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Name :: Hafeez Ullah

ID # :: 14941

Program :: BS Radiology

Paper :: Radiation Sciences and Technolo

Submitted to :: Waqas Ihsan

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Q No. 2:-
Ans No 2:- Characteristic Radiation:-

If the electrons interacts with an inner-shell electron of the target atom rather than with an outer shell electron, characteristic x-rays can be produced. Charateristic x-rays result when the interaction is sufficiently violent to ionize the target atom through total removal of an inner-shell electron.

When the cathode electron ionizes a target atom by removing a K-shell. This is an unnatural state for the target atom, & it is corrected when an outer-shell electron falls into the void in the K-shell.

Transition of an orbital electron from an outer shell to an inner-shell is accompanied by the emission of an x-rays. The x-ray has energy equal to the difference in the binding energies of the orbital electrons involved.

The energy of x-rays resulting from M to K, O to K & from P to K transition can be calculated. Tungsten, for example, has electrons in shells out to the P shell, & when a K shell

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electron is ionized, its position can be filled with electrons from any of outer shells. All of these x-rays are called K x-rays because they result from electron transition into the K-shell.

Similar characteristics x-rays are produced when the target atom is ionized by removal of electrons from shells other than the K-shell.

The vacancy in the L-shell would be filled by an electron from ~~to~~ any station to the L-shell are called L x-ray & have much less energy than K-shell because the binding energy of an L-shell electron is much lower than that of a K-shell electron.

Similarly, M characteristic x-rays, N characteristic x-rays & even O-characteristic x-rays can be produced in a tungsten target.

Although many characteristic x-rays can be produced, these can be produced only at

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specific energies, equal to the difference in electron-binding energies for the various electron transitions.

Except for K x-rays, all of the characteristics x-rays have very low energy. The L x-ray, with approximately twelve 12 KeV of energy, penetrate only a few centimeters into soft tissue. Consequently they are useless as diagnostic x-ray, as are all the other low energy characteristic x-ray. The type of x-ray radiation is called characteristic because it is characteristic of the target element.

Because the electron binding energy for every element is different the energy of characteristic x-ray produce in the various elements is also different. The effective energy of characteristic x-ray increases with increasing atomic number of the target elements.

Bremsstrahlung Radiation:- The production of heat & characteristic x-rays

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involves interaction b/w the projectile electrons & the electrons of x-rays tube target atoms. A third type of interaction in which the projectile electron can lose its kinetic energy is an interaction with the nuclear field of a target atom. In this type of interaction the kinetic energy of the projectile electron is also converted into electromagnetic energy

A projectile electron that completely avoids the orbital electron as it passes through a target atom may come sufficiently close to the nucleus of the atom to come under the influence of its electric field. Because the electron is negatively charged & the nucleus is positively charged. There is an electrostatic force ~~b/w~~ of attraction b/w them.

The closer the projectile electron gets to the nucleus, the more its is influenced by the electric field of the nucleus. This field is very strong because the nucleus contains many protons

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ef the distance b/w the nucleus of projectile & electrons is very small.

As the projectile electrons passes by the nucleus, its is slowed down the changes its course, leaving with reduced kinetic energy in a different direction. This loss of kinetic energy reappears as an x-ray.

Bremsstrahlung x-rays are produced when a projectile electron is slowed by the nuclear field of a target atom nucleus.

These types of x-rays are called bremsstrahlung x-rays. Bremsstrahlung is a German word which means slow down radiations. Bremsstrahlung x-rays can be considered radiation that results from the breaking of cathode electrons by the nucleus.

A cathode electron can loose any amount of its kinetic energy in an interaction with the nucleus of the target atom. Ef the bremsstrahlung x-ray associated with the loss can take on corresponding values. For example, when an x-ray imaging system is operated at 70 kVp, electrons ~~can~~ from the cathode have kinetic energies from zero to 70 KeV.

This is different from the production of characteristics x-rays, which have very specific energies.

Bremsstrahlung x-rays can be produced at any cathode electron energy. K characteristic x-rays require an x-ray tube potential of at least 69 kVp. At 65 kVp, for example, no useful characteristic x-rays are produced. therefore, approximately 15% of the x-ray beam is characteristic, & the remaining is bremsstrahlung.

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Q No (3)

Ans: Factors that effect x-ray quantity:- A number of factors effect x-ray quantity. the factor that effect x-ray quantity exposure of the image receptor similary. x-ray quantity is directly proportional to the milliampere sounds (mAS). when mAS is doubled, The number of electrons striking the tube target is doubled and therefore the number of x-ray emitted is doubled. x-ray quantity varice rapidly varies rapidly with changes in Kilovolt peak (KVP). The change in x-ray quantity is propotional to the square of the ratio of KVP; in other words. if KVP were doubled, the x-ray intensity would increase by a factor. In practice a slightly difference situation prevails. Radiographic technique factors must be selected form a relatively narrow range of values, form approximately

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40 to 150 kvp. Theoretically, doubling the x-ray intensity by kvp manipulation alone requires an increase of 40% in kvp. This relationship is not adopted clinically because as kvp is increased, the penetrability of the x-ray beam is increased, and relatively fewer x-rays are absorbed in the patient. more x-ray to through the patient and interact with the image receptor. Consequently, to maintain a constant exposure of the image receptor, an increase of 15% in kvp should be accompanied by a reduction of one half in mAs.

It is increasing kvp and and reducing mAs so that image receptor exposure remains constant. the patient dose is reduced significantly. The disadvantage of such a technique adjustment is reduced image contrast when screen film in the image receptor. there is little change in contrast when using digital image receptors.

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Quantity refers to the number of x-ray photons in the beam.

* As the number of photons increases, the beam intensity increase & any factors that effect the number of x-ray photons in the beam influence x-ray beam quantity.

Quantity is effected by:-

* Changes in mA (tube current)
* Changes in the filtration.
* Changes in KVP
* Changes in type of waveform used.
* Changes in the material (Z number of largest.
* Changes in distance form the tube (FFD).

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Q : N/O :: (3)

Ans :: Five Factors that effect Subject Contrast:.

Subject contrast it is refers to the difference in the intensity transmitted throug the different parts of an object. for example in an intraoral radiograph. enamel will attenuate x-ray more than dentin. subject contrast is effected by the following factors.

① Thickness::

If the x-ray beam is attenuated by 2 different thicknesses of the same materal. The thicker part will attenuatate more x-rays than the thinner part.

② Density::

This is also known as the mass per unit volume. it is the most important factors contributing to subject conrast. A higher density material will attenuate more x-ray than a lower

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density material.

(3):. Atomic number:.
A higher atomic number material will attenuate higher than a lower atomic number material.

(4):. Radiation quality or kvp:-
It has a effect on subject contrast. A lower make the x-ray beam less penetrating will result in a greater difference in attenuation between the difference part of the subject, leading to higher contrast. A higher kvp will make the x-ray beam more penetrating. this will result in less difference.

(5)

A person's size shape, age and condition of the body part all effect subject contrast.
The contrast of a radiograph viewed on an illuminator is called radiographic contrast. As indicated perviously, radiographic contrast is a function of image

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receptor contrast and subject contrast. In fact radiographic contrast is simply the product of image receptor contrast and subject contrast

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Q NO (4)

Ans:: Collimator Filtration::

* A Collimator is a metallic barrier with an aperture in the middle used to restrict the size of the x-ray beam and volume of tissue irradiated.
* Dental x-ray beams are usually Collimated to a circle 2 ¾ inches (7 cm) in diameter at the patient's face.
* In intraoral machines there are fixed Collimators & In extraoral machines there are adjustable Collimators.
* This involves removal of unwanted radiation whilst leaving the wanted radiation undiminished.
* Radiation emitted by an x-ray tube is made up of photons of much different energy.

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- The maximum photon energy depends only upon the kilovoltage used to generate the radiation.

☆ And the minimum energy depends upon the nature & thickness of the material of the wall of the x-ray tube.

☆ Because of their different energy depends upon the nature & thickness of the material of The photons have different penetrating powers.

☆ when the beam of radiation is incident upon the patient. the bulk of the low energy photons is absorbed in the superficial layers, which produce unwanted effects.

☆ Thus, These low energy radiations must be removed by a process called filtration.

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(2) Image Contrast :-

a image contrast is chemical substance which is introduced in human body via entral / parentral route to visualize certain structures not seen in plain radiography.

* It is used to see vascularity of certain lesions in CT scan and MRI.

* A higher density material will attenuate more x-rays than a lower density material.

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3) Aperture Diaphragm::
An aperture diaphragm is a flat piece of lead (diaphragm) That has a hole (aperture) in it. Commercially made aperture diaphrams are available as are those that are "homemade" (hospital-made) for purpose specific to a radiographic unit. Aperture diaphragms are easy to use. They are placed directly below The x-ray tube window.
As aperture diaphragm can be made by cutting rubberized lead to the size needed to create the diaphragm and cutting the center to create the shape and size of the aperture. Although the aperture's size and shape can be changed. The aperture cannot be adjusted from the designed size. Therefore the projected field size is not adjustable. In addition. because of the aperture's proximity to the radiation source (focal spot). a large area of unsharpness surrounds the radiographic

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image Although aperture diaphrams are still used in some applications, their use is not as widespread as that of other types of beam - restricting devices

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Q/5 NU/5 (5/2)

Ans: Compton Scattering

x-rays Throughout The diagnostic range can undergo an interaction with outer-shell electrons That not only scatters The x-ray but reduces its energy and ionizes the atom as well This interaction is called compton scattering

in Compton scattering The x-ray interacts With an outer shell electron and ejects it from The atom Thereby ionizing The atom The ejected electron is called a Compton electron The x-ray continues in a different direction With less energy.

The energy of The compton scattered x-ray is equal To The difference between The energy of The ejected electron The energy of The ejected electron is equal To The binding energy plus The Kinetic energy With which it leaves The atom Mathematically; This energy transfer is represented as follows.

During Compton scattering most of The energy is divided between The scattered x-ray and The Compton electron Usually, The scattered x-ray retains most of The energy Both The scattered x-ray and The Compton electron may have sufficient energy To undergo additional ionizing interactions before They lose all Their energy.

Ultimately The scattered x-ray is absorbed photoelectrically The Compton electron

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loses all of its kinetic energy through ionization and excitation and drops into a vacancy in an electron shell perevioresly created by same other ionizing event

Compton scattered x-ray can be deflected x-ray at a deflection direction including 180 degree, no energy from the incident x-ray at a deflection of a degrees no energy is transferred As the angle of deflection increases to 180 degrees more energy is transferred to the Compton electron but even at 180 degrees of deflection the scattered x-ray returns at least approximately two thirds of its original energy x-rays scattered back in the direction of the incident x-ray beam are called backscatter radiation in radiography. backscatter radiation is responsible for the even though the hinge was on the back side of the cassette in such situations the x-radiation has backscattered from the walls or the examination table, not from the patient.

The probability that a given x-ray will undergo compton scattering is a complex function of the incident x-ray in general, the probability of compton scattering decreases as x-ray energy increases

The probability of Compton scattering does not depend on the atomic number of the atom involved Any given x-ray is just as likely to undergo Compton scattering with an atom of soft tissue as with an atom of bone.

Compton Scattering Reduces image contrast

Compton scattering in tissue can occur with all x-rays and therefore is of considerable importance in x-ray imaging. However its importance makes a negative sense.

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Scattered x-rays provide an useful information on The radiograph Rather They produce a uniform optical density on The screen film radiograph and uniform inten sity on The digital image receptor That results in Reduced image contrast Ways of reducing This scattered Radiation are discussed later, but none is totally effective
The scattered x-rays from Compton scattering can Create a serious radiation exposure hazard in Radiography and particularly in fluoroscopy A large amount of Radiation can be scattered from The patient during fluoroscopy Such radiation is of most of The occupational radiation exposure That radiographers receive.

During Radiography The hazard is Less severe because no one but The patient is usually in the examining room Nevertheless, scattered radiation Levels are sufficient To necessitate protection of The x-ray examining room.

Photoelectric Effect.

X-rays in The diagnostic range also undergo Ionizing interactions With inner shell electrons The x-ray is not scattered but it is Totally absorbed This process is called The Photoelectric effect and it earned Albert Einstein The 1921 Nobel prize in physics not relativity

The electron removed from is called a photoelectron and escapes with kinetic energy equal To The difference between The energy of the incident x-ray and The binding energy of The electron.

The photoelectric effect is Total x-ray absorption Low atomic number atoms such as those found in soft tissue The binding energy of even of even k-shell electrons is Low Therefore The photoelectron released with Kinetic energy nearly equal To The energy of The incadent x-ray

for higher atomic number Target atoms electron banding enegies are higher therfore the kinatic energy of the photoelec Tron from barrom is porportionately Lower Table shows the approximate k shall binding energy for elements of Radiologic importance.

characteristic x-ray cans produced after a photoelec Tric interaction in a manner similar To that described in chapter 7. Ejectiong of a k shell photoelctron by the incident x-ray results in a vaccany in the k shell this unnatural state is immediately corrected when an outer shell electron usually from the L shell drops into the vaccancy

This electron Transition is accompanied by the emission of an x-ray whose energy is equal To the difference between binding energies of the shell involved these characteristic x-ray consist of secondary radiation and behave in the same manner as radiation The contribute nothing of diagnostic value and fortunately have sufficiently Low energy that they do not penetrate To the image receptor.

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