



RADIOLOGY-6

Fourth Professional UNIT 3

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Unit of Radiation Measurement & Hazards

Unit of Radiation Measurement

Exposure Quantity: - It measures the amount of radiation striking a subject: unit of measurement Roentgen.

One Roentgen – Production of 2.58×10^{-4} coulombs/kg in air.

Absorbed dose: - It measures differential absorption of x-ray among various tissue.

The SI unit for absorbed dose is Gray (Gy). Before Gray, unit was rad.

One Rad-Radiation necessary to deposit energy of 100 ergs/gm of irradiated material.

1 Gray = 100 rad.

- **Dose Equivalent:** - It measures damage produced in living tissue when absorption of the same dose in Gy from different types of radiation.
- The SI unit of dose equivalent is Sievert (Sv)
- Earlier unit was Rem (Roentgen equivalent man)
- **1 Sv = 100 rem.**
- **One rem = rad x quality factor.**
- Quality factor for x-ray & γ -ray is one and α -particles are 20.

Radiation hazards and safety

DNA molecules:- Pyrimidine base more sensitive to radiation than Purine base in DNA

Body cells :-

Regularly proliferative cells more sensitive
example – Epithelium, mucosa, germ cells.

Non-proliferating cells – Radio resistance,
Example-Muscle cells, Nerve cells.

Species:- Among animals Rabbits are more sensitive whereas, goats are least sensitive species.

LD 50/30 – dose that will kill 50% of population that exposed with radiation within a period of 30 days.

- ❖ Death caused by radiation damage to haemopoietic system is due to severe neutropenia that permit development of infections.
- ❖ Erythroblasts are more sensitive to radiation damage whereas myelocytes less.
- ❖ Duodenum is the most sensitive part of small intestine to radiation damage.
- ❖ Spermatogonia highly sensitive while mature sperms are radio resistant.

Radiation safety device

Lead apron – Lead thickness 0.25 mm.

Lead Gloves – Lead thickness 0.50 mm.

Lead Red goggles.

Radiation monitoring device

Film badge wear at belt level below the apron to monitor whole body exposure and other above the lead apron at neckline to estimate exposure to skin of head, neck and eye.

Person under 18 years age should not be involved in radiographic exposure.

MPD (Maximum Permissible Dose per year

$$= 5 \text{ rem } (N - 18) \quad (N = \text{Age in years}).$$

Protective Devices

Leaded Glasses

Lead Thyroid Collar

Lead Apron
(≥0.5 mm lead)

Over-Apron Badge

(head/thyroid/eyes)
[Red Icon] or
[Black Icon]

Under-Apron Badge

(whole body)
[Yellow Icon]

Finger Ring Dosimeter

Dosimeters

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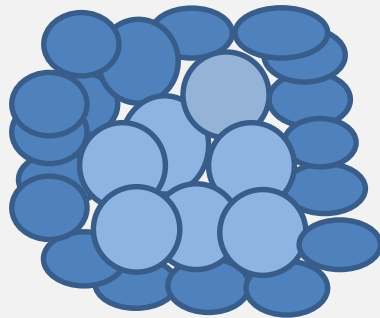
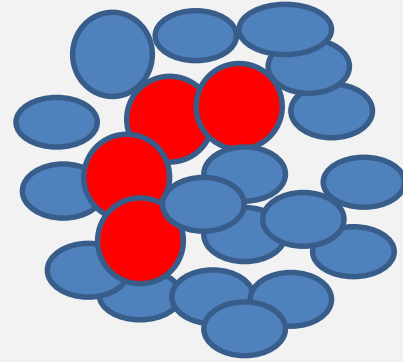
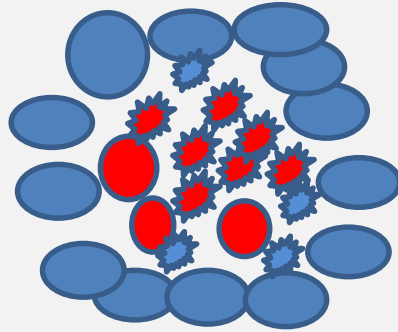
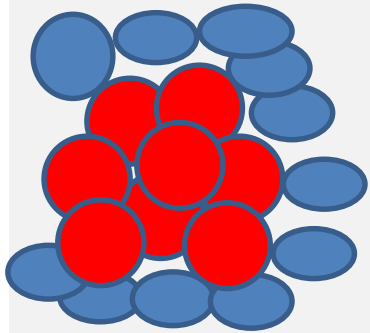
Principles of Radiation Therapy

- Indicated for localized solid neoplasms that cannot be excised completely.
- Not indicated if neoplasm has the potential of high incidence of metastases.
- Radiation therapy is more effective in oxygenated cells.
- Radiotherapy is not done by a single dose, rather multiple treatment are given over a period of time, termed fractionated therapy.

- **Therapeutic ratio:** - It is the ratio of normal tissue tolerance dose to the neoplasm lethal dose.
- On the basis of therapeutic ratio neoplasm classified into three categories.
- **Sensitive:-** Higher therapeutic ratio requires less dose for treatment – example – squamous cells carcinoma.
- **Moderately sensitive:-** Therapeutic ratio – 1 example – mast cell neoplasm.
- **Resistant:-** Therapeutic ratio less than 1 example – fibro sarcoma.

- 4 R's of Radiotherapy: - Re-oxygenation, repopulation, redistribution and repair.
- **Re-oxygenation**:- Oxygenated cells more sensitive to radiation damage are killed earlier, more oxygen becomes available to hypoxic radioresistant cells to make them radio sensitive.
- **Repopulation**: - The ability of neoplastic cells to repopulate is believed to be slower than the normal tissue after radiation.
- **Redistribution**:- Repair of most normal cells occurs much faster than that of neoplastic cells, so fractionated therapy provides less chance for repair of neoplastic tissue.
- **Repair**: - Progressively the neoplastic cells get destroyed and normal tissue grows faster and ultimately tumor get repaired with normal tissue.

Radiotherapy



Methods or technique used in radiation therapy:-

- **Tele therapy:** - Source of radiation is kept at a distance from the lesion.
- **Superficial x-ray therapy** – Radiation given through x-ray machine with energy range 60 – 100 Kev.
- **Deep x-ray therapy:-** Radiation given through x-ray machine with energy range of 200 to 300 Kev.
- **Super voltage therapy:-** Radiation given through x-ray machine having linear accelerator (1 Mev to 20 Mev.) or Betatron (20 Mev to 100 Mev) or cyclotron or through isotopic x-ray machine with cobalt or cesium in a sealed form.
- **Particulate beam therapy:-** Electron, neutron or proton beam used as a mode of therapy.

- **Brachy therapy:** - Therapeutic use of radio isotopes either within the interstitium or on the surface of neoplasm.
- **Interstitial brachy therapy** – ^{198}Au , ^{60}Co
- **Advantages :**
 - Continuous low dose irradiation of the neoplasm.
 - Low dose to the surrounding normal tissue.
 - Implantation requires a single anaesthetic procedure.
- **Pliesotherapy (Surface brachy therapy)** – use of ^{90}Sr for superficial lesions.
- **Systemic brachytherapy** - ^{131}I and ^{32}P can be administered systemically.

Complications of Radiotherapy

- **Immediate complication** :- Observed within minutes or days after irradiation eg : epilation (hair loss), moist desquamation of skin, skin erythema, chromosome aberration, haematological depression.
- **Latent complications**: - Observed within months or years eg :- leukaemia, cancer, life span shortening and lethal genes in coming generations.



Thank You

