

Therapeutic Radiology

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Answer to Question no. 1.

SIDE EFFECTS OF THERAPUTIC RADIOLOGY

There are two main types of side effects of therapeutic radiology.

(A) ACUTE SIDE EFFECTS.

(B) LATE SIDE EFFECTS.

(a) ACUTE SIDE EFFECTS. The major acute side effects may be summarized as follows.

(1) Nausea and vomiting. As with any distressing treatment, some patients vomit immediately during radio therapy or even in anticipation of it. Which is considered as a psychological response. Nausea for any reason can be treated with anti-emetics.

(2) Damage to epithelial surfaces.

Epithelial may sustain damage from radiation therapy. The rates of onset of damage and recovery from it depend upon the turnover rate of epithelial cells

Typically the skin starts to become pink and sore several weeks after the treatment

(3) Mouth, throat and stomach and sores. if the head and neck area is treated , temporary soreness and ulceration commonly occur in the mouth and throat.

When treating liver malignancies and metastasis, it is possible that collateral radiation may cause gastric or duodenal ulcer

(4) Intestinal discomfort. the lower bowel may be treated directly with radiation which causes soreness diarrhea and nausea

(5) Inflammation. Swelling of the soft tissues may cause problems during radiation therapy

(6) Infertility. The gonads (Ovaries and testes) are very sensitive to radiation and may lead to infertility.

(7) Fatigue and hear loss.

(8) Head ache.

- (9) **Blurred vision.**
- (10) **Skin color changes.**
- (11) **Urinary and urinary bladder changes.**
- (12) **Changes in taste.**
- (13) **Fertility problems.**

(b) Late side effects.

Some of the important late side effects of radio therapy are listed as follows

- (1) **Fibrosis.** Tissues which have irradiated tend to become less elastic over time due to a diffuse scaring process.
- (2) **Epilation.** Epilation i.e. Hair loss may occur on any hair bearing skin due to high dose radiations.
- (3) **Dryness.** Sweat glands, salivary glands tear glands etc. When treated with radiation, skin tend to stop working resulting in skin dryness.
- (4) **Lymphedema.** It is a condition of localized fluid retention and tissues swelling which results from damage to the lymphatic system, sustained during radiation therapy.
- (5) **Cancer-malignancies.** Radiation is a potential cause of cancer in the area of radiation therapy.
- (6) **Heart diseases.** Radiation has potentially high risk of death from heart disease and other cardiovascular complications.
- (7) **Cognitive decline.** Radiation applied to the head radiation therapy may cause cognitive decline especially in children between the ages of five-eleven years.
- (8) **Cumulative side effects.**
- (9) **Effects on reproductive and reproduction.**
- (10) **Effect of pituitary system and related endocrine activity.**



Answer to Question No. 03

(a) Photo electric effect.

Introduction. First observed by Henrich hertz in 1887.

Definition. The ejection of electron from a metallic surface in the light suitable frequency is allowed to fall on the surface

Or

The phenomenon of metals releasing electrons when they are exposed to light of the appropriate frequency called the photo electric effect, and the electron emitting during the process are called photo electrons.

PHOTO Electric effect

Suitable frequency is called threshold frequency and the corresponding wavelength is called threshold wavelength.

Work Function. The work function is the energy required to remove an electron from the highest field levels in the Fermi distribution of a solid.

$$W=hf_0$$

Laws of photo electric effect.

Photo electric effect is directly proportional to intensity

If the frequency of the incident light is less than the threshold frequency then no electron ejected, no matter what the intensity is

The maximum kinetic energy of the electrons depend on the frequency of the incident light.

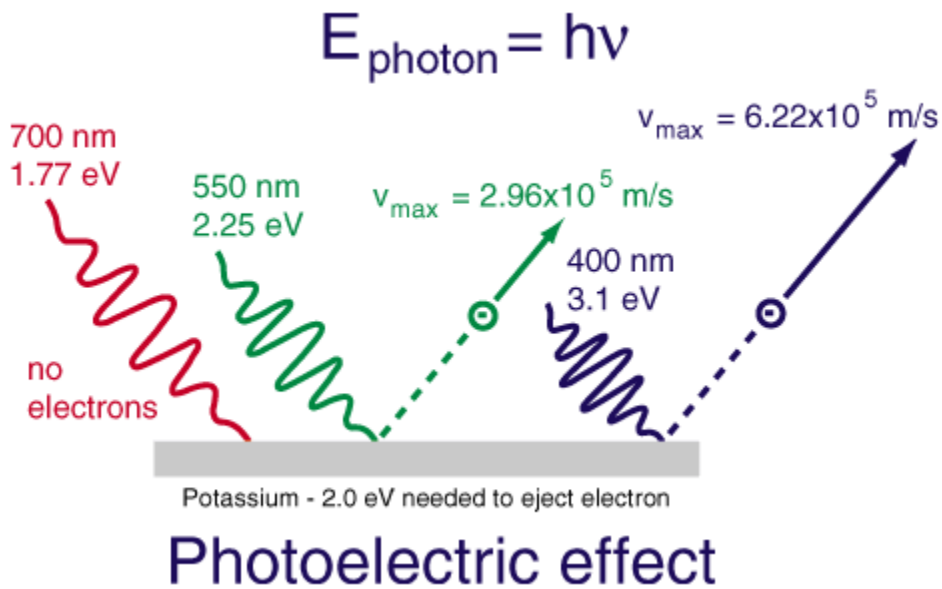
The electron were emitted immediately

Einstein's equation for the photo electric effect

$$h\nu = W + E$$

(B)

Compton Effect. Compton scattering occurs in the incident X-ray photon is deflected from its original part by in an interaction with electron. The scattered X-Ray photon has less energy, it has a longer wavelength and less penetrating than the incident photon. The Compton Effect is the most important photon tissue interaction for the treatment of cancer. In this case a photon collides with free electron i.e. one which is not tightly bound to the atom. The Compton Effect is the most common interaction which occur clinically, as most radiation treatments or performed at energy level of about 6-20 MeV.



Answer to Question No.04

Brachy therapy

Brachy therapy is a procedure that involves placing radioactive material inside the patient's body. Brachy therapy is one type of radiation therapy that is used to treat cancer. This type of therapy is sometime called eternal radiation.

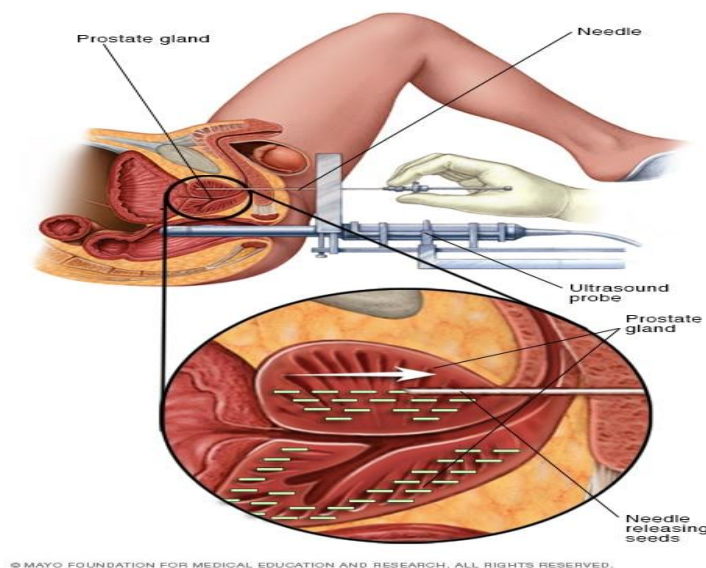
Types of Brachy therapy

There are three main types of Brachy therapy

- (1) Low dose rate implants also called LDR. Which are implants that stay in for seven days or less before they are taken out.
- (2) High dose rate implants.
- (3) Permanent implants.

Advantages of Brachy Therapy. The main advantage of Brachy therapy is use of a high dose radiation in a more targeted area and in shorter period of time, that is, possible with a beam of radiation delivered from outside the body.

Permanent prostate Brachy therapy involves placing many radioactive seeds within the prostate gland to treat prostatic cancer.



Answer to Question No. 02

Linear accelerators:- linear accelerator is phenomenon/device in particles travels in straight lines and not in closed orbits

Explanation. High energy radiation is delivered to tumors by mean of mean of linear accelerator. A beam of electrons is generated and accelerated through a wave-guide that increases their to the KeV to MeV ranges. These electron strike a tungsten target that produce X-Rays. X-rays generated in the 10-30 KeV range are known as grenz rays whereas the energy ranges for superficial units is about 30-125KeV. Orthovoltage units generate X-Rays from 125-500KeV.

The linear accelerator uses in a micro wave technology to accelerate electrons in a part of the accelerator called Wave Guide, then allows these electron to collide with a heavy metal target in order to produce high energy X-rays.



Answer to Question No. 05

Volumetric modulated ARC THERAPY:- IT is a novel radiation therapy technique which gives a continuous radiation dose as therapy to a tumor, simultaneously

reducing/ minimizing the radiation dose to the organs of the body surrounding the tumor zone.

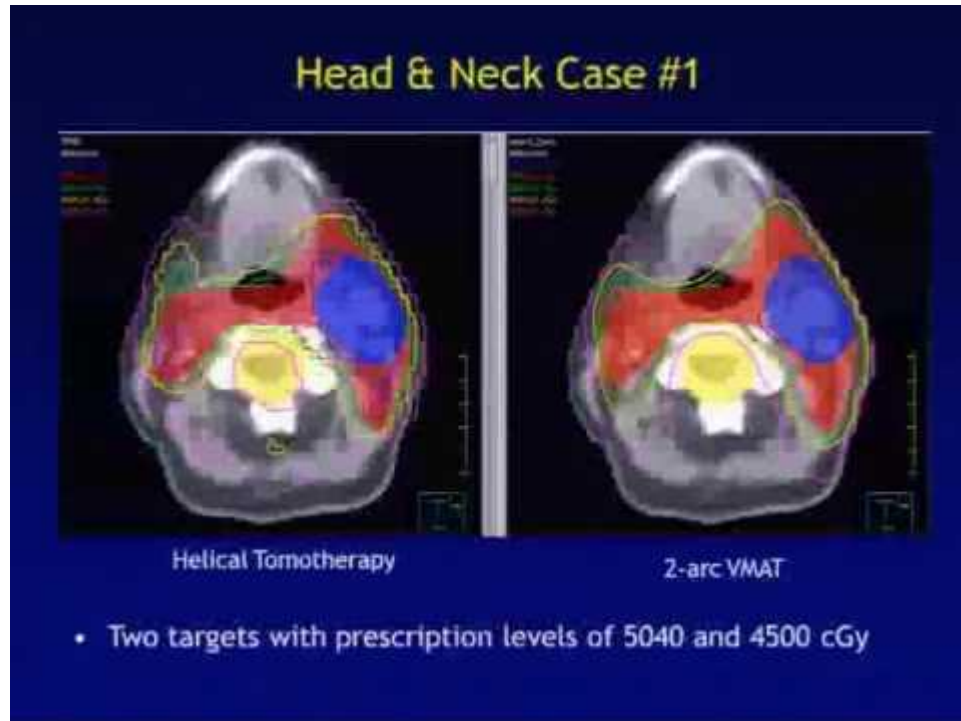
Mechanism of working of VMAT:- the mechanism of VMAT is based on photons i.e. W-Rays produced by linear accelerator. In this process small beams of variable intensities are generated and focused on the tumor site for treating the malignancies.

The beam is inrotated 360 around the patient in order to target the tumor zone in three dimensional manner.

This type of therapy basically consists of three steps

1. Diagnosis
2. Treatment planning
3. Delivery

Three dimensional diagnostic images of the patient are generated which are then used to ensure specific dose of the required radiation in order to treat the tumor in more précised and technical medical procedure by professional and technical medical team. In this mechanism the three dimensional diagnostic images are the patient's anatomy are usually CT and/or PET.



The End