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IONIZING RADIATION AND ITS BIOLOGICAL EFFECTS

Maryam zaman jabbar rhaif
University of Wasit. College of Science Medical physics.
mz044274@gmail.com

Najlaa Hamed Anad Fnkhyr
University of Wasit College of Science Medical physics
najlaahamedaa34@gmail.com

Dhuha Adnan Sultan a'arebe.
University of Wasit. College of Science Medical physics.
dhuhaa446@gmail.com

Naba'a Jabbar Farhan Oda
University of Wasit. College of Science Medical physics.
fadakalzahra858@gmail.com

Fatima kareem Mohammad Ali
University of wasit College of Science Medical physics.
tamtamk999@gmail.com

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Abstract: Ionizing radiation is a type of energy released by certain atoms in the form of electromagnetic waves or particles. People are exposed to natural sources of ionizing radiation, including those found in soil, water, and plants, and to other man-made sources such as X-ray machines and medical devices. Ionizing radiation has many useful applications, including its uses in areas such as medicine, industry, agriculture, and research. As the use of ionizing radiation increases, so does the potential for health risks if it is not used or contained properly. Acute health effects such as skin burns or acute radiation syndrome can occur when radiation doses exceed very high levels. Exposure to low doses of ionizing radiation can increase the risk of long-term effects, such as cancer. The first chapter discussed the importance of radiation, its sources, types, and methods of protection from it. The second chapter discussed the effects of radiation, including biological effects and their impact on humans. In the third chapter, we discussed in detail how to protect against radiation. Finally, through what we discussed in the research, we reached the most important conclusions and also the most important recommendations.

Keywords: -

Introduction

A basic understanding of radiation physics is important when dealing with radiation and explaining the health effects associated with it. Atoms are the basic building blocks of matter and are made up of protons, neutrons, and electrons. A chemical element has the same number of protons, which corresponds to its atomic number. However, depending on the number of neutrons in the nucleus, the atomic mass of an element can vary. This variation is what creates the isotope of an element. Electrons orbit the nucleus and are arranged in layers called shells. Removing one of the outer electrons from an atom results in the emission of energy, usually in the form of gamma rays. This phenomenon can be called ionizing radiation [1]. An important principle in ionizing radiation is the stability of isotopes and nuclides. When an isotope of an element has too few or too many neutrons in its nucleus, it becomes unstable. Nuclei are most stable when the sum of protons and neutrons is certain numbers, including 2, 8, 20, 82, and 126. Physics shows that odd numbers of neutrons and protons are less stable than even numbers. In the process of radioactive decay, these unstable radionuclides can transform into a more stable nuclide that eventually emits beta particles, alpha particles, or photons, including X-rays and gamma rays. The emitted particles are a form of radiation [2]. Radioisotopes have unique properties that are determined by the type of particle, the amount of energy emitted, and the rate of decay. The different types of particles include alpha, beta, and photons. It is important to appreciate the different properties of each particle to understand its effect on the atoms it interacts with. Depending on the mass, speed, charge, and electron density of the target material, the extent of kinetic energy loss and subsequent energy transfer to a given medium varies.

Alpha particles consist of two protons and two neutrons. The emission of this particle results in a decrease in its atomic mass by four and a decrease in its atomic number by two. Alpha particles are usually emitted by the radioactive decay of heavy elements such as plutonium, uranium, and radium. Alpha particles have a positive charge of +2 and have a high ionizing power. However, because of their high charge and density, they usually lose energy quickly over a short period and distance. The average distance an alpha particle travels is about 3 to 5 cm, and they are usually unable to penetrate clothing or skin. Due to these properties, in order to have any effect or damage, alpha particles must be emitted close to their target. Beta particles are divided into negative and positive emissions. A negative beta emission has one negative charge, increases the number of protons by one and decreases the number of neutrons by one. A positive beta emission has one positive charge, decreases the number of protons by one and increases the number of neutrons by one. In both cases, the atomic mass remains the same, but it constitutes a different element. Unlike alpha particles, beta particles can travel long distances and penetrate water and tissue with high energy. When radioactive decay occurs in an element, the remaining energy from the transformation is usually stored within its nucleus, eventually exciting the nucleus. Since high energy states cause instability, the nucleus releases this energy to return to its original energy level. The energy released is usually in the form of gamma rays. Gamma rays can also travel long distances and can be deposited or transmitted through materials such as iron, tissue, and even concrete. X-ray production occurs in a similar manner, but instead of energy being generated in the nucleus, energy is generated in the surrounding electrons. This process is called internal conversion. When the nucleus is in an excited state, it emits a gamma ray. The gamma ray interacts with one of the orbiting electrons, usually in the innermost K shell. The gamma ray is completely absorbed, leaving the atom with a gap in the shell where the electron was originally located. The empty spot is then filled by an outer shell electron, producing an X-ray. X-rays can also be generated by accelerating an electron. This mechanism is demonstrated in the production of radiographic images using X-rays.

The aim of the research

.1Identify ionizing radiation and its types
.2Study the biological effects of ionizing radiation
.3Know the mechanism of radiation protection

1-2Discovery of radiation: Electromagnetic radiation with wavelengths other than visible light was discovered in the early 19th century. The discovery of infrared radiation is attributed to the astronomer William Herschel. Herschel published his results in 1800 before the Royal Society of London. Herschel, like Ritter, used a prism to refract sunlight and discovered infrared radiation (beyond the red part of the spectrum), by increasing the temperature recorded by a thermometer.

In 1801, the German physicist Johann Wilhelm Ritter discovered ultraviolet radiation by observing that the rays emitted from a prism darkened silver chloride preparations more quickly than violet light. Ritter's experiments were an early precursor to what would become photography. Ritter noted that ultraviolet radiation was capable of causing chemical reactions. The first radio waves discovered were not from a natural source, but were deliberately and artificially produced by the German scientist Heinrich Hertz in 1887, using electrical circuits calculated to produce oscillations in the radio frequency range, following the formulas suggested by James Clerk Maxwell's equations.

Wilhelm Röntgen discovered X-rays and named them . While experimenting with applying high voltage to a vacuum tube on November 8, 1895, he noticed a flash on a nearby plate of coated glass. Within a month he discovered the main properties of X-rays that we understand to this day.

In 1896, Henri Becquerel discovered that rays emitted by certain minerals penetrate black paper and cause an unexposed photographic plate to fog. Her doctoral student Marie Curie discovered that only certain chemical elements emit these energy rays. She called this behavior radioactivity . Alpha rays (alpha particles) and beta rays (beta particles) were distinguished by Ernest Rutherford in a simple experiment in 1899. Rutherford used a common pitchblende radiation source and determined that the rays produced by the source had different penetrations into materials. One type had a short penetration (stopped by paper) and a positive charge, which Rutherford called alpha rays. The other was more penetrating (able to see through film but not metal) and had a negative charge, which Rutherford called beta rays. This was the radiation first discovered by Becquerel from uranium salts. In 1900, the French scientist Paul Villard discovered a third type of radiation, neutral in charge and especially penetrating, from radium, and after describing it, Rutherford realized that it must be a third type of radiation, which Rutherford in 1903 named gamma rays. Henri Becquerel himself proved that beta rays were fast electrons, while Rutherford and Thomas Royds in 1909 proved that alpha particles were ionized helium. Rutherford and Edward Andrade in 1914 proved that gamma rays were like X-rays, but with shorter wavelengths. Cosmic ray radiation hitting the Earth from outer space was finally recognized and proven in 1912, when the scientist Victor Hess carried an electrometer to different heights in a free balloon flight. The nature of these radiations was only gradually understood in the following years. James Chadwick discovered neutron and neutron radiation in 1932. A number of other high-energy particle radiations, such as positrons, muons and pions, were discovered by examining the cloud chamber for cosmic ray interactions shortly thereafter, and other types of particle radiation were produced artificially in particle accelerators during the latter half of the 20th century.

Results and Discussion

12samples were taken from used clothing stores in Diwaniyah Governorate (Intersection Street, behind which there is an oil station, Alawi Street, 6 samples from Intersection Street and 6 other samples from Alawi Street). In the 6 samples from Alawi Street, the concentration of arsenic was (3.4 Mg / g) dry weight, the concentration of cadmium was (1.1 Mg / g) dry weight, and the concentration of lead was (0.2 Mg / g) dry weight in the first place. As for the second place from Alawi Street, the percentage of arsenic was (2.2 Mg / g) dry weight, the concentration of cadmium was (1.2 Mg / g) dry weight, and the concentration of lead was (0.1 Mg / g) dry weight. As for the other 6 samples from Intersection Street, the concentration of arsenic was (4.3 Mg / g) dry weight, the concentration of cadmium was (0.4 Mg / g) dry weight, and the concentration of lead was (0.8 Mg / g) dry weight in the first place. As for the second place, the concentration of arsenic was (1.9 Mg / g) dry weight, the concentration of cadmium was (0.6 Mg / g) dry weight, and the concentration of lead was (0.2 Mg / g) dry weight. In the third place, the percentage of arsenic was (3.7 Mg / g) dry weight, the concentration of cadmium was (0.1 Mg / g) dry weight, and the concentration of lead was (0.3 Mg / g) dry weight. The results did not exceed the permissible values in the air of arsenic (10 Mg), cadmium (5 Mg) and lead (0.15 Mg) as set by the Environmental Protection Agency. The results showed a large difference in the percentage of heavy elements. The percentage of arsenic was greater than cadmium and lead. This is due to the presence of large quantities of arsenic combined with the elements carbon, hydrogen, chlorine and sulfur. When these clothes are exposed to the atmosphere for a long time, the concentration of this element increases. After that, the percentage of cadmium is less than arsenic because this element is found in very low concentrations in nature and can be eliminated by sterilizing the clothes by heating. As for the percentage of lead, it is lower among the elements due to the lack of natural activities such as volcanic activity and geochemical weathering. The clothes were contaminated with elements (cadmium, lead, arsenic) and no percentage of nickel and copper was found because these elements are found in the solid parts of the clothes such as buttons and were not tested. As for phosphorus, no percentage was found because it does not react with the clothes, but it reacts when it comes into contact with the skin. Its danger lies in the cumulative effect of heavy elements in the body to slow down the progress of physical, muscular and nervous processes that cause some diseases such as Parkinson's and Alzheimer's. Moreover, long-term repeated contact with heavy elements or their compounds may lead to damage to amino acids and cause mutation and imitation of hormones, which leads to disruption of the endocrine glands and the reproductive system and ultimately leads to cancer. Comparing the two places, we find that the concentration of arsenic in the intersection street is higher, and the reason may be that these clothes have been on the street for a longer period of time, so they were exposed to more dust and dirt, and because the element is found in good concentrations in nature, as well as the oil station, it may have an effect in increasing the concentration of arsenic behind the street. As for the cadmium percentage, it was higher in Alawi Street, and the reason is that these clothes are randomly displayed on the street and are directly exposed to dust storms and dirt. Cadmium is also used to fix clothing dyes, or the reason may be in the incorrect storage and transportation method. We find that the concentration of lead in the intersection street was higher, and the reason is that lead comes from fuel stations such as gasoline and oil, and the oil station behind the street may be the reason for the lead contamination of the clothes, and also that these clothes are displayed on the street, so they are more susceptible to contamination through car exhaust and the fumes emitted from them. Handling used clothes without storing them in sterile bags, especially, makes them more susceptible to contamination through the transportation and storage process and chemicals such as factory dust and the materials with which they dust these clothes. (Al-Shabli, 2013) The accumulation of clothes for a long time and in places where there is no ventilation is considered a cause of clothing pollution, and smuggling is considered illegal, so it is not subject to monitoring and therefore dangerous and polluting.

Conclusion

4-3-2 Patient Protection When conducting radiological examinations, the patient is the primary recipient of the largest amount of radiation dose, but the radiation worker must be aware that the dose he receives is related to the amount of dose received by the patient, and the more the patient's dose is reduced, this means reducing the dose of the radiation worker, so the process of achieving the best quality of the radiological image with the least radiation exposure falls on the radiation worker. It is also necessary to weigh the benefit of the radiological examination against the damage that will result from the examination. Therefore, the radiation worker must not conduct any radiological examination without a written request from the doctor stating the justifications for this examination, with the radiologist having the right to refuse to conduct the examination in the event that he is not convinced of the necessity of the examination, or the existence of an alternative to it. In radiological imaging, the radiological imaging technician is responsible for ensuring the performance of the device and the patient's readiness for this examination and providing means of protection to protect the sensitive parts of the patient such as the reproductive glands, whether for adults or children. He must also ensure the presence or absence of pregnancy in the case of women, determine the appropriate radiation dose for the examination that achieves the required quality of the radiological image, avoid repeating images, and determine the area to be imaged well. In case of pregnancy, it is the duty of the radiologist to assess the condition and decide on the necessity of conducting the examination. The number of images should be reduced or the endoscopy time should be reduced as much as possible in case of endoscopy, and the abdominal area should be protected in case of pregnancy with a suitable lead shield. The examination process should also be documented in terms of radiation energy during the examination, the current used, the time and the area of the radiation field during imaging, for the purpose of calculating the fetal dose later if needed. 4-3-3 Public Protection The public and the general public are protected by providing appropriate radiation shields and providing suitable waiting areas for them away from the imaging rooms, or appropriately protected according to the classification of radiation work areas, and ensuring that radiation does not leak or scatter into them. The design and shielding of radiology rooms are considered major factors in radiation protection, so radiology rooms must be shielded with appropriate radiation shields according to the nature of the radiology work, the volume of work and the degrees of work in the surrounding areas. And the nature of this work. A radiation survey must be conducted in the radiation work areas and the areas adjacent to them, above them, or below them, and it must be ensured that there are no openings or cracks through which radiation can leak, whether in the room walls, doors, floors, or ceilings. Based on these factors, the X-ray rooms are designed and shielded in a way that ensures the safety and security of the radiological imaging process

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