Occupational Diseases of Medical Radiation Workers in the Hospital

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Abstract

For the first time, the effect of radiation on the use of x-ray in medical imaging has been established. Ionising radiation is a critical component of diagnostic imaging and therapy, which has significantly improved health care services and patient outcomes over the years, along with a better understanding of the risks and consequences. The more visible harm caused by high doses of radiation, such as radiation burns, was noticed in the early days, and protection efforts were focused on avoiding them, especially for clinicians. Despite the fact that the issue was minor, it led to the development of radiation protection as a discipline. Following that, it became increasingly clear that there were other, less obvious, negative effects of radiation, such as radiation-induced cancer, which can occur even at low doses of radiation. Acute health effects such as skin burns and acute radiation syndrome ("radiation sickness") can occur when people are exposed to extremely high levels of radiation in hospitals. This chance cannot be completely eliminated; however, it can be reduced. As a result, balancing the benefits of nuclear and radiation practices against the risk of radiation, as well as measures to minimize residual exposure, has become a critical component of radiation safety. This paper looks at some of the diseases linked to radiation in hospitals, as well as the precautions taken to protect people's health, resources, and the environment from ionizing radiation.

Introduction

According to the International Labour Organization (ILO), almost 160 million people worldwide suffer from work-related illnesses, such as musculoskeletal disorders and mental health issues. They went on to say that over 270 million fatal and nonfatal work-related injuries occur each year, resulting in over 350,000 fatalities and over 2 million work-related deaths. (ILO, 2017). An occupational hazard, as stated by the Canadian Centre for Occupational Health and Safety (CCOHS), is any cause of possible injury, danger, or adverse health effects on anyone at work under some circumstances. (CCOHS, 2016) Research from Sub-Saharan Africa showed a variety of workplace hazards that health-care employees face. This emphasizes the importance of taking adequate precautions to reduce their risk of workplace injury. Tinubu BM et al. 2010:12; Ndubuga FM, Jaakkola MS 2005:773-81; Ndubuga FM, Jaakkola MS 2005:773-81; Ndubuga FM, Jaakkola MS 2005:773-81; Ndubuga FM

The risk of cancer in radiation medical and healthcare personnel who are regularly exposed to ionizing radiation in the workplace has been the focus of research since the 1940s, when there was a documented rise in mortality from leukemia and other cancers among radiologists when compared to other medical professionals (Ndubuga FM, Jaakkola MS 2005:773-81; Tinubu BM et.al 2010:12).

Because of the high rates of associated morbidity and mortality among exposed workers, workplace health and safety is a major concern in the practice of radiation medicine. Medical radiation personnel are health professionals who use ionizing radiation in the detection and treatment of illness (Ajayi AD, Garba SN, Abdul AJ, Mfuh A, 2006:14; Bell JL, et.al 2013:147-152). They are unquestionably exposed to radiation-related dangers as a result of this.

William Roentgen was awarded the first Nobel Prize in Physics in 1895 for his invention of radiographs. Radiographs were shown to cause tissue injury, which was later revealed to be beneficial in the treatment of breast cancer. As a result, radiation may be described as the propagation or release of energy through space or through objects. Ionizing and non-ionizing radiation are also possible sources of radiation. Acute radiation syndrome (ARS), described by the National Council on Radiation Protection and Measurements as "a general term used to denote a variety of signs and symptoms that reflect serious damage to specific organ systems and that may lead to death within hours or up to several months after exposure," can result from sustained or substantial exposure to ionizing radiation.

(Chapter 3:39, by Ryan K. Funk, Abigail L. Stockham, and Nadia N. Issa Laack)

Atoms produce ionizing radiation in the form of electric waves or ions (neutrons, beta, alpha). Radioactivity refers to the degradation of elemental materials that result in the emission of ionizing radiation (Rahman, 2019). There are various types of radiation, each of which has its own shape, appearance, weight, and structure, such as X-rays, gamma rays, and microwaves, which transmit fast-moving, invisible, or huge amounts of energy, and other types such as WiFi and cellular waves, which transmit fast-moving, invisible, or huge amounts of energy, and other types such as WiFi and cellular waves, which transmit fast-moving, invisible, or huge amounts of energy, and other types such (Anjan, 2018). Atomic energy, nuclear technology, and atomic/radioactivity have all been synonymous with radiation. UV radiation (which increases the body's temperature), infrared radiation (which emits heat), and long-wave and microwave signals (which raise the body's temperature) are all common forms of radiation (CNSC, 2012).

Radiation injury may result from external irradiation, external contamination with radioactive materials, and internal contamination with radiologic materials incorporated into cells and tissues by inhalation, ingestion, or transdermal absorption. Radiation sensitivity to patients and radiology staff has increased dramatically in the health industry, owing to the advantages of improved diagnosis and care. Many experiments have been conducted to date that have specifically identified the adverse consequences of ionizing radiation exposure (Subedi, Suwal & Pant, 2014). According to the Nuclear Research and Development Service and the World Information Service, an "unintended incident, including operational errors, mishaps, and consequences" can be called an accident, and individuals or the environment may be subjected to unsafe amounts of radiation (NIDS, 2005).

Medical and health professionals who are subject to high levels of radiation on a regular basis may develop acute radiation syndrome, whilst others may develop cataracts and skin cancers, but it is assumed that there is no safe level of radiation exposure. Radiation is a danger to healthcare staff, according to new research (Keijjeers & Britton, 2010). These results back up the widely held belief that exposure to radiation risks can be reduced by following the basic radiation safety concepts of optimization and rationale (Kase, 2004). According to a previous study, about 30% of radiological procedures requested by doctors was needless.

The use of advanced medical imaging devices in healthcare facilities has increased dramatically in recent years, leading patients and health workers to a higher risk of radiation exposure. In view of this, the Nigeria Nuclear Regulatory Authority (NNRA) has recently re-energised its regulation of ionizing radiation-using facilities (both medical and non-medical). The assessment of frontline employees' baseline awareness of radiation risks and radiation safety procedures is critical for developing effective methods for preventing excessive ionizing radiation exposure, not just among health workers but also among their patients.

Similarly, assessing the psychological history of a health worker at risk can be very useful in identifying the negative health effects of radiation exposure (Awosan et al, 2016) as well as acting as a guide point for future tests. Radiation is energy that comes from a source and travels through air and may be able to penetrate various materials, light, radio, and microwaves

As a result, the aim of this paper is to draw attention to the occupational diseases that medical radiation staff face in the hospital.

Different Kinds of Radiation

Radiation is a kind of radiation that comes in the form of particle waves. Non-ionizing and ionizing radiations are the two types of radiation.

Non-ionizing radiation (NIR) is a form of radiation that does not

Non-ionizing radiation has less energy than ionizing radiation and is incapable of generating ions. Visual light, infrared, radio waves, microwaves, and sunlight are also examples of non-ionizing radiation. Non-ionizing radiation is used in GPS devices, smart phones, tv stations, FM and AM radio, baby cameras, cordless phones, garage door openers, and ham radios. The earth's magnetic field, as well as magnetic field penetration from proximity to transmission poles, home wiring, and electric equipment, are examples of such types. They are known as very low-frequency (ELF) waves, and they are not thought to be harmful to humans. (Canadian Nuclear Safety Commission, 2012)

Radiation that causes ionization

Ionizing radiation is the kind of radiation that has enough ability to strip closely bound electrons from atoms, resulting in ions. We use this kind of radiation to produce electricity, destroy cancer cells, and in certain industrial processes. Ionizing radiation is a source of energy that atoms emit in the form of electromagnetic waves (gamma or X-rays) or particles (neutrons, beta or alpha). Chaturvedi is a term used to describe a person who is (2019).

Ionizing radiation will shake electrons out of their orbits around atoms, causing the electron/proton equilibrium to be thrown off and the atom to take on a positive charge. Ions are molecules and atoms that have an electric charge attached to them. Radiation emitted from both natural and man-made radioactive sources is referred to as ionizing radiation. Though ionizing radiation has many advantages, such as the growth of plant varieties and applications in medicine, industry, agriculture, and science, it also has the ability to cause health problems if not used or contained properly (Valentin, 2002; Mosse, 2012; Chen, 2014).

Ionizing radiation comes in a variety of forms:

() Alpha radiation

Alpha radiation is made up of alpha particles with a double positive charge that are made up of two protons and two neutrons each. They have an extraordinarily small ability to penetrate matter due to their comparatively large mass and charge. A sheet of paper or the dead outer layer of the skin should be used to avoid alpha radiation. As a result, alpha radiation from radioactive materials outside the body does not pose a risk of radiation poisoning. As alpha-radiation-emitting radioactive elements are introduced into the bloodstream (for example, by inhaling or ingesting them), the alpha radiation's energy is totally consumed by bodily tissues. As a result, alpha radiation is only a threat to the individual who is exposed to it. Radon-222, which decays to polonium-218, is an example of a radioactive material that experiences alpha decay.

Beta radiation (β)
Beta radiation is made up of charged particles that are physically similar to electrons that are ejected from the nucleus of an atom. Beta particles have a negative charge, are very thin, and have a greater depth of penetration than alpha particles. Tiny quantities of insulation, such as plastic, glass, or metal, will, however, avoid the majority of beta radiation. Beta radiation with adequate energy can enter the body's dead outer layer of skin and deposit the energy inside activated skin cells while the source of radiation is outside the body. Beta radiation's ability to infiltrate deeper tissues and organs in the body, on the other hand, is severely limited. Nuclear compounds that release beta radiation can be harmful to the body if ingested. Tritium (hydrogen-3), which decays to helium-3, is an example of a radioactive element that undergoes beta emission.

Photon radiation (gamma and X-ray) is a kind of radiation that consists of photons.
Electromagnetic radiation is made up of photons. For the purposes of this paper, gamma () and X-ray photon radiation are the two kinds of photon radiation that are of concern. Photons that come from inside the nucleus are known as gamma radiation, while photons that originate from outside the nucleus are known as X-ray radiation and are usually lower in intensity than gamma radiation. Photon radiation can penetrate very deeply, and materials that are thick, such as lead or steel, can sometimes only reduce the strength.

When the radiation source is outside the body, photon radiation can travel far longer distances to enter biological tissues and organs than alpha or beta radiation. When photon-emitting radioactive compounds are ingested into the bloodstream, photon radiation can be dangerous. Cobalt-60, which decays to nickel-60, is an example of a radioactive material undergoing photon emission.

In the field of medicine, there is a lot of talk around radiation exposure.

Ionising radiation exposure happens on a normal basis, accounting for approximately 3 mSv/year from all sources worldwide, of which normal background radiation exposure accounts for about 2.4 mSv/year, depending on region. The greatest man-made cause of exposure is medical imaging and rehabilitation, which contributes around 0.6 mSv/year. 2016 World Health Organization

Ionizing radiation is a critical aspect of medical imaging and treatment, which has significantly increased health care access and patient outcomes over the years. (PB 2016) (Zanzonico) (Zanzonico) (Zanzonico) (Zanz Nuclear medicine diagnostic and therapeutic procedures have increased in popularity in the world of medical imaging, with over 625,000 diagnostic and therapeutic oncological and non-oncological procedures conducted in England alone last year. The National Health Service of England (NHS England) published a report in 2014 that said Nuclear medicine is the use of radioactive substances to detect and treat various diseases by analyzing both physiological and functional aspects of the body. In recent years, the use of hybrid modalities such as Single Photon Emission Tomography/Computed Tomography (SPECT/CT) and Positron Emission Tomography/Computed Tomography (PET/CT) has increased, especially in developing countries and primarily in the oncology sector, resulting in an increase in the whole body annual dose of patients. (World Quality Organization, 2016; United Nations Environment Programme, 2016).

CT, plain radiography, nuclear medicine, and fluoroscopy are examples of radiologic techniques that emit ionizing radiation. CT radiation accounts for the majority of imaging-related radiation. Ionizing radiation damages cells by causing the development of free radicals, which leads to DNA mutation or cell death. (Bolus 2011: 67-73; Dowd S, Tilson E, 1999; Bolus 2011: 67-73; Bolus 2011: 67-73; Bolus 2011: 67-73; Bolus Radiation-induced cancers such as leukemia, myeloma, and cancers of the thyroid, breast, lung, bone, and skin can develop as a result of cellular mutations. (Source: ICRP, 2001)

Medical imaging is estimated to be responsible for almost half of all radiation exposure in the United States, according to the National Council on Radiation Protection and Measurements. National Center for Research on Poverty, 2009. X-rays are a well-known carcinogen, including the fact that the biological effects of low-dose ionizing radiation are still debated. As a result, ionizing radiation used in medical imaging should be held to a bare minimum for successful health treatment. (Verdun FR et al. 2008:7-16; Haramati LB 2008:73-76; Little MP et al. 2009:13-22; Tubiana M et al. 2009:6-12) Hospitals and practices should begin monitoring patient radiation exposure, according to the American College of Radiology [6]. This is essential in order to justify the advancement and application of alternative radiation-reduction treatments for individual patients. Annual exposure limits for the general population are set at 2% of annual workplace dose limits by the Nuclear Regulatory Commission. The reasoning for these limitations is based on both stochastic and deterministic biological consequences of ionizing radiation. Carcinogenesis and genetic disorders are examples of stochastic effects; they may occur at any degree of radiation exposure, although the likelihood of incidence increases with increasing exposure. Skin burns and cataracts are examples of deterministic symptoms that arise when a certain dosage level has been met. While the threshold for observable lens opacities for a single exposure has been calculated to be 0.5 to 2.0 Sv for cataracts and 5.0 Sv for detectable lens opacities for a single exposure, recent publications indicate that the cataracts threshold could be 700 mSv [16,17].

During the last two decades, the use of diagnostic imaging to represent and aid in the diagnosis of sickness and accident, as well as to direct clinical treatments for disease and disability, has grown dramatically. Imaging practices are now commonplace in health care, and they support people with a wide range of ailments. In the United States, computed tomographic (CT) tests rose from 26 million in 1998 to more than 70 million in 2008, while nuclear medicine procedures increased from 12 million to almost 20 million in the same time span (NCRP 2009). Ultrasonography and magnetic resonance tests, as well as image-guided interventional treatments, have seen a similar dramatic increase. The exponential increase in medical imaging use is excellent news, as it means that imaging techniques are constantly being improved and used in new and extended ways for the benefit of patients. Medical imaging is also an integral part of most patients' treatment in the United States, and a comparable reliance can be seen in other developing countries around the world. Ionizing radiation is used in many imaging modalities, and as a result, patient sensitivity to radiation has increased as medical imaging has grown. In the early 1980s, the average annual per capita radiation dosage in the United States was 3.6 mSv. The bulk of the annual exposure came from radon, dust, building materials, and gamma rays, with medical radiation accounting for just 0.54 mSv. Medical radiation added 3 mSv to the annual dosage in 2006, bringing the per capita dose to 6.2 mSv on average across the United States (NCRP 2009). The rise in annual per capita radiation exposure is due to technological advancements and expanded medical imaging technologies, which have the potential to support more patients per year. Because of the increased sensitivity to patients to medical radiation, some scholars have predicted that thousands of radiation-induced tumors and cancer deaths will occur in the United States in the coming years. In 2007, Brenner and Hall (Brenner DJ, Hall EJ 2007:2277-2284) projected that CT examinations would cause 1%– 2% of all cancers in the United States in the future, and Berrington de González et al predicted in 2009 that CT examinations would cause 29000 additional cancers and 14 500 cancer deaths per year. (Berrington de González and colleagues, 2009).

For example, after the Chernobyl nuclear plant explosion in 1986, 15 million people in Belarus, Ukraine, and Russia developed psychosomatic problems that were not caused by radiation exposure (Ilin LA 1995, Jaworowski Z 1999). Instead, the illnesses were due to the widespread misconception that any level of radiation, no matter how little, would cause damage to the body. Medical and health staff who use ionizing radiation are also exposed to both the acute and cumulative effects of ionizing radiation, and it is important to raise this issue as well as provide necessary and sufficient care for these workers. The use of routine x-rays and CT scans exposes the bulk of medical and health professionals to radiation. The application of ionizing radiation in nuclear medicine as well as interventional cardiovascular treatments exposes medical and health personnel to radiation.

Medical radiation exposure

Exposure to medical radiation is classified into three types by the International Commission on Radiological Protection (ICRP, 2003).

1. Individuals that have been exposed for diagnostic, interventional, or clinical reasons

2. Individuals exposed consciously and enthusiastically when assisting in the support and convenience of patients awaiting illness or recovery, whether in the hospital or at home.

3. Volunteers who have been exposed as part of a biomedical research project.

Ionizing Radiation's Health Consequences

Radiation will affect your health in ways that aren't related to cancer. Genetic mutations will be passed on to subsequent generations if genetic information in reproductive cells is disrupted. This destruction has an effect on living tissues because it changes the structure of cells and destroys DNA. The amount of radiation absorbed is proportional to the source of radiation, its energy, and the amount of radiation absorbed (EPA, 2012). Ionizing radiation provides energy to body tissue and has the potential to interfere with the molecules' structure. This energy transfer in living organisms may cause cellular functions to be disrupted or killed (fatal and nonfatal somatic effects), or the genetic code of the cells to be altered (hereditary effect).

Deterministic (acute) effects can also occur only in situations when there is a significant dose of radiation, such as in accidents. Single cell disturbance can result in stochastic effects (cancer and genetic effects) (Hamada and Fujimichi, 2014). When the dose to the tissue is increased from a low level, more and more cells become damaged, increasing the risk of stochastic effects. Exposure to high doses of radiation for a short period of time results in temporary or short-term effects (deterministic), while exposure to low doses of radiation for a prolonged period of time results in chronic or long-term effects (deterministic) (Stochastic). The risk of birth defects increases as the egg or fetus is exposed to radiation. Although such high doses of radiation are uncommon, a person who is exposed to a large amount of radiation will become sick or even die within hours or days. The Environmental Protection Agency of the United States of America (EPA) published a report in 2012 that stated:

Some cells are far more sensitive to radiation than others. The effect of even minor exposure cannot be seen because of disturbance at the cellular level (EPA, 2012).. Radiation reactions that last for years following the original dosage are known as long-term effects. The body has mechanisms in place to repair damage caused by both nuclear and chemical carcinogens. The majority of cellular loss can be reversed. Some cells, on the other hand, do not heal as well as others and may develop cancer. Radiation's biological effects on living cells, on the other hand, may result in one of three outcomes:

- Cells that have been injured or destroyed rebuild themselves, leaving no damage behind;

- Cells die, much as millions of other body cells do every day, and are replaced by natural biological processes.
- Cells patch themselves poorly, resulting in a biophysical transition.

Hospital-Acquired Radiation Diseases

Acute health problems such as skin burns and acute radiation syndrome ("radiation sickness") can occur when people are exposed to very high levels of radiation in hospitals. Weakness, nausea, fainting, and confusion are some of the signs and symptoms of radiation sickness. The nose, lips, gums, and rectum are all bleeding. Bruising, skin burns, open sores on the skin, and skin sloughing are all common symptoms. Long-term health consequences, such as cancer and cardiovascular disease, are also possible.

Ionizing radiation's harmful effects on human tissue and clinical diseases can be classified into two categories:

1. Non-stochastic is a concept used to describe situations that are not random (deterministic)
2. Effects of stochasticity.

Effects that are deterministic (as opposed to stochastic)

Deterministic effects are usually only seen after a high-dose acute dosage and are characterized by a non-linear dose-response curve with a threshold dose at which the effect is undetectable. In radiotherapy, deterministic effects are the most important; daily doses in tissue therapy are limited to avoid these effects. The death of vast quantities of cells in the tissues involved, leading to a deterioration of the operation of the damaged organs, is thought to be the cause of deterministic effects. Deterministic signs often appear days (e.g. prodromal syndrome, gastrointestinal syndrome, central nervous system syndrome) or weeks (e.g. haematopoietic syndrome, pulmonary syndrome) following exposure; however, some deterministic causes (e.g. cataracts, hypothyroidism) can take years to manifest.

Major cell loss or death may result in deterministic outcomes. When the cell death load is high enough to induce noticeable functional deterioration of a tissue or organ, the physical symptoms can occur.

The following are clinical diseases linked to the group of radiation:

Erythema, necrosis, and exfoliation of the skin

Erythema that develops 1 to 24 hours after receiving 2Sv. Since receiving 15 Sv, the skin surface begins to break down after around four weeks. Epilation happens three weeks after exposure and is reversible after three Sv but permanent after seven Sv.

Cataract is a condition that occurs when the lens of

Cataracts develop when there is an accumulation of weakened or dead cells in the lens that cannot be naturally removed. Cataract develops after 2 to 10 Gy of radiation, although it can take years to mature.

Infertility

Radiation can damage oocyte function, resulting in infertility or infertility. Due to dwindling total oocyte levels, the radiation dose needed to achieve this effect decreases with age. Similarly, radiation damage to the testes can cause azoospermia, which can be transient or permanent. Since the gonads have been exposed to 2.5 to 3.5 Gy, permanent sterility exists.

Sickness caused by radioactivity

Radiation sickness (also known as acute radiation syndrome) is characterized by nausea, vomiting, and diarrhea that appear within hours or minutes of being exposed to radiation.

This is due to deterministic effects on the bone marrow, gastrointestinal tract, and central nervous system (CNS).

IUGR, teratogenesis, and fetal death are all terms used to describe the process of a pregnant woman becoming pregnant.

The results of deterministic radiation exposure during pregnancy are determined not only by the dosage administered, but also by the gestational age at which it occurred. During the preimplantation process, the embryo is largely radio insensitive, but highly radiosensitive during the organogenesis (two to eight weeks) and neuronal stem cell proliferation phases (eight to 15 weeks). After this time, the radio sensitivity of the fetus decreases. Radiation exposure at high levels during pregnancy can cause growth retardation, especially microcephaly.

1. EFFECTS OF STOCHASTIC EXPERIENCE

The linear non-threshold theorem is assumed in stochastic effect occurrence. This implies that, while no criteria exists for these results, the likelihood of an effect occurring increases linearly as the dose is increased. Somatic uncertainties monitor the overall health cost forecast; stochastic impacts are the key late-term health consequences expected to occur in areas subjected to ionizing radiation. For both somatic and genetic results, the probability of their presence, but not their extent, is assumed to be proportional to the dose of radiation. In terms of deterministic effects, the dose-response relationship can be non-linear.

In relation to deterministic effects, it is generally accepted that most stochastic effects have a non-zero linear dose-response vector at sufficiently low doses, i.e. there is no threshold.

Mechanisms in action

The ionizing radiation effect of symmetrical translocations occurs during cell division, resulting in stochastic effects. The following are some examples of diseases linked to these types of radiation:

Cancer is a disease that can affect everyone

Ionizing radiation, according to anecdotal evidence, can cause cancer over time. Credible information, on the other hand, is only now becoming accessible. The Radiation Effects Research Foundation found that people who were exposed to atomic bomb radiation in Hiroshima and Nagasaki had a higher relative risk of malignancy (leukemia, oral cavity, esophagus, throat, colon, lung, breast, ovarian, urinary bladder, thyroid, liver, non-melanoma skin, and nervous system). As a result, several government departments, such as the United States Department of State, have taken action. Ionizing radiation has been classified as a human carcinogen by the US Department of Health and Human Services. There is some disagreement about extrapolating a very low-dose linear non-threshold hypothesis if no increased cancer incidence is seen in areas of high background radiation or among airline pilots. However, if the stochastic results are cumulative, caution should be exercised during repetitive radiation exposures. Similarly, certain high-dose medical imaging therapies, such as CT, can soon cross the limits that are thought to increase the relative risk of cancer.

Impact on the gastrointestinal system

High acute radiation doses can cause severe gastrointestinal effects, which normally occur after oral radionuclide ingestions or full-body radiation exposures. Within five days after the initial contact, the gastrointestinal condition typically manifests. Only the prodromal process of nausea, vomiting, and gastric atony is detected at doses of less than 1.5 Gy. (A. Dubois and R. I. Walker, 1988.) Due to the depletion of intestinal crypt cells and the breakdown of the mucosal membrane, more extreme symptoms occur at doses between 5 and 12 Gy. (Chinsoo Cho L, Glatstein E. Radiation injury in Fauci AS, Braunwald E, Isselbacher KL, et al., Fauci AS, Braunwald E, Isselbacher KL, et al., Fauci AS, Braunwald E, Isselbacher KL, et al., Fauci AS, Braunwald E, Cramping stomach pain, diarrhea, nausea, and vomiting, gastrointestinal bleeding with anemia as a result, and abnormal fluid and electrolyte balance are all symptoms of these shifts. This initial period is often preceded by a latent phase, which lasts 5– 7 days and is marked by a reduction in symptoms. The symptoms of the disease include vomiting and heavy diarrhea, as well as a high fever.

The high doses needed to cause these signs, as well as the absence of effects after dental x-rays, demonstrate that the salivary glands are not especially radiation-sensitive.

Because of the reduced rate of cell turnover associated with this form of epithelium, structures near the stomach with stratified squamous epithelial coverings seem to be much less severely affected than the stomach, small and large intestines, and colon. Because of the high rate of cell turnover, gastrointestinal epithelium, which includes epithelium in the stomach and intestines, is the most susceptible to radiation effects.

Impact on the hematological and lymphoreticular systems

At whole-body levels of 2– 3 Gy or greater, the hematopoietic syndrome associated with radiation injury occurs. N. Dainiak, N. Dainiak, and N. Dainiak, N. Daini Acute doses of around 50 rad to the bone marrow, however, will have hematological symptoms (0.5 Gy). The cumulative dose absorbed determines the extent of the effect on hematopoiesis, regardless of the route of exposure. The hematopoietic system, including the gastrointestinal system, has a huge population of cells that necessitates the removal of senescent cells on a regular basis. To fulfill this need, stem cells in the red marrow of certain bones (e.g., the ribs, pelvis, vertebrae, skull, and ends of long bones) undergo elevated rates of mitotic activity and divide into multiple cell types to replace those that die off naturally. The development of replacement cell populations for erythrocytes, granulocytes, lymphocytes, and thrombocytes is dependent on this pool of cells. Anemia, leukopenia, thrombocytopenia, septicemia, tuberculosis, and death occur from the dose of radiation absorbed by stem cells, which destroys or destroys these cells and therefore suppresses marrow function. (Fliedner TM, Tibken B, Hofer EP, and others, 1996).

Impact on reproduction

The research of Amanda L. Ogilvy-Stuart and Stephen M. Shalet (1993) showed that radiation had various effects on male and female reproductive systems. Radiosensitivity is higher in cells that replicate frequently, such as those present in intestinal crypts, bone marrow, and animal reproductive systems, than in cells that are poorly differentiated and reproduce slowly. The type of ionizing radiation or the cause determines the radio exposure. Both males and females have cells in their reproductive tracts that reproduce at a faster pace, putting them at greater risk from ionizing radiation. Spermatogonia are the cells of males that are most vulnerable to the effects of ionizing radiation. This are the germ cells that produce spermatocytes, spermatids, and mature sperm, among other things.

Impact on the central nervous system (CNS)

The adult human and experimental animal central nervous systems are also highly immune to the effects of radiation. The central nervous system, in contrast to the quickly dividing cells of the gastrointestinal and hematopoietic systems, has a comparatively steady population of cells, with cell mitosis happening only over lengthy periods of delay, if at all. After an incidental exposure to gamma radiation before and during the Chernobyl atomic power plant explosion, Birioukov et al. (1993) confirmed that one man exposed to 200-350 rad (2-3.5 Gy) developed psychiatric symptoms such as permanent headache and visual damage.

The results on the skin

Following external beta, gamma, and x ray penetration over threshold doses at elevated dosage rates, clinically detectable dermal radiation symptoms ranging from erythema (skin reddening) to necrosis have been observed. Bullae, moist descamation, ulceration, and onycholisis are few examples of more advanced lesions (Rezvani M, Hopewell JW, Wilkinson JH, et al.2000; Peter RU 1996). The first symptom of skin overexposure is temporary erythema, which happens after a dosage of around 300 rad (3Gy) and was once used by doctors to calibrate x-ray machines. The erythema emerges several hours after being exposed and fades within a day.

Effects on the senses and movements

Norton and Kimler (1987) looked at the thickness of the sensorimotor cortex in prenatally irradiated rats that obtained a dose of 100 rad (1 Gy) from a 137Cs source, as well as the early postnatal behaviors involving sensorimotor integration (Acevedo et al., 2008). The cerebral mantle's cortical thickness did not change substantially. The number of pyknotic cells, macrophages, nuclear field, and mitotic cells were all affected in a dose-dependent fashion. In fetuses from the 50-, 75-, and 100-rad (0.5, 0.75, and 1 Gy) therapy cohorts, the number of mitotic figures in the ventricular region was substantially decreased, whereas the number of macrophages was significantly increased. In fetuses prenatally exposed to 50 rad, the amount of macrophages in the ventricle and cortical mantle was substantially increased at 12 and 24 hours (0.5 Gy).

The impacts on the lungs and the heart

The respiratory tract has long been recognized as an internal and external radiation target organ. Humans (Stavem et al., 1985) who had undergone radiotherapy for breast cancer and others who had been inadvertently overexposed, as well as laboratory animals, have both recorded respiratory symptoms (Rezvani et al., 1989; Salovsky and Shopova, 1992). Of the millions of patients who have chest x-rays on a regular basis, no negative side effects have been observed (Wall et al., 2006).

Localized injuries are tolerated much better than scattered injuries. Based on the total dosage administered, irradiation of large parts of one or both lungs causes changes in blood supply, which occur as edema at first and later as pneumonitis and pulmonary fibrosis. Two of the more often reported aberrations in laboratory animals after inhalation of large amounts of radioactive material are radiation pneumonitis and pulmonary fibrosis (i.e., fibrosis of alveolar structures including changes in the ratios of certain pulmonary collagens) (Brooks et al. 1971, 1992; Hahn et al. 1975, 1981; Benjamin et al. 1978, 1979; Lundgren et al. 1980, 1991).

Effects on the eyes

While the lens of the eye is not one of the body's most radiosensitive tissues, it does have less effective repair capability than many other tissues. Even where doses are fractionated or administered at reduced dose rates, this causes radiation exposure to accumulate with less fixes (Botkin and Keller, 2011). Cataract development occurs as the lens is exposed to high levels of ionizing radiation, and it can range from barely visible opacities that do not affect vision to blindness. In certain human exposure events, the effects of ionizing radiation on the eye have been reported. Radiogenic cataracts in cyclotron physicists caused by mixed gamma neutron doses of 700-1,000rad (70-100 Gy) to the lens were identified by Ham (1953). (Ross et al., 1990).

Impact on the human genome

Ionizing radiation genotoxicity is a hot topic of research, as DNA damage is ultimately to blame for much of the toxicological side effects reported so far. To make specific enzymes, proteins, hormones, vasoactive compounds, and a variety of other important chemicals, cells depend on their DNA for coding information (Shapiro, 2002). As the genetic material supplying the " blueprint" for these compounds is compromised, cellular homeostasis is disrupted, resulting in a wide spectrum of immediate and/or delayed toxicological effects in a variety of organ systems, as previously mentioned in this work. Cancer is believed to develop in both humans and laboratory animals as a result of disruptions and modifications in the cellular genome.

Measures to Prevent Radiation

In this new age of medical and clinical radiology and nuclear medicine, radiation disorders remain a big concern. Radiation safety is an essential aspect of every radiology or nuclear medicine department's operational infrastructure. The basic objectives of radiation safety are to provide sufficient protection against excessive radiation exposure to workers that are personally or indirectly exposed to radiation by not minimizing the advantages of radiation exposure. Justification of the treatment involving radiation exposure, use of minimal radiation exposure consistent with the protocol that offers sufficient medical information, protecting of workers and patients from excessive radiation exposure, and control of radiation exposure to the patient, nurse, and working environment are some of the components of radiation safety. The Radiation Safety Officer and other administrative officials of the department/hospital are responsible for regularly monitoring the radiation levels in the concerned department, as well as monitoring the radiation control programmers and conducting routine instructional exercises.

Conclusion

The challenges and health implications of these radiations have grown in tandem with advancements in medical research, especially in the field of ionizing radiation in medicine. In this new age of medical and clinical radiology and nuclear medicine, radiation disorders remain a big concern. As a result, radiation workers are vulnerable to the harmful effects of ionizing radiation, which can be classified as either deterministic or stochastic, resulting in a variety of diseases. As a result, better radiation safety for medical personnel is needed.
The basic objectives of radiation safety are to provide sufficient protection against excessive radiation exposure to workers that are personally or indirectly exposed to radiation by not minimizing the advantages of radiation exposure.

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