International Journal of Scientific Trends- (IJST)
ISSN: 2980-4299
Volume 1, Issue 1, October, 2022
Website: https://scientifictrends.org/index.php/ijst
Open Access, Peer Reviewed, Scientific Journal

Study of the Effect of Radiology X-ray and its Risks on Human

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Abstract
In this research, we must know the dangers of x-rays on the human body were identified. The possibility of damage that radiation can cause is related to being in high quantities, while radiological examinations are governed by international controls and standards that determine the amount of radiation within safe limits. The possibility of damage due to an examination using x-rays is a very small theoretical possibility. It is known that X-rays are a form of energy (electromagnetic waves) such as light and radio waves. But the difference is that the rays have the ability to penetrate the human body unlike light. After the discovery of X-rays by the scientist Roentgen, it was exploited in the medical field for the purpose of viewing and diagnosing the internal organs in the human body. We can say that the use of radiology in the medical field has a great impact in helping doctors to make decisions in treating their patients better.

Keywords:

1-1: Introduction:

By chance, the American scientist saw Code Speed in 1895, the appearance of a picture of two pieces we are driving on a photographic newspaper located next to the Crocus tube, but he did not recognize it and did not follow it. During his experiments on the behavior of electronics in the same year, an electrical discharge was obtained inside a partially emptied tube of air by fast electrons. When projecting voltage into a dark laboratory, he noticed a faint light on a small piece of paper attached to it, covered with potassium cyanide, near the tube.the location of X ray radiation is between Uv and Gama ray.

The fluorescence of potassium cyanide is the cause of the faint light and is not due to the electrons emitted from the cathode because it does not penetrate the glass or from the electrical discharge process because the tube is covered with a thick piece of black paper. Unidentified rays were generated as a result of applying a high voltage to the cathode and anode as a result of the conclusion of the German scientist Roentgen, which has the ability to penetrate glass and fluoridate some materials, and it was called x-rays. The great surprise was when he noticed the image of his wife's bones on a paper covered with a fluorescent substance in 1895, which is the beginning of X-ray diagnosis. X-rays have been used in diagnosis since that time and developed in secret. In 1913, Coleridge designed a tube that emits X-rays, which consists of a filament of tungsten, which has the ability to emit electrons when heated. In 1917, the German

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Yuki and the American Potter managed to manufacture the filter that increases the contrast in the image as a result of reducing the scattered rays in the patient's body. In 1920, Bowser in the Dutch company Philips was able to design the rotating anode instead of the fixed anode. In 1948, the scientist Cotman was able to design a tube that generates a clearer image and the ability to display the image on television and store it. With this technique, imaging of the heart, arteries, and digestive system was possible. The scientist Hutchfield in Britain in 1968 used tomography, where the first image of the brain was taken using this technique in 1971 in London.

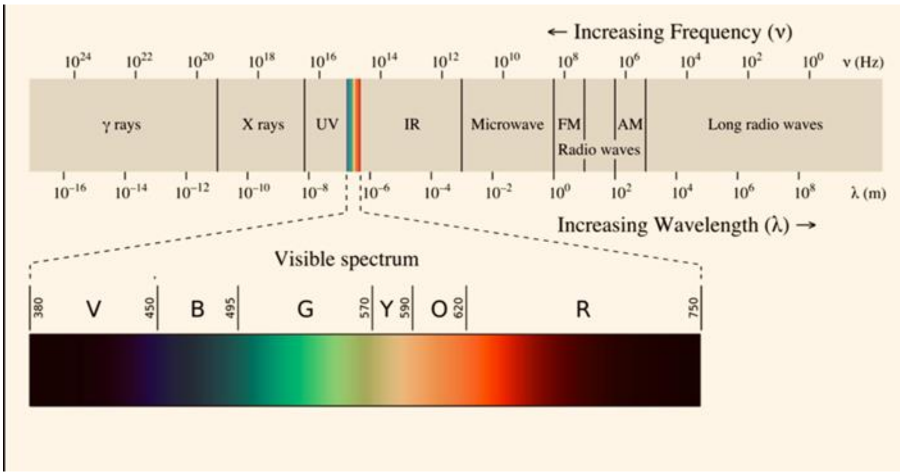

Fig.(1) electromagnetic radiation.

In 1977, digital x-ray imaging (computed tomography CT) was used, where a computer was used for recording, processing, and display. The arteries were photographed for the first time by injecting them with a dye to increase the contrast in the vein or arteries, but this image contains the background of the bone image that covers the image of the arteries, so the computer deletes the image of the bones and clearly shows the image of the arteries and the movement of the dye within them.

There are new diagnostic x-ray techniques by adopting, displaying, storing and replaying images.

Radiograph with developing means of archiving communications with images and the method of using x-rays remotely and extensively .although radiology is a modern science, the developments in it were enormous and it is a useful diagnostic medical revolution for humanity and helped diagnose many unknown diseases, including:

1. The introduction of axial tomography in the late seventies and early eighties.
2. The introduction of new imaging techniques, including radiological imaging such as radioisotopes (nuclear medicine), non-radiological imaging such as ultrasound in the late seventies and magnetic resonance imaging in the late eighties. The last three methods were three revolutions in rays (3D helical CT scan, color gradient Doppler ultrasound), (magnetic resonance imaging). Radiation has many benefits that are difficult to enumerate, but at the same time there are some unexplained and unexplained harms.

As the damages caused by medical radiation are divided as follows: The type of radiation used - diagnostic or therapeutic.

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• Amount of radiation - the dose of radiation. The place of exposure (the type of tissue exposed to the rays).

• Age of the patient exposed to radiation. In the field of diagnostics, it is strictly forbidden to irradiate the fetus in its mother's womb, especially during the first period of pregnancy, and then it is allowed to be exposed within very narrow limits in the last periods of pregnancy if necessary (fetal age) for (Mother) to determine the type of disease and then treat it. After delivery, it is generally recommended to reduce radiation exposure.The danger of radiation exposure lies in stopping the growth of cells or causing changes in the cytoplasmic organelles inside the cells, and here is the danger as these cells are subject to random growth, which is known as cancerous tumors. To avoid such risks, there are special techniques and means to protect patients and workers from radiation hazards, such as the use of lead limiters, protective shields and personal dosimeters. Electrons between the different energy levels of the orbitals surrounding the nucleus. They are called characteristic rays, or as a result of the sudden stopping of fast electrons when they hit the target material inside the X-ray tube.

1-2 : The X-ray tube parts:

- Cathode (-)
  - Filament made of tungsten
- Anode (+) target
  - Tungsten disc that turns on a rotor
- Stator
  - motor that turns the rotor
- Port
  - Exit for the x-rays

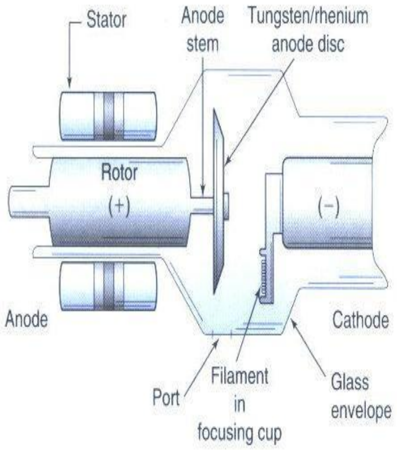

FIGURE 2-5 Structure of a typical x-ray tube, including the major operational parts.

Fig. (2) x-ray tube.

The basic X-ray tube consists copper, tungsten or molybdenum anode (+ve electrode) and cathode (-ve electrode). Electrodes are mounted in a solid metal or Pyrex evacuated tube. The anode consists a tungsten target inclined by 100 to 200. The cathode consists tungsten filament. Both anode and cathode electrodes are connected to high energy electric power supply (high electric tension).

1-3: X-ray production

Push the “rotor” or “prep” button Charges the filament – causes thermionic emission (e- cloud) Begins rotating the anode. Push the “exposure” or “x-ray” button e-’s move toward anode target to produce x-rays

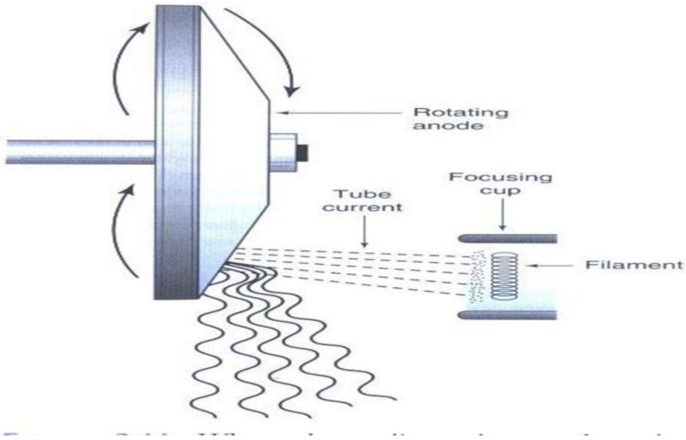

Fig. (3) X-ray production

1-4: Characteristics of X-rays:

1. X-rays penetrate materials to varying degrees and weaken when passing through a plate made of aluminum, it has a thickness of (15 mm) to a large extent, but it cannot erase its effect totally, the fluorescence of the screen can be seen while the beam of radiation passes through it. That this ray is Very weak in lead glass. But it can penetrate other types of Glass that have the same thickness easily.
2. Its ability to ionize the atoms of the gases that pass through it - where this can be used phenomenon in the detectors, measure the amount of X-rays passing through the material, and know Radiation exposure.
3. It affects the screen coated with platinum barium cyanide and other materials such as stone salt, calcium salts, glass and uranium and leads to its fluoridation.
4. It affects photographic plates and fast films. Therefore, radiography is an important way to study the properties and effects of these rays.

1-5: Measurement of X-rays radiation.

The units used in the measurement of radiology are many and varied. In order for it to be easy to understand and assimilate, it must, be classified. Divided the topic into four parts. Each segment expresses either the state of the outgoing ray. the purpose of calculating the amount of rays. The first case: the units of measurement of the active radiation source radioactive radiation are the radiation emitted by a substance continuously and actively regardless of external factors. There are two units commonly used to measure this type of radiation and are commonly used in nuclear medicine. The Becquerel is the SI unit of radioactivity and we can define it as the number of radiations that a radioactive sample emits at a rate of one decay per second. The following symbol is taken by Bq. The decay is the decay of radioactive material and is called decay .But the most commonly used unit is the curie and its symbol is Ci. A curie is the activity of a sample that dissolves in one second $3.7 * 10^{10}$. They are often expressed in either $_{m}$Ci or µCi .The second units of measurement of the rays the electric charge is measured in coulomb. This unit can be applied to either gamma rays or x-rays. We use it when we measure enough radiation to produce a charge of 1 coulomb in one kilo of air. Here the unit is coulomb/kg .Another traditional unit of measurement for this type is the Roentgen unit.

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This unit is an old unit and we can define it as follows: The amount of rays sufficient to produce a charge of 2.58 * 10^-4 coulombs/kg .To convert between Rontgen and coulomb/kg we use this relationship I R = 2.58 x 10-4 Coulomb/kg air. units of measurement of radiation absorption. When rays enter the human body, for example, they are absorbed and are called Absorbed Dose. These units can be applied to calculate the amount of absorbed radiation for different types of radiation such as X-rays, gamma rays, beta and alpha rays. The international unit for measuring radiation absorption is the gray unit and the symbol Gy. Gray is the absorption of 1 joule of energy in 1 kg of matter. This means that when 1 joule of radiation energy is absorbed by (1 kg) of matter, the energy absorbed is 1 gray.Another traditional unit for measuring radiation absorption is the RAD unit. It is equal to absorbing $10^{\wedge-2}$ joules of radiation energy in 1 kg of matter .To convert between gray and rad, we use this relationship **1 Gy = 100 rad**. The equivalent dose unit is the Sievert and has the symbol Sv .the equivalent dose is calculated by multiplying the absorbed dose by a specific factor for each type of radiation. X-rays have a different factor than gamma, beta. Effective Dose Different types of organs and tissues of the human body have different sensitivity to radiation. Some tissues are weak in the face of radiation. The effective dose takes into account the sensitivity of different organs to radiation. The effective dose unit is also the Sievert, symbol Sv. the effective dose is calculated by multiplying the equivalent dose by a certain factor. This factor varies with different tissues of the human body

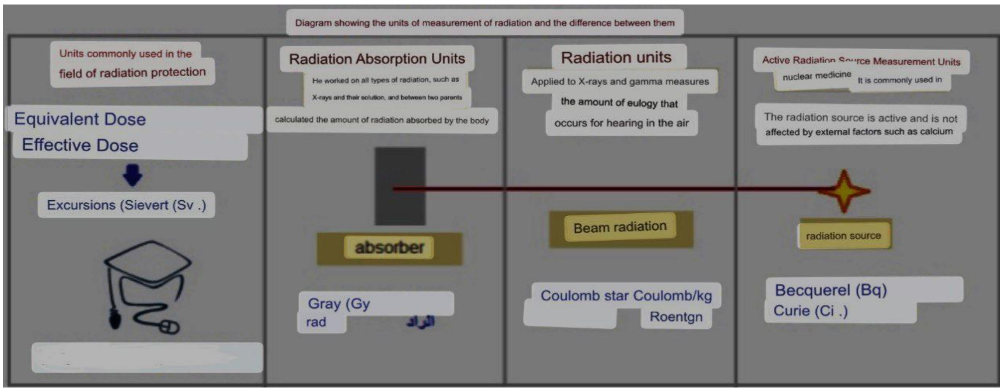

Fig.(4)measurements and converts units x ray

1-6: Types of rays

1-6-1: Characteristics x-rays:

This type of x-ray is emitted when atomic electrons move from higher-energy orbitals (shells) to lower-energy orbitals in the same atom, as it is clear from the drawing. An electron in a large orbital has a higher energy than an electron in a smaller orbital. This means that the energy of the photon is equal to the energy difference between the first and second orbitals.

1.6.2: Bremsstrahlung:

This type is produced when an electron decelerates, or in other words, a deceleration. It is the interaction of the electron with the intense electric field of the atom or the nucleus, as the energy lost by the electron due to its decreasing speed is released in the form of X-ray photons, where the energy of the photon released as a result of the deceleration is equal to the energy difference

Between the electron before the interaction with the electric field and after the interaction with it Severe in it speed.

The spectrum of brittle rays is characterized as a continuous spectrum, meaning that the energy of the photons takes different values, starting from zero and ending at the maximum value of the stifled electron. Examples of bruxism x-rays are those rays that are generated in x-ray tubes used in medical diagnosis and in various industrial applications. Where the electrons are accelerated using a large potential difference, then the accelerated electrons are suppressed on the anode material, and the rays are emitted.

2: The purpose of the research (Aim of study):

The aim of this research is to study the properties of X-rays, understand the experimental methods used, and know their most important applications and the fields in which these applications are used. The research also aims to know the risks of radiological imaging, which have a significant impact on human health and safety.

3: Literature revue.

The properties of radiological films used in medical diagnosis differ according to the different parts of the body that X-rays penetrated by the techniques used to conduct these examinations. There have been many studies And research in quality control measurements, radiography, and film properties in terms of density Photoluminescence, exposure rate, diagnostic dose amounts and their relationship to tissue thickness and exposure rate and peak voltages (kvp). The following is a review of some previous studies in this field. The two scientists (Chloe Phil and Cameron) calculated the rate of exposure in the air at the position of the surface of an object Patient output from single-phase x-ray machines of a wide range of (kvp) and filters Used in X-ray diagnosis at a distance of (100) cm from the target to the surface. This study found a linear relationship between exposure rate (mAS) and peak voltages (KvP) for a number of filters and radiation dose.

In 1971, Otoka and Russell calculated the radiation dose to the head and gonads And the skin by conventional radiography, using the phantom and ionization chamber to measure This dose and resulted from this study that the radiation dose varies from one site to another as well It varies with (kvp) and exposure (mAs) with different tissue types to be examined. This study in Iraq (an approximate calculation of the genetically affected doses for the Iraqi population in 1972 One of the diagnostic and x-ray examination devices for medical purposes (by Dr. Musa El-Sayed Abbas , The Seventh Arab Scientific Conference in Cairo for the purpose of reducing the danger of radiation to the present and generations The genetic influence of the annual genitalia dose is the basis for estimating this the risk. The examination study was conducted on 124 devices for the whole body and the exposure rate was 19,104 people In the year, 78 dental devices and the rate of exposure was 30,398 people per year, as they were examined Genetic effect on the whole body.

In 1982, Harrison and his colleagues conducted a survey study to find out the radiation dose for patients resulting from diagnostic X-ray examinations. The researchers used the indirect method to measure the dose entering the examination for a number of patients (502) patients

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during a chest radiological examination in Britain. It was concluded from this research that the dose The surface radiation changes by a factor of (4) and this is due to the difference in the quality of the film and screen Used in all studies in which the highest and lowest doses were recorded. In these studies, researchers concluded that high radiation doses can be reduced by changing the Technology and exposure conditions.

4– The Theoretical part:

4-1 Medical x-ray diagnosis

X-rays are still one of the effective and important methods for knowing the components of the body and what affects it It changes and is also more widely used in medical diagnosis, especially after using techniques digital image acquisition. This process depends on producing a visible radiological image with different optical density in terms of shape, size and degree of blackening for that part to be examined after exposing it to the radiation beam, through which information about the anatomical and functional structure is obtained and thus the health status of that part is determined.

The information obtained depends on the efficiency of the radiological image, which changes depending on the type of examination and the anatomical structure of the organ to be examined. The ability to extract this information from the radiological image depends on distinguishing between the different components of the human body, varying in composition from one organ to another, as well as from one part to another, the anatomical structure within each organ in it. Where the rays pass easily through the soft tissues and are absorbed in a greater amount in the bones because they contain calcium with a high atomic weight

The human body, when a beam of X-rays passes through it, it attenuation of these rays occurs inside the body to different degrees depending on the atomic number, density and thickness of the part through which the rays pass through. The body and therefore the penetrating rays that passed through it carry the details of that organ, so it is called the radiograph.

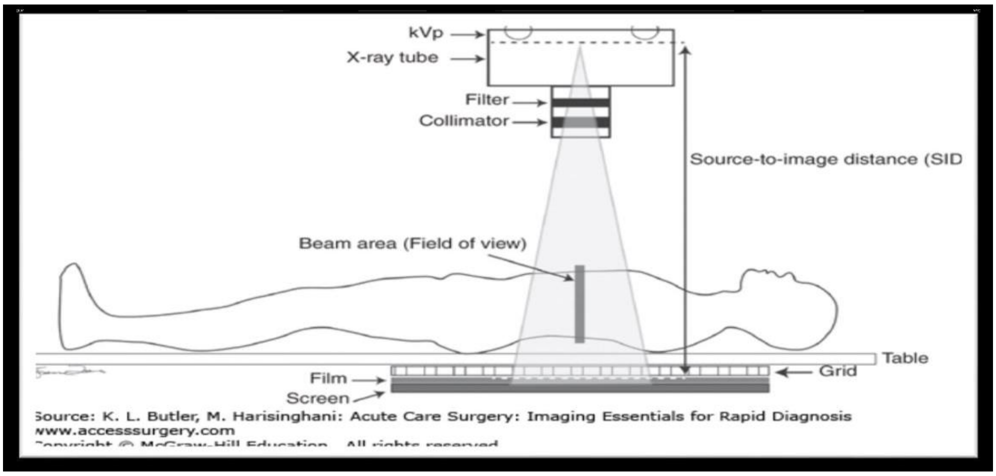

Fig.(5)Shows the schematic diagram of the formation of a basic radiograph.

Since the eye is not sensitive to the x-rays coming out of the body, the radioactive film is located behind the patient, and after the film is chemically acidified, a stable visible image appears that can be seen. Or display it on a fluorescent screen or display it digitally on a calculator. The components of the image on the film are a negative image, as the black areas

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on the film correspond to those places in which little X-ray energy has been absorbed, and the light-colored (white) areas correspond to those places where a large absorption of that energy has occurred.

(4-2) The Effect of Long-Term X-Ray Exposure on Human Lymphocyte

X-ray is electromagnetic radiation produced outside of a nucleus. It has energy lower than γ-ray. X-ray mainly is produced artificially; the major application of x-ray is in medicine . Ionizing radiation can ionize atoms by removing an electron from their orbits producing ions with positive charge and free electron with negative charge. Ionizing radiation includes the radiation that comes from both natural and man-made radioactive materials Both low and high doses of ionizing radiation can harm living cells depending on the amount of the dose, dose rate, sex, age, and the type of the target. If the ionizing radiation interacts directly with critical targets for example with DNA, the mechanism is called direct interaction. The process by which ionized radiation interacts with water inside a cell, producing both ions and free radicals is called indirect interaction .Health physics, radiological health, or radiological engineering are concepts used in the field of public health and environmental health engineering which deal with the use of ionizing and nonionizing radiation safely to avoid any biological effects of the radiation on humans. The health physicist is responsible for safety aspects in the design of processes, equipment, and facilities utilizing radiation sources and the safe disposal of radioactive waste so that radiation exposure of personnel will be minimized and will at all times have acceptable limits; they must keep personnel and the environment under constant surveillance in order to ascertain that these designs are indeed effective. If control measures are found to be ineffective or if they break down, the health physicist must be able to evaluate the degree of hazard and make recommendations regarding remedial action.

All cells and tissues of human body do not have the same radio sensitivity; some of them are radiosensitive while others are radio resistance. Hematopoiesis is one of the most radiosensitive systems to radiation. It was considered that peripheral blood count is suitable to use as bio indicator to estimate damage from ionizing radiations Recently, the use of ionizing radiation in medicine has increased, thus it is expected to increase the number of x-ray technicians. Diagnostic technicians not using radiation protection tools for low doses of x-ray during their working days were observed at the hospitals while we did the study. Any variation of blood cell count in human may lead to suspicion of disease. In numerous studies the importance of blood cell count was explained through the effects of partial or total body irradiation on peripheral blood cell count and most of the studies were focused on high dose radiation received accidentally or therapeutically. While many studies were conducted on the risks of high-dose radiation, the insufficient information on the radiation takes a risk on technicians working at the clinical radiology departments especially the probable change in the basic hematological parameters such as red blood cells, (RBCs), white blood cells (WBCs) and platelets count that can be used in the determination of the harmful effects of x-ray radiation. The present study is conducted in Kirkuk hospitals and aims to study the long-term effect of x-ray on technician's blood while measuring lymphocytes, reactive lymphocytes and their morphology.

(4-3) The risk of x-ray on human

Risks X-rays can cause mutations in our DNA and, therefore, might lead to cancer later in life. For this reason, X-rays are classified as a carcinogen Trusted Source by both the World Health Organization (WHO) and the United States government. However, the benefits of X-ray technology far outweigh the potential negative consequences of using them.

- Each procedure has a different associated risk that depends on the type of X-ray and the part of the body being imaged. The list below shows some of the more common imaging procedures and compares the radiation dose Trusted Source to the normal background radiation that all people encounter on a daily basis.

Chest X-ray: Equivalent to 2.4 days of natural background radiation
Skull X-ray: Equivalent to 12 days of natural background radiation
Lumbar spine: Equivalent to 182 days of natural background radiation
IV urogram: Equivalent to 1 year of natural background radiation Upper gastrointestinal exam: Equivalent to 2 years of natural background radiation
Barium enema: Equivalent to 2.7 years of natural background radiation
CT head: Equivalent to 243 days of natural background radiation
CT abdomen: Equivalent to 2.7 years of natural background radiation.
These radiation figures are for adults. Children are more susceptible to the radioactive effects of X-rays.

(4 -4) Ionizing radiation and cancer risk

We've long known that children and teens who receive high doses of radiation to treat lymphoma or other cancers are more likely to develop additional cancers later in life. But we have no clinical trials to guide our thinking about cancer risk from medical radiation in healthy adults. Most of what we know about the risks of ionizing radiation comes from long-term studies of people who survived the 1945 atomic bomb blasts at Hiroshima and Nagasaki. These studies show a slightly but significantly increased risk of cancer in those exposed to the blasts, including a group of 25,000 Hiroshima survivors who received less than 50 mSv of radiation — an amount you might get from three or more CT scans. (See "Imaging procedures and their approximate effective radiation doses.")

(4-5) Protection from the dangers of x-rays

Despite the risks of dental radiation on the human body, but it contribute to the diagnosis of many diseases and cannot be dispensed with in most emergency cases, there are steps that we must follow to reduce and protect against radiation risks. As it is known, when radiation enters the human body, the beam of radiation kills some cells. The percentage of affected cells of the human body varies from one organ to another. For example, the cells of the reproductive system or the fetus are highly affected by radiation. Usually a pregnant woman is not x-rayed, especially if she is in the first months of pregnancy. Therefore, a pregnant woman should inform the radiologist about this before the scan. She should also avoid accompanying her son inside the imaging room if it is for him. Only in emergency cases can the pregnant mother be photographed using x-rays, after providing her with protection means, such as clothes that are made of lead, and there are many steps that are taken during filming in order to reduce the amount of radiation entering the human body. Exposure to X-rays in a small amount does not harm, but its repetition at frequent times leads to human exposure to an amount of radiation that is harmful. A Chest X-Ray is roughly equivalent to being exposed to sunlight for 3 days.

5 -: Conclusion:

This study is a descriptive study on the nature of x-rays and the study of the types of risks they cause in high doses, as they are widely used to detect most diseases. So Only x-rays of sufficient energy (quality) can transmit through body to create an image and the low energy x-rays don't contribute to the image, but add to patient radiation dose. Also, different thicknesses, and composition of body parts will determine amount of x-ray penetration. Therefore we need to reduce low energy (low quality) x-rays, but at the same time have the right quantity of x-rays hitting the body part and the Exposure to low doses of radiation alone does not have a significant impact on human health, but exposure to low doses for a long time and over years weakens the body's immunity against other diseases and leads to death.

Recommendations:

1- Use lead barriers because X-rays cannot penetrate lead.
2- Directing the x-rays towards the target spot only instead of slackening in using it randomly.
3- Exposing a pregnant woman to x-ray should be in cases of necessity.
4- X-rays may only be used after adequate protection is provided to all persons.
5- Minimize or avoid exposure to X-rays unless advised by a specialist.

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