Syed Tufail Jan
I.d 15371
B 4th Semester Radiology

Radiation Diotiction.

Deterministic Effect:-

Deterministic effects are those responses which increase in severity with increased dose if the dose increases the severity of an effect increases.

1) Deterministic effects are also called non-stochastic effect.
2) These effects depends on time of exposure, doses type of radiation.
3) It has a threshold of of doses below which the effect does not occur.
4) The threshold may be vary from person to person.

5) Deterministic effects are those responses which increase in severity with increase dose if the dose increases the severity of an effect increases.

6) All early effect and most tissue late effect is determini-stic.

7) Machanism involve effect on many cells.

Stochastic Effect:-

Effects that occur by chance, generally occurring without a threshold level of dose, whose probability is proportional to the dose and whose severity is independent of the dose.

1) Stochastic effect is those effect which occur when a person receives a high dose of radiation.

ity

2) These effects have an increa-se probability of accurence with increase dose
3) There is no threshold.
4) which is creatively certain that a stochastic effect can not accur.
5) Severity does not depend on magnitude.
6) These effects accur by chance usually without threshold level of dose.
7) Occurence of stochastic effect is probabillistic in nature.

(2) Radiation: Energy that emitted from a source is referred as radiation. Radiation is energy that travels through spaces. It can be defined as energy released in form of particales. It is in the form of waves or moving subatomic particales and rays.

Radioactivity: Some atom exist in an abnormally excited state characterized by an unstable nucleus. To reach stability, the nucleus spontaneously emits particales and energy and transform itself into another atom This process is called radioactivity.

Ionizing Radiation:

The radiation which has very high energy is called ionizing radiation. It is dangerous and leaves bad impact on human body. Alpha, Beta, x-Rays are some examples of ionization radiation. It has high energy and displace electron from their orbit.

Non-Ionizing Radiation:

The type of radiation is low energy radiation no ion charge are are produce in this radiation. UV rays, microwaves, Radiofrequency waves are some examples of non-ionizing radiation. These rays are not directly harmful impact our lives. Non-Ionizing radiation originates from various sources naturally originated or man made.

3 (a) Two Basic principles of radiation protection:

Minimize Time:

The dose to an individual is directly related to the duration of radiation of exposure.

→ If the time during and which one is exposed to radiation in doubled the exposure will be double.

→ Keep the time of exposure to radiation as short as possible.

→ During ~~radiograph~~ radiography the time of exposure is kept to a minimum to reduce motion blur.

→ During fluroscopy, the time of exposure also should kept to a minimum to reduce patient radiation exposure.

2) Minimize Distance:

→ Maintain as large a distance as possible between the source of radiation and exposed person.

→ As the distance between the source of radiation and the person increase radiation exposure decrease rapidly.

→ If the distance from the source exceeds five times the source diameter. It can be treated as point source.

→ Most radiation sources are point sources. The x-rays tube target, for example, is a point source of radiation.

→ The square law was used as to calculate exposure in radiographic technique.

$$\frac{\text{New exposure}}{\text{old exposure}} = \frac{\text{old distance square}}{\text{New distance square}}$$

Protection procedure.
The technologist should remain as far from the patient as practicable.

(b) Radiation protection devices:
* Radiation protection Aprons.
* Radiation protection Assecceories
* Radiation protection Gloves
* Radiation protection Glasses.
* Radiation protection thyroids shield.
* Radiation protection Apron Racks.
* Radiation protection Apron Racks and Drap shields.

(4) Protection Features Design:

Protective Housing:
= Reduce leakage
= less then 100mR
= distance 1m.

Control panel:-
= Condations and when tube is energized.
= Beam On must be clear to teach.

SID Indicator:
Indicator must be present with in 2%.
= It must be accurate.

Collimation:
= light failled
= variable apertum
= X-Ray beam and light filled must concide with 2% of SID.

PBL - Positive Beam Limitation

= Auto Collimation crica 1974-1994.

= Must be accurate with in 2%.

Beam Alignment:

= How do we know the tube is aligned with the image receptor.

Filtration:

= Inherent plus added

= Must be at least 2.5mm above 70 kvp

Reproducibility:

= Constant output radiation intensity.

= Should not exceed 5%.

Linearity:

= Constant output for varied

mA Seatings while time is adjust to keep MAs the same.

= Maximum variation is 10%. from one mA.

Operator Shield:

= It must not be possible to expose in a room out-side of the operator booth.

= portable x-ray must have > 2m tether for exposure.

Fluroscopic protection:

= Divergence of X-ray beam means the ESE or entrance skin exp. is lessened for the required exposure as SSD is increased.

(5) Geiger-Muller Counters: 1

A Geiger-Muller counter is a gas-filled detector designed for maximum gas amplication effect. The principles of a GM counter are the center wire (anode) is maintained at a high positive voltage relative to the outer cylindrical electrode (cathode). The outer electrode may be a metal cylinder or a metallic film sprayed on the inside of a glass or plastic tube. Some GM counters have a thin radiation entrance window at one end of the tube.

When ionization occurs in a GM counter, electrons are accelerated toward the center wire. Gas amplication occur in the GM counter as in a proportional counter.

The gas complication factor may be as high as 10^{10}. The large 2 electrical signal is easily detected with electronic circuits. Thus a GM counter like a proportion-cil counter. GM counter cannot be used to distinguish between radiation events of different energies.

Once the avalanche has terminated in a GM counter, an additional problem arises.
2 The positive ion cloud moves towards the outer electrode when the ion is very close to the outer electrode.

This can cause the relase of more electrons from the outer wall and set off another avalanche. This problem is prevented by the introduction of a quenching gas into the GM counter.

In addation of ionizing gas molecules, the accelerating elec-trons also can cause excitation of gas molecules through collision.

3 As the avalance progresses, the electrons, being relatively light are quickly collected, but the heavy, slow moving positive ions are not. Eventually a "hose" of slow moving positive charges is formed around the center wire.

The avalance then termin-ates because the positive ions reduce the effective electric field around the anode wire, eventually dropping.

The avalance ionization in a GM tube releases a large and essentially constant quantity of electrical charges regardless of voltage applied to the tube.

First they tend to give up electrons easily.
Secondly when the quenching gas molecules are neutralized by electrons entering higher energy orbit.
Thirdly, the quenching gas molecule are strong absorbers of UV radiation.

USES OF GM Counter:

GM Counter operate under even higher voltages between the anode and the cathode, usually in the 200 to 1200 volt range
* like the proportional counter the high voltage accelerate the charges produced in the initial ionization to where they have enough energy to ionize other electrons in the gas.

* The collection of the large number of secondary ions in the GM counter region is known as an avalanche and produces a large voltage pulse
* The electric circuit of a GM counter and records the number of pulses and the information is often displayed in counts per minute
* In the instrument has a speaker the pulses can also produce an audible click.
* This only takes a fraction of a second, but this process slightly limits the rate at which individual events can be detected.
* GM counters are generally more sensitive to low level of radiation.
* GM meters are typically calibrated for the energy of the gamma radiation being used.