Medical physics module
Semester 1

Session 8
Lec.16

Physics of Radiation Therapy

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Objective

❖To get information about ionizing radiations and medical applications.

❖Important factors of treatment.

❖Dose units used in radiotherapy.

❖Treatment of tumors with radiotherapy:

Obj.1

Nuclear Decay

- When nuclei are unstable, particles and photons are emitted.
  - The process is called *radioactivity*.
  - It occurs because the nucleus has too many or too few neutrons.
  - Three types of radiation can occur:
    - Alpha
    - Beta
    - Gamma

Ionizing radiations that are used in medicine can be divided into two major types:

- Partial radiation; such as α, ß and neutrons
- Electromagnetic radiation; such as γ and X- Rays

Three main uses of these radiations in medical applications;

Treatment of cancer (therapy), diagnosis, sterilization

Obj.2 The choice of treatment depends on a number of factors including:

- ✓The size of the tumor.
- ✓The position of the tumor.

The aim of the radiation therapy is to cause damage to the cancerous cells whilst minimizing the risk to surrounding healthy tissue.

Obj.3 Dose units used in radiotherapy

For exposure: Roentgens (R) is measuring the amount of electric charge produced by ionization in air (exposure) using γ, X-Rays, since.

$$1R = 2.58 \times 10^{-4}\ C/Kg \text{ of air}$$

When an limited area of body exposure to the radiation

EAP (rap) = exposure (R) x area (cm^2)

For therapy (absorbed dose):

Rad (rad): The amount of radiation beam that give 100 ergs of energy to (1g) of tissue.

1 rad = 100 erg/g = 0.01 J/Kg

Gray (Gy): It is the accepted as international unit (SI) system of absorbed dose.

1Gy = 1 J/Kg,

1 Gy = 100 rad

Obj.4

Treatment of tumors with radiotherapy

There are two techniques of treatment:

- External beam radiotherapy by passing high energy photons through the body from an external source.
- Beach therapy, placing a radioactive source inside the body adjacent to or within the tumor.

The dose to the particular organ of the body depends on the physical characteristic of the radionuclide

- ✓What particles it emits
- ✓Their energies
- ✓The length of the time the radionuclide is in the organ.

Two factors determine the length of the time the radionuclide in the organ, or the effective half-life $T_{1/2\ eff}$, the physical half-life $T_{1/2\ phy}$ and the biological half-life T_{bio}.

- **The biological half –life of an element is the time needed for one half of the original atoms present in organ to be removed from the organ.**

T1/2eff = T1/2 bio*T1/2phy/T1/2bio+T1/2phy

- Exe.1: What is the effective half-life of I^{131} in the thyroid if the: $T_{1/2}$ bio = 15 days & $T_{1/2}$phy=8 days

Answer:

$T_{1/2}$eff = (15 days) (8 days) / 15 days + 8 days

= 5.2 days

Exe:2

What is the effective hale-life of I^{131} in the hipuric acid if half of it excreted in the urine in (1 hr).

Answer:

$T_{1/2}\ eff = (1\ hr)\ (192) / 1hr + 192\ hr = 0.99hr.$

Exe. 3

What is the effective half-life of F^{18} in bone if $T_{1/2\ phy}$= 110 min (7 days = 10^4 min)

Answer:

$T_{½}$ = (110 min) (10^4 min)/ 110min + 10^4 min

= 109 min


Thank you