ISSN 0976 – 3333

Available Online at www.ijpba.info.
International Journal of Pharmaceutical & Biological Archives 2010; 1(3): 195 - 198

REVIEW ARTICLE

Global Scenario of Radiation in Cancer Risk: A Review

Govind Pandey[1*] ,Madhuri, Sharma[2]

[1]*RinderPest (Veterinary / Animal Husbandry Department, Govt. of MP, Jabalpur Division, Jabalpur, MP, India.*
[2]*Department of Zoology & Biotechnology, Govt. Model Science College, Jabalpur, MP, India.*

Received 8 May 2010; Accepted 22 July 2010

ABSTRACT

Emission of energy from any source is known as 'radiation'. High frequency radiation, e.g., ionizing radiation and ultraviolet (UV) radiation may cause genetic damage, leading to cancer. The ionizing radiations include x-rays, γ-rays, cosmic rays and particles given off by radioactive materials, such as α and β particles, protons and neutrons. Radiant energy (UV rays of sunlight, ionizing electromagnetic or particulate radiation) induced the neoplasm (cancer) in both human beings and experimental animals. The ionized molecules are unstable and quickly undergo chemical changes, thereby forming the 'free radicals' that can damage the DNA molecule or other molecules around it. Hence, the ionizing radiations can cause mutation (change) in a cell's DNA, resulting into cancer. Thyroid gland and bone marrow are most sensitive to radiations; while kidney, bladder and ovary are least affected. Some forms of leukemia (bone marrow cancer) appear to be the most common radiation-induced cancers. The atomic blasts in Japan showed that high-dose radiation increases the risk of developing several cancers, including leukemia. Breast cancer can be developed in elderly women by a much more extensive use of personal computers (more than 3 hours a day), mobile telephones, TV sets and other household electrical appliances. Children appear to be twice as sensitive as adults to the leukemia-causing effects of radiation, and unborn children exposed to radiation in the uterus are even more sensitive. The breast cancer risk is more than twice as high as normal; however, the risk of developing lung cancer is 50% higher and the risk for multiple myeloma is more than twice as high as in the general population. The radiation therapy at high doses can cause DNA mutations in cells that survive the radiation, which may lead to a second primary cancer. Of all the types of non-ionizing radiations, only UV rays are cancer-causing agents. The most skin cancers are a direct result of sunlight exposure as sun is the major source of UV radiation.

Key-words: Cancer, Radiation, UV rays, x-rays, γ-rays

INTRODUCTION

Cancer is an abnormal growth and proliferation of cells. It is a frightful disease which is uncontrollable and incurable, and may occur at any time at any age in any part of the body. Cancer is caused by a complex, poorly understood interplay of genetic and several environmental factors. It represents the largest cause of mortality in the world and claims over 6 millions.[1-3] Many studies showed that several environmental factors, including air, water and industrial pollutants, environmental chemicals and radiations, etc. may cause various types of cancer.[4-6]

Emission of energy from any source is known as 'radiation'. Presently, there is hardly any aspect of human welfare in which nuclear radiation does not play an important role. The use of radiation has become an integral part of modern life. Radiation is used for scientific purposes, medical reasons and for power and energy generation. It has been stated that the high frequency radiations, e.g., ionizing and UV radiations may cause genetic damage, leading to cancer.[4] Radiant energy, whether in the form of the UV rays of sunlight or as ionizing electromagnetic and particulate radiations, induced the neoplasm (cancer) in both human beings and experimental animals. The ionizing radiations include x-rays, γ-rays, cosmic rays and particles given off by radioactive materials, e.g., α and β particles, protons and neutrons. The ionizing radiations consist of high-energy waves that are able to penetrate cells and can cause ionization. It has been narrated that the ionized molecules are

***Corresponding Author:** Govind Pandey, **Email:** drgovindpandey@rediffmail.com, **Contact No:** 09713827709.

unstable and quickly undergo chemical changes, thereby forming the free radicals that can damage the molecule or other molecules around it. One type of molecule that is sensitive to ionizing radiation is the DNA. Thus, the ionizing radiations can lead to a mutation (change) in a cell's DNA, which could contribute to cancer, or to damage / death of the cell. The amount of damage is related to the dose of radiation received by the cell. Organs differ in their sensitivity to the effects of radiation. The thyroid gland and bone marrow are most sensitive to radiations; while the kidney, bladder, and ovary seem to be least affected. Some forms of leukemia (the cancer of bone marrow) appear to be the most common radiation-induced cancers. Ionizing radiation is an effective way to treat certain kinds of cancer.[7] The cancer of thyroid gland follows closely but only in the young persons; while in the intermediate category are the cancers of breast, lung and salivary gland.[4]

Over all, the present article has been put forth to elucidate the various kinds of radiation which can develop different cancers in humans and animals. This knowledge would be definitely fruitful to the oncologists, biologists, pharmacologists and pharmaceutical scientists.

EFFECTS OF RADIATION

Normally, the health is affected on the basis of amount and duration of radiation exposure. The health can be reduced or death may occur due to radiation exposure as mentioned below:[8]

1. Stochastic health effects: The stochastic effects are associated with long-term, low-level (chronic) exposure to radiation. 'Stochastic' refers to the likelihood that something will happen. Increased levels of exposure make these health effects more likely to occur, but do not influence the type or severity of the effect. Cancer is considered as the primary health effect from radiation exposure. The radiations can cause changes in DNA, which are called mutations.

2. Non-stochastic health effects: These effects appear due to high levels of radiation exposure and become more severe as the exposure increases. The short-term, high-level exposure is known as 'acute' exposure. Many non-cancerous health effects of radiations are non-stochastic.

3. Other long-term health effects: Other than cancer, the most prominent long-term health effects are mutations. The mutations can be teratogenic or genetic. The genetic mutations are those which can be passed from parent to child (offspring). The teratogenic mutations are caused by exposure of the fetus in uterus, and affect only the individual who was exposed. The teratogenic mutations can be smaller head or brain size, poorly formed eyes, abnormally slow growth and mental retardation.

VARIOUS RADIATIONS CAUSING CANCER

The childhood leukemia was early connected to power-frequent magnetic fields of radiation already in the pioneering work by Wertheimer and Leeper[9], and more recently Scandinavian scientists have identified an increased risk of malignant brain tumors, e.g., astrocytoma and meningioma.[10-11] Furthermore, a clear association between adult cancers and FM radio broadcasting radiation has been noticed, both in time and location.[12] The breast cancer developed in elderly women by a much more extensive use of personal computers (more than 3 hours a day), mobile telephones, TV sets and other household electrical appliances. Among the elderly women who developed breast cancer in the first time frame, 20% were regularly exposed to power-frequent fields. But in the more modern period 51% were so exposed, mainly through the use of personal computers. A significant influence of electromagnetic fields on the formation of epithelial mammary tumors was found.[13] It has already been pointed out[12] that there is a strong association between the body-resonant non-ionizing radiation (FM radio, 100 MHz) and the existence of malignant melanoma of skin. Since this frequency range has a penetration depth of about 10 cm into the human body there is a suspicion that resonant currents may affect the immune defense system also when it comes to beating cancer cells in lungs. Due to that, it is well motivated to study in detail how the presence and rate of lung cancer have changed in Sweden, UK and other countries as this new environmental factor was added.

No safe level or threshold of ionizing radiation has been said. Even the exposure to background radiation causes some cancers. Additional exposures cause additional risks. The hazards of exposure to some kinds of radiation were recognized shortly after the discovery of x-ray in 1895. The skin reactions were observed in many people working with early x-ray generators, and by 1902 the first radiation-caused cancer was reported in a skin sore. Within a few years, a large number of such skin cancers had been observed. The first report of leukemia in radiation workers appeared in 1911. Marie Curie (discoverer of

radium) and her daughter are believed to have died of radiation-caused leukemia. Since then, many studies have confirmed the cancer-causing effects of some types of radiation.[7] The sun is the major source of UV radiation. There is ample evidence from epidemiologic studies that UV rays derived from the sun induce an increased incidence of basal cell and squamous cell carcinomas (the most common types of skin cancer), and possibly malignant melanoma of skin.[14] It has also been mentioned that the UV rays have a number of effects on cells, inhibition of cell division, inactivation of enzymes, induction of mutation, and in sufficient dosage, death of cells.[4] Further, the relationship between UV radiation and cancer of the face, lower lip and other exposed areas (especially in fair-skinned individuals) is considered to be causal for a long period of time, particularly in people with outdoor occupation or rural residents.[15]

Both electromagnetic (viz., x-rays and γ-rays) and particulate (viz., α and β particles, protons, and neutrons) radiations are carcinogenic. The evidence is so voluminous that a few examples suffice. Many pioneers of x-rays developed the skin cancers. Miners of radioactive elements in central Europe and Rocky Mountain region of the USA have a tenfold increased incidence of lung cancers; most telling is the follow-up of survivors of the atomic bombs in Hiroshima and Nagasaki. Initially, there was increased incidence of leukemias, mainly acute and chronic myelocytic leukemia after an average latent period of about 7 years. Subsequently, the incidence of many solid tumors of breast, colon, thyroid and lung increased with longer latent periods. In humans, there is a hierarchy of vulnerability of different tissues to radiation induced cancers. Most frequent are the leukemias, except chronic lymphocytic leukemia. An increased risk of breast cancer has become apparent decades later among women exposed during childhood to the atomic bomb.[16] A marked increase in thyroid cancer incidence was also seen in areas exposed to the fallout from the nuclear power plant accident in Chernobyl in 1986.[17]

Therapy by ionizing radiation is an effective way to treat certain types of cancer. During radiation therapy, high doses of ionizing radiation are directed at the cancer, resulting in the death of the cancer cells. However, this can lead to DNA mutations in cells that survive the radiation, which can eventually lead to another cancer, called a second primary cancer. An increase in second primary cancers in the area being irradiated has been observed in patients with several types of cancer following radiation therapy and / or chemotherapy. Treatment for Hodgkin disease (a type of lymphoma) often delivers lower radiation doses to many areas of the body. These treated areas include large amounts of normal tissue. Patients with Hodgkin disease who are treated with radiation therapy are at an increased risk for developing second primary tumors. When considering radiation exposure from radiation therapy treatment, the benefits generally outweigh the risks. However, some combinations of radiation therapy and chemotherapy are more risky than others. Children treated with radiation therapy for hereditary retinoblastoma, a malignant eye tumor, are at an increased risk for developing a type of bone cancer called osteosarcoma. Similarly, people who have nevoid basal cell carcinoma syndrome, a type of skin cancer, are at high risk for development of basal cell cancers in irradiated areas.[7]

REFERENCES

1. Brunton LL, editor. Goodman & Gilman's The Pharmacological Basis of Therapeutics, 11th ed. New York: McGraw-Hill Co.; 2006, pp. 1315-1403.
2. Madhuri S. Studies on oestrogen induced uterine and ovarian carcinogenesis and effect of ProImmu in rats. PhD thesis, Rani Durgavati Vishwa Vidyalaya**,** Jabalpur, MP, India; 2008.
3. Pandey Govind and Madhuri, S. Medicinal plants: Better remedy for neoplasm. Indian Drugs 2006;43(11):869-874.
4. Kumar V, Abbas AK, Fausto N. Pathologic Basis of Disease, 7th ed. New Delhi: Saunders, Elsevier India Pvt. Ltd.; 2006, pp. 269-342.
5. Mukherjee S, Bidhan CK, Ray S, Ray A. Environmental contaminants in pathogenesis of breast cancer. Indian J Exp Biol 2006;44:597-617.
6. Pandey Govind. Role of malnutrition in causing cancer and its safety measures. Diploma in Nutrition and Health Education project report. Indira Gandhi National Open University, New Delhi; 2007
7. www. cancer. org/ docroot /PED/ content/ PED_1_3X_Radiation_Exposer_and_Cancer.asp www. icucec. Org /files /radiation bertell. pdf.
8. Bhatia AL. Effect of radiation and gene mediated radiation protection with special reference to melatonin. Proceedings (Part II, Abstracts- Animal, Veterinary & Fishery

Sciences) of 95th Indian Science Congress of the ISCA, Visakhapatnam, AP, 3-7 January, 2008; pp. 1-51.
9. Wertheimer N, Leeper E. Electrical wiring configurations and childhood cancer. Am J Epidemiol 1979;109:273-284.
10. Hardell L, Carlberg M, Mild KH. Case-control study on cellular and cordless telephones and the risk for acoustic neuroma or meningioma in patients diagnosed 2000-2003. Neuroepidemiology 2005;25:120-128.
11. Lonn S, Ahlbom A, Hall P, Feychting M. Mobile phone use and the risk of acoustic neuroma. Epidemiology 2004;15:653-659.
12. Hallberg A, Johansson O. FM broadcasting exposure time and malignant melanoma incidence. Electromag Biol Med 2005;24:1-8.
13. Beniashvili D, Avinoachm I, Baasov D, Zusman I. The role of household electromagnetic fields in the development of mammary tumors in women: Clinical case-record observations. Med Sci Monit 2005;11:10-13.
14. Cleaver JE, Crowley E. UV damage, DNA repair and skin cancinogenesis. Front Biosci 2002;7:1024.
15. Sen R. Oral cancer: The global scenario. Proceedings (Part II, Abstracts- Medical Science) of 95th Indian Science Congress of the ISCA, Visakhapatnam, AP, 3-7 January, 2008; pp. 1-26.
16. Preston et al. Radiation effects on breast cancer risk: a pooled analysis of eight cohorts. Radiat Res 2002;158:220.
17. Williams D. Chernobyl, 15 years later, correlation of clinical, epidemiological and molecular outcomes. Ann Endocrinol 2003;64:72.

