Hazard and protection

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The importance of radiation hazards should be fully realised by all the workers in the X-ray fields. We all are aware of radiation hazards since the discovery of X-rays. Various reports of erythema, dermatitis, ulceration and neoplastic changes are commonly seen after the X-ray exposure. Many dentists have lost fingers due to their negligence to radiation hazards as they use to hold the film in the oral cavity with their finger

Ionising radiations produce biological changes in living tissues, and patient should not be misled that dental X-rays have no effect on human cells. The question is not whether dental X-ray is able to produce risk; but, it is that how much of it produces risk.

RADIATION BIOLOGY

Radiation biology is the study of the effects of ionising radiation on living systems. It is also defined as the study of the biological effect of radiation caused mainly by ionisation of water molecules within cells which produce highly reactive free radicals which, in turn, damage macromolecules, such as DNA

Note: The initial interaction between ionizing radiation and matter occurs at the level of the electron within the first 10–13 s after exposure.

TYPES OF BIOLOGICAL EFFECT

First classification

•Somatic: The radiation effects produced in an exposed individual during his or her lifetime are called somatic effect. Somatic cells are all the cells in the body except reproductive cells.

• Somatic Stochastic effect: It includes increase in probability of occurrence of biological effect with increasing absorbed dose rather than its severity. It occurs as direct effect of dose. For example, radiation-induced cancer is a stochastic effect because greater exposure of a person or population to radiation increases the probability of cancer but not its severity.

Genetic (the effect produced in the successive generation of the exposed individual): The reproductive cells are termed genetic cells

The reproductive cells are prone to damage with a comparatively much smaller dose than the amount needed to produce radiation effect on other organs of the body .

If the person crosses the reproductive age, there is no genetic effect.

Genetic effects are not seen in the person irradiated but are transferred to the future generation. Radiation induced mutation affects the health of offspring

Second classification

•Acute or immediate effect: The effect appearing shortly after the exposure as a result of large dose.

Skin: Excessive exposure causes dermatitis

Finger: Fingernail may become brittle

Hair: Hair loss can be permanent

Blood-forming tissue, it can manifest itself as change in blood count. The usual picture is leucopenia.

Eyes: Radiation dose can cause cataract and larger doses can cause detached retina.

- Chronic or long-term effect: The changes become evident after a long period of time

Carcinoma: Cancer of skin

Leukaemia

Necrosis: Destruction of tissue

Retardation of growth: Irradiation of developing teeth has resulted in disorganization of the odontoblast. With larger dose retardation of bone and tooth development is more obvious.

Latent period:- Is a period of time interpose between exposure and clinical symptoms such period varies with the dose. So the more is sever dose the shorter is the latent period some time the latent period is as long as 25 years for some minimum doses.

RADIATION CHEMISTRY

Ionising radiation **excites** dna **ionises** eht fo smota lacimehc setaitini ygrene fo refsnart eht dna ,eussit gnibrosba .seussit fo noitcurtsed sa stsefinam yletamitlu hcihw noitcaer rof elbisnopser era smsinahcem tcnitsid owt ,level ralullec tA dna tceffe tcerid :sllec eht ot egamad ro yrujni noitaidar ceffe tceridni

1-Direct Effect.

When biological molecule is ionised by radiation, direct alteration begins with the absorption of energy by the biological molecule and formation of unstable free radicals (atoms or molecules having an unpaired electron in the valence shell). These free radicals are extremely reactive and transform into stable configuration

When ionising radiation directly hits the vital target in the cell nuclei, there is damage to DNA molecule or a breach in chromosomes occurs. The subsequent chromosomal effect can be inability to pass information, abnormal replication, cell death. If the radiation hits the somatic cells, the effect on the DNA could result in a radiation induced malignancy. If the damage is to the reproductive system, the result could be radiation-induced congenital abnormality.

***Direct injuries from exposure to ionising radiation occur infrequently and most of the X-ray photons pass through the cell and cause little or no damage.

2. Indirect effect:- It happened in several ways where new chemicals result from process of ionization are in compatible with body tissues example conversion of water to H_2O_2 which cause cellular dysfunction also X- radiation can alter the chemical composition of hormones, enzymes and other body secretions make them partially or to tally in effective such indirect effects depend on the amount of exposure to X- ray.

Radiosensitivity of organs

High	Intermediate	Low
Lymphoid organs	Fine vasculature	Optic lens
Bone marrow	Growing cartilage	Mature erythrocytes
Testes	Growing bone	Muscle cell s
Intestine	Salivary gland	Neurons
Mucous membrane	Lungs	
	Kidny	
	Liver	

Method of dose and exposure reduction to patient:

Before Exposure

Patient selection: The most important thing is proper prescription of dental radiograph

Focal spot to skin distance: Increased source to patient distance reduces the amount of radiation to patient

Collimation: The tissue area exposed to primary X-ray beam should not exceed the minimum coverage consistent with meeting diagnostic requirements and clinical feasibility

Filtration: The purpose of conventional filtration is to selectively remove low-energy X-ray photons from the X-ray beam which will result in decreased patient exposure with no loss of radiographic information

Head leakage: Dental X-ray machine must be monitored for leakage radiation

Kilovoltage: Patient skin exposure is decreased as the kilovoltage peak (kVp) increases

Milliampere seconds: Film should not be overexposed or underexposed which can result in needless patient exposure

Film-holding device: It is also effective in reducing a patient exposure to X-radiation

Lead apron: Leaded apron should be used to minimise unnecessary radiation

Thyroid collars: They are used when thyroid gland is in the primary beam

Film processing: From the beginning of exposure of film till its processing, careful handling of the film should be done

Storage of film: Films may get displaced or lost due to carelessness, so to avoid repetition of radiographs proper storage of film should be done

To minimize the exposure the operator:-

1. position:- Operator must stand behind the patient because the head of the patient will absorb scattered radiation operator must stand with an angle of 90 - 135° to the radiation beam because in this area we have less scattered radiation.

2. Barrier:- It interpose between the source of radiation and the operator it is the most effective method of providing safety to the operator and barrier is made of lead , steel , concert ,or barium plaster of 1/16 inch.

3. Distance: - The intensity of radiation inversely proportional to the distance (inverse square law) so it's recommended for him to stand 6 feet away from the source of X-ray radiation.

Operator received dose from

1. Scattered radiation from the patient.
2. Primary beam if he stand in it's path.
3. Radiation leakage from the tube head.

Operator received secondary radiation and generally workers in X-ray clinic should not received more than 5 rem of whole body radiation each year.

* Film badges

They consist of:-

A. Blue plastic frame containing a variety of metal filters and a small radiographic film which exposed to X- ray.

B. It provide a permanent record of the dose received and it used for 1 – 3 months before being processed.

Thanck you