

## RADIATION THERAPY

**Dr. S. P. Tyagi**

Biological effects of radiation have been discussed in previous lecture; such lethal effects of radiation can also be used for our benefit by using them against unwanted cells of body such as neoplasms. This is precisely “the radiation therapy”.

Various terms of radiation therapy:

1. **Radiosensitivity:** It refers to the susceptibility of the cells or tissue to the lethal effects of absorbed radiation. Radiosensitivity is usually directly proportional to the mitotic activity of the cells and indirect proportional to their level of specialization.
2. **Radioresponsive:** It is the degree to which a normal or neoplastic tissue’s visibility changes during or after radiotherapy.
3. **Radiocurability:** In context to veterinary medicine it is the two year patient survival after radiotherapy without further progress of the neoplasm and subsequent metastases.
4. **Isotopes:** Isotopes of a given atom have same number of protons but different numbers of neutrons.
5. **Radioisotopes (Radionuclides):** Most of isotopes of the heavy elements are unstable and hence undergo the process of spontaneous decay to form stable nuclides (By the process of radioactive decay). During this process there is emission of radiation energy from the isotopes. Such isotopes are called radioisotopes.

### **Mechanism of action of radiation for radiation therapy**

The mechanism of action is similar to what has been described in previous lecture (Direct and indirect effects). However, for therapy purpose the X-rays are directed only to a specific and limited body area where neoplasm is present and therefore the effects of radiation are also localized.

Neoplasm radiosensitivity is based on three factors-

- Neoplasm lethal dose- It is the dose of radiation which *in vivo* produces lethal effects on the neoplasm *i.e.* 80-90% regression of the neoplasm in the affected area. It varies for neoplasm of different histological types.
- Normal tissue tolerance dose- It is the dose of radiation which normal tissue can absorb without any pathological effects. This also varies for different types of tissues.

- Therapeutic ratio- It is the ratio of normal tissue tolerance dose to the neoplasm dose. Neoplasms can be classified on the basis of therapeutic ratio in the following categories-
  - ★ Sensitive: In this the therapeutic ratio is higher than one *e.g.* Squamous cell carcinoma.
  - ★ Moderately sensitive: Ratio is almost equal to one *e.g.* Mast cell neoplasm.
  - ★ Resistant: Ratio is less than one *e.g.* Fibrosarcoma.

#### Indications for radiotherapy-

- ★ Localized solid neoplasms that can not be excised completely.
- ★ When surgery has failed.
- ★ When regional or distant metastases has not occurred.
- ★ When bulk of neoplasm has to be reduced so that it can subsequently be removed surgically.

#### Methods of radiotherapy-

Radio therapy is generally not done by a single dose; it is rather given over a period of time in multiple doses and termed as "Fractionated therapy". Advantages of this are following-

- During fractionated therapy as oxygenated cells are killed earlier, more oxygen becomes available to the hypoxic radio-resistant cells to render them radiosensitive.
- Since repair of most normal cells occurs much faster than that of neoplastic cells, the fractionated therapy provides fewer chances for repair of neoplastic tissue.

#### Different techniques used in radiation therapy are as follows-

1. **Teletherapy:** In this radiation source is kept at a distance from the lesion. It is of four types-
  - Superficial x-Ray therapy : It is given through X-ray machine with energy range of 60-100 keV.
  - Deep X-ray therapy: It is given through X-ray machines with energy range of 200-300 keV.
  - Super voltage therapy: It can be provided through machines with energy range above 1MeV.

- Particulate beam therapy: Electron, proton or neutron beam can also be used as a mode of teletherapy.
2. **Brachytherapy**: In this the source of radiation is kept in contact with neoplasm. It is accomplished with the application of radioisotopes. This can be done by-
- Interstitial brachytherapy: When the source of radiation is within the interstitium of the neoplasm *e.g.*  $^{198}\text{Au}$ ,  $^{60}\text{Co}$  etc.
  - Plicotherapy or surface brachytherapy: Such as  $^{90}\text{Sr}$  is applied over superficial lesion surface.
  - Systemic brachytherapy: Such as  $^{131}\text{I}$  and  $^{32}\text{P}$  can be administered systemically.

#### Complications of radiotherapy -

- **Immediate complications**: These are observed within minutes or days after irradiation *e.g.*
  - Epilation(Hair loss)
  - Desquamation of skin
  - Erythrema
  - Haematological depression
- **Latent complications**: These are observed after a long gap *e.g.*
  - Leukaemia
  - Lethal genes in coming generations
  - Life span shortening
  - Miscellaneous types of cancers