Radiation Protection

It is the science of protecting humans from the effects of ionizing rays, whether they are elementary particles such as protons or electromagnetic rays such as x-ray or gamma ray.

In the field of health institutions that contain nuclear medicine and radiotherapy, there are two classes of physicists:

1-Medical Physicist.

2-Health Physicist (Radiation Protection Officer)

Classification of radiation

Radiation, the transport of energy by electromagnetic waves or atomic particles, can be classified into two main categories depending on its ability to ionize matter. The ionization potential of atoms, i.e. the minimum energy required to ionize an atom, ranges from a few electronvolts for alkali elements to 24.6 eV for helium which is in the group of noble gases. Ionization potentials for all other atoms are between the two extremes

1-Non-ionizing radiation cannot ionize matter because its energy per quantum is below the ionization potential of atoms. Near ultraviolet radiation, visible light, infrared photons, microwaves and radio waves are examples of non-ionizing radiation.

2-Ionizing radiation can ionize matter either directly or indirectly because its quantum energy exceeds the ionization potential of atoms. X rays, γ rays, energetic neutrons, electrons, protons and heavier particles are examples of ionizing radiation

Classification of ionizing radiation

Ionizing radiation is radiation that carries enough energy per quantum to remove an electron from an atom or a molecule, thus introducing a reactive and potentially damaging ion into the environment of the irradiated medium. Ionizing radiation can be categorized into two types: (i) directly ionizing radiation and (ii) indirectly ionizing radiation. Both directly and indirectly ionizing radiation can traverse human tissue, thereby enabling the use of ionizing radiation in medicine for both imaging and therapeutic procedures

i-Directly ionizing radiation consists of charged particles, such as electrons,protons, α particles and heavy ions. It deposits energy in the medium through direct Coulomb interactions between the charged particle and orbital electrons of atoms in the absorber.

ii-Indirectly ionizing radiation consists of uncharged (neutral) particles which deposit energy in the absorber through a two-step process.

In the first step, the neutral particle releases or produces a charged particle in the absorber.

In the second step, deposits at least part of its kinetic energy in the absorber through Coulomb interactions with orbital electrons of the absorber in the manner discussed above for directly ionizing charged particles.

Classification of indirectly ionizing photon radiation

Indirectly ionizing photon radiation consists of three main categories: (i) ultraviolet, (ii) X ray and (iii) γ ray. Ultraviolet photons are of limited use in medicine. Radiation used in imaging and/or treatment of disease consists mostly of photons of higher energy, such as X rays and γ rays. The commonly accepted difference between the two is based on the radiation's origin. The term 'γ ray'is reserved for photon radiation that is

emitted by the nucleus or from other particle decays. The term ‘X ray’, on the other hand, refers to radiation emitted by electrons, either orbital electrons or accelerated electrons (e.g. bremsstrahlung type radiation). With regard to their origin, the photons of the indirectly ionizing radiation type fall into four categories: characteristic (fluorescence) X rays,bremsstrahlung X rays, photons resulting from nuclear transitions and annihilation quanta.

Medical use of ionizing radiation

The medical use of ionizing radiation is of great importance for diagnosis, therapy and research in modern health care. It includes several medical specialties, often classified according to the following four groups:

(1) Diagnostic radiology.

(2) Radiotherapy.

(3) Nuclear medicine.

(4) Biomedical research.