumour cells. Three different types of radiation are relevant to understanding RPT: photons, electrons and α- particles. Photons come in two 'flavours' — X- rays and γ- rays. The former are derived from orbital electron transitions and are typically lower in energy than γ- rays. Radionuclide photon emissions are useful for imaging the distribution of the RPT but not for localized delivery of cytotoxic radiation. Although a wide range of photon energies may be imaged (70–400 keV), photon emission energies in the range from 100 to 200 keV are optimal for all nuclear medicine imaging cameras (γ- cameras and single- photon emission computed tomography (SPECT) cameras). A number of radionuclides also emit positrons which lead to the emission of 511- keV photons that are detected by positron emission tomography (PET) cameras.

Electron emissions are classified by energy and also by the type of decay. Auger electrons, β- particles and monoenergetic electrons are relevant to RPT. Auger electrons are generated from suborbital transitions. They are typically very- short- range emissions, of the order of 1–1000 nm, depending on their emission energy. If the RPT

drug localizes within the cell nucleus, these emissions could be highly cytotoxic. Auger electron- emitter RPT has not been widely adopted, however. Although preclinical studies have shown substantial therapeutic efficacy, the small number of human investigations did not lead to clinical efficacy. Human studies using locoregional administration showed promise in terms of tumour cell incorporation of the Auger emitters. The requirement that these agents be incorporated into the DNA and also their unfavourable pharmacokinetics are thought to be the reasons underlying the lack of efficacy. Encouraged by ongoing technological developments that could overcome the factors, these agents continue to be of interest to the RPT community.