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Review Article

A REVIEW ON BIOLOGICAL EFFECTS OF RADIATION ON HUMAN HEALTH AND ITS PREVENTIVE MEASURES

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Abstract

Radiation is a type of energy that originates from sources such as x-rays, gamma rays, alpha and beta particles, uv, infrared, microwaves light and radio waves, which are harmful to human body. The effects of radiation in a biological cell can cause damage to either whole body or can damage to eggs & sperms. The symptoms arise because the biomolecule atoms are ionized due to ionizing radiation. It also effects on organ system on brain, skin, lungs, lymph nodes, gastrointestinal tract, gonads, blood and bone marrow. Diagnosis through thermography, cytogenetic, radio isotopic lymphocyte count, and chromosomal aberration analysis from cultured lymph. Protection of radiation is based on three principles explained below. And it is essential component for infrastructure of any radiology department and also public. So we hope the present review gives an idea regarding the biological effects of radiation on human health and the measure to be taken for its prevention.

Keywords: Radioactive Substances, Ionizing Radiation, UV Rays, Exposure to Radiation, DNA Damage, Radiation Injury.



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INTRODUCTION

Radiation is energy that originates from different sources that travels/moves in the form of waves or high speed particles, it had broad of energies that span the electromagnetic spectrum and also can penetrate through various materials. There are two types of radiation, a) ionizing radiation and b) non-ionizing radiation Sources [1,2].

a) Ionizing radiation : This has a sufficient energy to remove tightly bound electrons from an atomic orbital [2].

Eg: X-rays and gamma rays , alpha and beta particles

b) non-ionizing radiation : This energy release from the electromagnetic spectrum. Can move atoms in a molecule cause them to vibrate but is not sufficient to displace electron from atoms [2].

Eg.Ultraviolet light (UV) , infrared , microwaves , light and radio waves

EXAMPLES OF DIFFERENT TYPES OF RADIATION [3]

1. The burning candles expels radiation in the form of heat and radiation.
2. The emission of radiation from sun in the form of light heat & particles.
3. Uranium decaying into Thorium emits radiation in the form of alpha particles.
4. Electrons dropping from one state of energy to another lower state emit radiation in the form photon.
5. Microwaves from a microwave oven.
6. Sound waves from your stereo.
7. X-rays from an x-ray machine
8. Electromagnetic radiation from cell phone.
9. Beta particle radiation from a sample strontium-90.
10. Microwave radiation from wifi router

BIOLOGICAL EFFECTS OF RADIATION ON HUMAN HEALTH

Radiation can cause many harmful and particular health effects when our body exposure to it. Radiation can damage to whole body (somatic damage) and can damage to eggs & sperm (genetic damage). It can effects the body in a number of ways and effects of exposure may not know for many years and are more conspicuous, such as the stomach lining, hair follicles , bone marrow and embryos. So that the patients can undergo radiation

therapy [4]. Biological effects are demonstrate as clinical symptoms occurs when body is exposed to radiation. The symptoms arises because the biomolecule atoms are ionized due to ionizing radiation. Is manage for alter the behavior of the amino groups of proteins, dissociation of carbohydrates, and deactivation of enzymes, morphological modification of nucleic acid chains, peroxidation of lipids [5].

MECHANISM OF RADIATION DAMAGE

Basically radiation damage begins with cellular level. The most important cellular target of ionizing radiation primarily is DNA [4,5].

Once a cell is damaged by ionizing radiation by 3 things can happen

- 1) The cell can repair itself and cell back to normal
- 2) The damage is not repair or miss repair so the cell authored, this may lead to cancer.
- 3) Too much damage to the cell leads to cell death.

Two mechanisms are involved via one of two scenarios result in ultimate damage to the biological cell [4].

These includes as follows 1)Direct action 2)Indirect action

DNA is the primary target for biological damage by direct and indirect effects [5]

- 1) Direct action: direct ionization of the DNA molecule which may result in genetic damage.
- 2) Indirect action: Radiation ionizers water which can cause free radical to form , free radicals attack targets such as DNA much more.

POSSIBLE EFFECTS TO THE CELL [5,6]

- The radiation may travel through cell without occurs any damage;
- The radiation may damage the cell ,but the cell can repair the damage;
- The radiation may damage the cell, the damage is not repaired and the cell replicates itself in the damaged form.
- The cell may die.

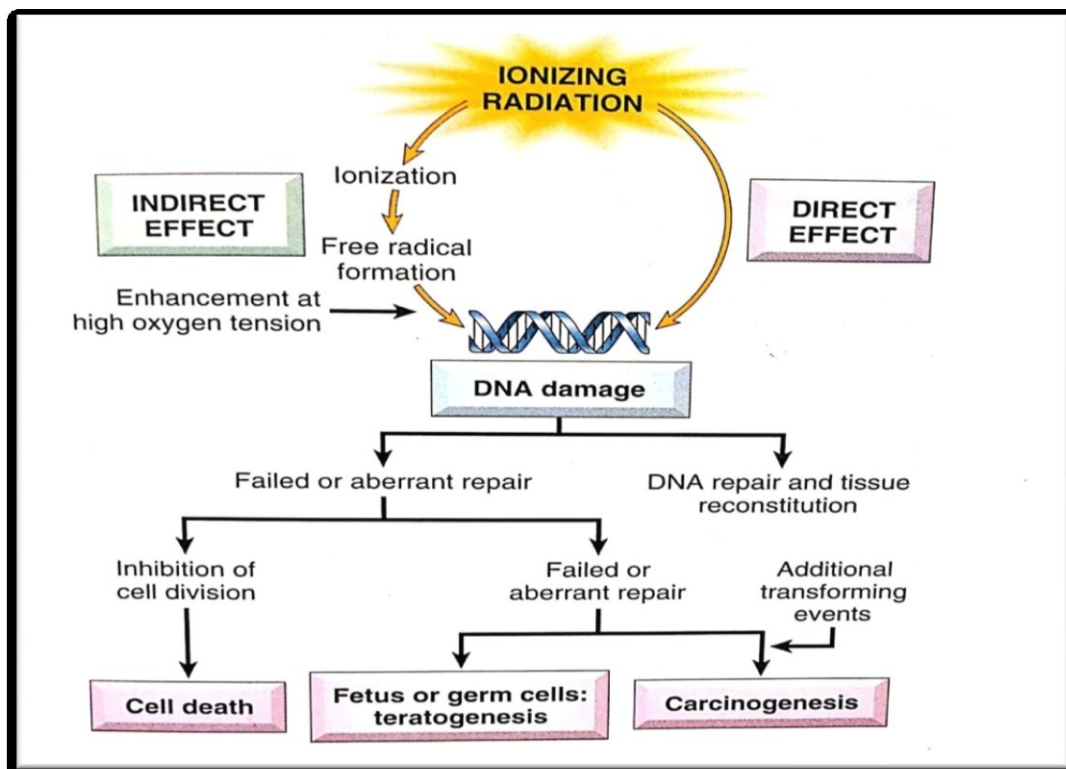


Figure 01: Representing the effects of ionizing radiation on DNA and their consequences [5]

EFFECTS ON ORGAN SYSTEM

In addition of the health effects of radiation are also depends on dose rate.

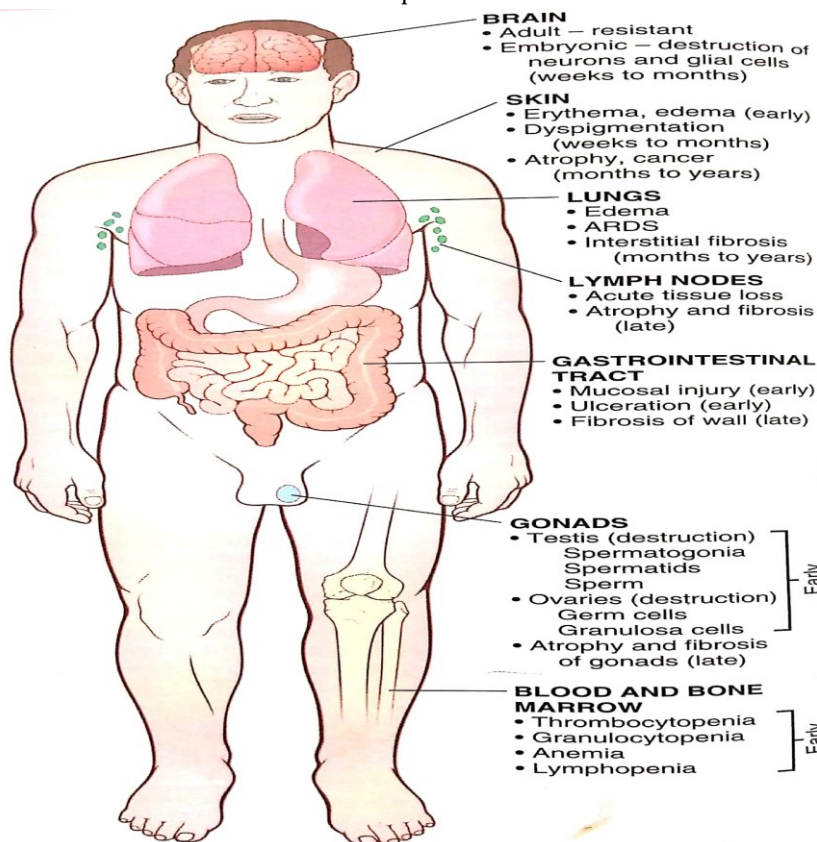


Figure 02: Representing the Morphologic consequences of radiation injury [4]

Table 01: Showing the estimated threshold doses for radiation effects on specific organs

HEALTH EFFECTS	SPECIFIC ORGANS/STRUCTURES	DOSE(SV)
Temporary sterility in males	Testes	0.15
Depression of hematopoiesis	Bone marrow	0.50
Reversible skin effects(erythema)	Skin	1.0-2.0
Permanent sterility in females	Ovaries	2.5-6.0
Cataract	Lens of eye	5.0
Temporary hair loss	Skin	3.0-3.5
Permanent sterility in males	Testis	3.5

SIGNS AND SYMPTOMS

- Nausea - Vomiting
- Diarrhea
- Blood in stools
- Decreased number of erythrocytes
- Decreased number of leucocytes
- Decreased number of platelets
- Decreased the formed elements
- Removal of mucosal layer
- Loss of vision
- Nervousness
- Confusion
- Seizures
- Loss of consciousness
- Coma

DIAGNOSIS OF RADIATION EFFECTS

- Thermography , cytogenetic method
- Infrared thermo vision test
- Radio isotopic test
- Hair cortical cell counting
- Clinical and laboratory test and data
- Lymphocyte count
- Chromosomal aberration analysis from cultured lymphocytes

RADIATION PROTECTION

Preventive measures

Radiation protection is essential concern for the radiation therapy, hospital staff, patients, families and visitors plays an important grade of care. Radioactive material (cesium-137, iridium-192, cobalt-60, californium-157, radon gas etc.) can fall from air, buildings, roads and other objects is called contamination and it looks like dust or sand .The international commission of radiation protection(ICRP), has been starts its function since 1928. The regulatory act laydown typically for protect against radiation and also advice the dose limits for radiation workers and public [4,5,6].

PURPOSE OF RADIATION PROTECTION [4]

- To prevent acute and chronic effects like serious radiation induced condition
- To reduce stochastic effects
- To prevent occurs of deterministic effects due to doses below relevant thresholds.

PRINCIPLES OF RADIATION PROTECTION [3,4]

Currently there are three general principles;

1. Stop the practice involving exposure to radiation and must be modify unless it provides sufficient benefits to balance deterministic effects.
2. Radiation protection should be developed to the consequence of doses
3. Dose limitation. And shielding & distance

PREVENTIVE MEASURES

We know that radiation is part of our life , we can prevent their effects on biological cell as follows[5]

- Removing radioactive contamination from our body of exposed parts by taking shower, washing hands and face as soon as come to home from outside.
- Should close the doors and windows always.
- Take sealed container food and drink purified bottled water.
- Avoid frequent x-rays such as chest x-ray, lower back x-ray.
- Prevent leakage of radioactive materials from nuclear reactors, industries & laboratories.
- Safety maintained during disposal of radioactive wastes.

- Must and should take a safety measures against accidents in nuclear power plants.

CONCLUSION

Radiation is a part of our life. Ionizing radiation generates free radicals those free radicals are acts with biological tissue, i.e. most importantly DNA. The severity of radiation induces damage depends on cell sensitivity and type and dose of radiation. DNA damage can repair but there are deterministic effects that can be visible over short term period and over long term period. Late somatic effects may leads to malignancy and other genetic mutations. Radiation protection is essential component for those working infrastructure of any radiology department, and also public.

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