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Q1:- what are the side effect of Therapeutic radiology on the human body?

Ans:-

## Side Effects of Therapeutic Radiology

### Acute SIDE EFFECTS

- Nausea and vomiting
- Swelling
- Hair loss
- Skin damage
- Infertility
- intestinal Discomfort
- Mouth sores
- Throat and stomach sores
- Damage To the Epithelial Surfaces
- Fatigue

### Late side effects

- Fibrosis
- Epilation
- Dryness
- cancer
- Heart dieases
- cognitive Decline
- Blood cancer
- Anemia
- LymPHEDEMA
- Radiation Protitis
- cumulative side effect
- Effects on Reproductive System
- Effects on Pituitary System



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Acute side effect

① Nausea and Vomiting

→ This not a general side effect of radiation Therapy, and mechanistically is associated only with treatement of the stomach or abdomen.
→ It is commonly react a few hours after treatement.
→ The radiation Therapy to certain nausing producing structures in the head during treatement of certain head and neck tumors, most commonly the vestib-ules of the inner ears.
→ As with any distressing treatement, some patient vomit immediately during radio Therapy.
→ Nausea, for any reason can be treated with antiemetics.

② Damage to the epithelial surfaces

→ Epithelial surfaces may sustain damage from radiation Therapy.
→ Depending on the area being treated, this may include the skin, oral mucosa, Pharyngeal, bowel, mucosa and ureter.
→ The rates of onset of damage and recovery from it depend upon the turnover rate of epithelial cells.
→ Typically the skin start to become pink and sores several weeks into treatement.
→ Skin reactions tend to be worse in area where there are natural folds



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in the skin such as underneath and female breast, behind the ear and in the groin.

(3) Mouth, throat and Stomach sores

→ If the head and neck area is treated, temporary soreness and ulceration commonly occur in the mouth and throat.
→ If severe, this can affect swallowing, and the patient may need painkillers and Nutritional support/food supplements.
→ It is radiation during treatement of lung cancer.

(4) Intestinal Discomfort

→ The lower bowel may be treated directly with radiation (treatement of rectal or anal cancer.
→ Typical symptoms are soreness, diarrhoea, and nausea.

(5) Swelling

→ As part of the general inflammation that occur, swelling of soft tissues may occur cause problem during radiation Therapy.
→ The patient may receive steroids during radiation Therapy to reduce swelling.

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(6) **Infertility**

→ The gonads are very sensitive to radiation.
→ They may be unable to produce gametes following direct exposure to most normal treatement doses of radiation.
→ Infertility can be efficiently avoided by sparing at least one gonad from radiation.

## Late side effect

(7) **Epilation :-**

→ Epilation may occur on any hair bearing skin with doses above 1 Gy.
→ only occurs within the radiation field/s.
→ Hairloss may be permanent with a single dose of 10 Gy.

(8) **Dryness**

→ The salivary glands and tear glands have radiation tolence of about 30 Gy in 2 Gy fractions dose.
→ Dry mouth (xerostomia) and dry eyes (xeropthalmia) can become irrating long term problems.
→ And severly reduce the patient quality of life.

(9) **Lymphedema**

→ Lymphedema, a condition of localized fluid retention and tissues, can result from damage to the lymphatic system sustain during

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radiation Therapy most commonly reported complication in breast radiation Therapy patients.
→ It is sugery to clear the axillary lymph nodes.

## Fibrosis :-

→ Tissues which have been irradiation tend to become less elastic over time due to a diffuse scarring process.

## Cancer

→ Radiation is a Potential cause of cancer, and secondary malignanices are seen in a very small minority of patient.
→ usually less than 1/1000.
→ Its usually occurs 20-30 years following treatement, although haematological malignancies may develop within 5-10 years.
→ The cancer occurs within the treated of the patients.

## Heart diease

→ Radiation has potentially excess risk of death from heart diease seen after some past breast cancer RT regimenes.

## Cognitive Decline

→ In cases of radiation applied to the head radiation Therapy may cause cognitive decline.

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→ Congnitive was especially apparance in young childdren, blw ages 5 to 11.

## Radiation proctitis

→ This can involve long-term effects on the rectum including bleeding, diarhea and urgency and is associated with radiation therapy to pelvic organs.

→ radiation therapy can also cause radiation cystitis with the bladder is affects.

## cumulative side effects

→ cumulative side effects from this praess should not be confused the long term effects.

## Effect on reproducation system

→ During the first two weeks after fertilization, radiation therapy is lethal but not teratogenic.

→ High dose of radiation during pregnancy cause and intellectual disability, ↑ risk of children leukemia and other tumors in the offspring.

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## Effect on Pituitary System

→ Hypopituitarism commonly develop after radiation therapy for sellar and parasellar neoplasms, extrasellar brain tumors head and neck tumors, and following whole body irradiation for system malignancies.

Q2:-

Ans:- Linear accelerator

→ A medical Linear accelerator (LINAC) ~~cut~~ customizes high energy x-rays or electrons to conform to a tumors shape and destroy cancer cells while sparing surrounding normal tissues.

→ It features several built-in safety measures to endure that it will deliver the dose as prescribed and is routinely checked by a medical physicist to ensure it is working properly.

→ If you're sheduled for radiation therapy using a LINAC, your radiation oncologist will collaborate with a radiation dosimetrist and a medical physicist to develop a treatement plan for you.

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→ They will double check this plan before treatement begins and implement quality assurance procedures to ~~expostre~~ ensures that each treatement is delivered in the exact same scanner.

## How does the equipment work?

→ The linear accelerator uses microwave technology to accelerate electrons in a part of the accelerator called the "wave guide" then allows these electrons to collide with a heavy metal target to produce high-energy x-rays.

→ These high energy x-rays are shaped ~~of the~~ as they exist the machine to conform to the shape of the patient tumor and the customized beam is directed to the patient tumor.

→ The beam is usually shaped by a multileaf collimator that is incorporated into the head of the machine.

→ The patient lies ~~into~~ on a moveable treatement couch and lasers are used to make sure the patient is in the proper position.

→ The treatement couch can move in the many directions including up, down, right, left, in and out.

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→ The beam comes out of a part of the accelerator called a gantry, which can be delivered to the tumor from many angles by rotating the gantry and moving the treatement couch.

## What is this equipment used for?

→ A medical linear accelerator (LINAC) is the device most commonly used for external beam radiation treatements for patient with cancer.
→ It delivers high energy x-rays or electrons to the region of the patient tumor.
→ These treatments can be designed in such a way that they destroy the cancer cells while sparing the surrounding normal tissues.
→ LINAC is used to treat all body sites, using conventional techniques, (IMRT), (VMAT), (IGRT), (SRS), (SBRT).

## Who operates this equipment

→ The patients radiation oncologist prescribes the appropriate treatment volume & dosage.
→ The medical physicist and the dosimetrist determine how to deliver the prescribed dose & calculate the amount of time it



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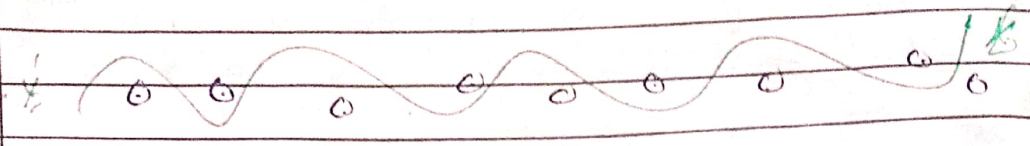
will take the accelerator to delivers that dose.

→ Radiation Therapists operate the linear accelerator and give patients their daily radiation treatements.



Q?:-

Ans:- Photon-tissue interactions

→ Three interactions describe Photon absorption in tissues.

① Photoelectric effect
② Compton effect
③ Pair ~~Fact~~ Production

## Photoelectric effect:-

→ In this process, an incoming Photon undergoes a collision with a tightly bound electron.
→ This Photon transfers Practically all of its energy to the electron and ceases to exist.
→ The electron departs with most of the energy from the Photon and begins to ionize surrounding molecules.
→ This interaction depends on the energy of the incoming Photon, as well as the atomic number of the tissues.

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→ The lower the energy and the higher the atomic number, the more likely that a photoelectric effect will take place.
→ An example of the interaction a practice can be seen on a diagnostic x-ray film.
→ Since the atomic number of bone is 60% higher than that of soft tissue, bone is seen with much more contrast and detail than is soft tissues.
→ The energy range in which the photoelectric effect predominates in tissue is about 10-25 Kev.

## Compton effect :-

→ The compton effect is the most important photon-tissues interaction for the treatement of cancer.
→ In this case, a photon collides with a "free electron" i.e, one that is not tightly bound to the atom.
→ unlike the photoelectric effect, in the scattered.
→ The photon can then continue to undergo additional interactions, energy given to it by the photon.
→ The probability of a compton interactions is inversely proportional

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to the energy of the incoming photon and is independent of the atomic number of the material.

→ When one takes an image of the ~~atomic~~ tissues using photons in the energy range in which the compton effect dominates (~25 kev - 2 (MeV), bone and soft tissues interface are barely distinguishable.

→ It is result of the atomic number independence.

→ The compton effect is the most common interaction occuring clinically as most radiation treatements are performed at energy level of about 6-20 Mev.

## Gray

→ The basic unit of radiation absorbed is the amount of energy (joules) absorbed per unit mass (kg).

→ This unit, known as the gray (Gy), has replaced the unit of rad used in the past (100 rads = 1 Gy : 1 rad = 1 (Gy).

## Percentage depth dose

→ This dose absorbed by tissues due to these interactions can be measured & plotted to form a percentage depth dose

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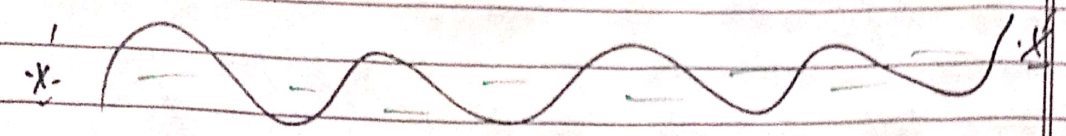
curve.

→ As energy ↑, the penetrative ability of the beam ↑ and the skin dose ↓.



Q4:-

Ans:- Brachytherapy:-

→ Brachytherapy also called internal radiation therapy.

→ Brachytherapy is delivered by placing radiation source(s) inside or next to the area requiring treatement.

→ Brachytherapy is commonly used as an effective treatement for cervical, prostate, breast, and skin cancer and can also be used to treat tumors in many other body sites.

→ As with stereotactic radiation, Brachytherapy treatements are often known by their brand names.

→ For example, brand names for breast cancer brachytherapy treatements include SAVI, Mammosite, and Contura.

→ Brand names of prostate cancer include Proxcelan, TheraSeed, and I-Seed.

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→ In Brachytherapy, radiation Source are precisely placed directly at the side of the cancerous tumor.
→ This means that the irradiation only affects a much localization area - exposure to radiation of healthy tissues further away from the Source is reduced.
→ These characteristics of Brachytherapy Provide advantages over external beam radiation Therapy.
→ The tumor can be treated with very high doses of localized radiation, whilst reducing the Probability of unnecessary damage to Surrounding healthy tissues.
→ A course of Brachytheraphy can often be completed in less time than other radiation Therapy techniques.
→ As one example of the localized nature of breast brachytherapy, the SAVI device delivers the radiation dose through multiple catheters, each of which can be individually controlled.
→ Brachytherapy is the term used to describe radiation treatement in which the radiation Source is in contact with external beam radiotherapy, in which the radiation Source 80-100cm away from the Patient.

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→ In brachytherapy, dose distribution is almost totally dependent on the inverse square law because the source is usually within the tumor volume.
→ Bic of this inverse square dependence, Proper Placement of radiation source is crucial.

Q.S:-

Ans:- Volumetric modulated arc Therapy (VMAT)

→ This advanced form of IMRT can cut the time needed to deliver a radiation dosage from 20 minutes to 5 to 7 minutes.
→ Like IMRT, it lets your radiation oncology team conform the beams to the shape of your tumor & ↓ strength where needed to cause less harm to healthy tissues.
→ Volumetric (VMAT) is a new radiation technique, which can achieve highly conformal dose distributions on target volume coverage and sparing of normal tissues.
→ The specificity of this technique is to modify three parameters during the treatement.

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→ VMAT delivers radiation by rotating gantry changing speed & shape of the beam with a (MLC) and fluence output rate of the medical linear accelerator.
→ VMAT also has potential to give additional advantages in patient treatement, such as reduced delivery time of radiation @ Compared with conventional static field (IMRT)

## (i) Particle Therapy

→ In Particle Therapy, energetic ionizing particle are directed at the target tumor.
→ The dose ↑ while the particle penetrates the tissues, up to maximum that occurs near the end of the particle's range, and it then drops to zero.
→ The advantage of this energy deposition profile is that less energy is deposited into the healthy tissues surrounding the target tissues.

## (ii) Auger Therapy

→ Auger Therapy makes use of a very high dose of ionizing radiation in situ that provides molecular modifications at an atomic

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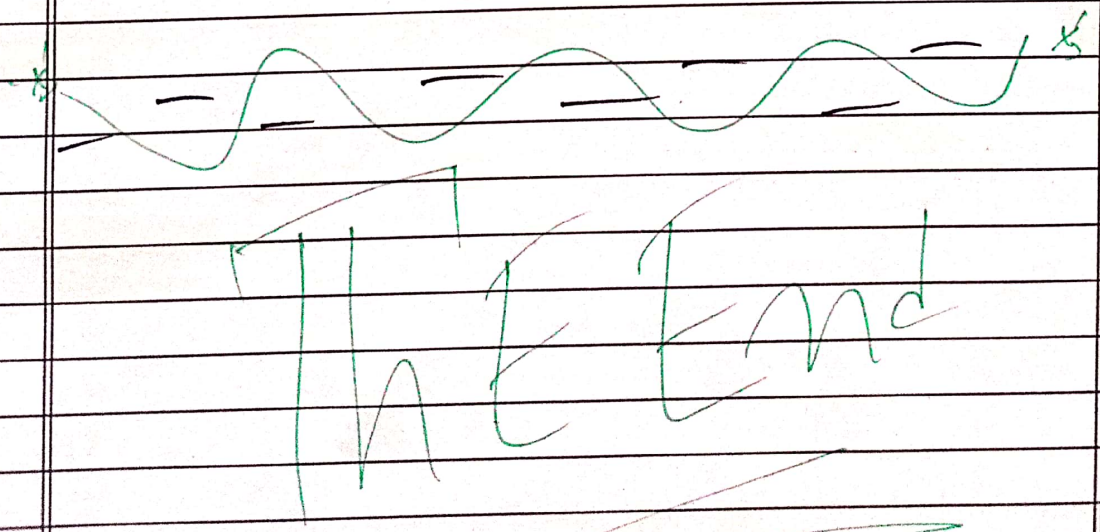
Scale.

→ AT differs from conventional radiation therapy in several aspects.

→ It neither relies upon radioactive nuclei to cause cellular radiation damage at a cellular dimension, nor ~~can~~ ~~exact~~ engages mutiple external pencil-beams from diff directions to zero-in to deliver a dose to the target area with reduced dose outside the targeted tissues / organ locations.

→ Instead, the in situ delivery of very high dose at the molecular level using AT aims for situ molecular modifications involving molecular breakages and molecular re-arrangements such as change of stacking structures as well as metabolic related to the side molecule structure.



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