Medical Applications and Biological Effects of Radiation

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Table of Contents

1. Abstract
2. Introduction
3. Sources of Radiation

Abstract

With the development of radio-therapeutic oncology, computer technology and medical imaging technology, radiation therapy has made great progress[10]. Radiation's benefits were initially realised in the use of X-rays for medical diagnosis, and then later with the discovery of radiation and radioactivity. The desire to take advantage of the medical benefits led to a reasonable assessment of the hazards and resulting consequences. Only the most evident effects of large doses of radiation, such as radiation burns, were noticed in those early days, and protection efforts were concentrated on preventing them, mostly for practitioners rather than patients[3]. In this term paper we will be discussing about the various sources of radiation, medical applications of radiation and how the damage produced by ionizing radiation in biological molecules affects the body cells.

Introduction

Modern techniques in nuclear medicine have proven to be powerful tools for diagnosis and treatment of an increasing number of diseases[7]. However, they all add to the patient's radiation exposure. As a result, constant attention should be paid to reducing the radiation dose involved. The risks associated with a specific nuclear procedure should be known in order to weigh its advantage against its disadvantages[1]. These risks depend on the dose and dose and dose-effect relationship. The discipline involved in dose calculation is called

dosimetry. The combination of the results of dosimetry and dose-effect relation allows the estimation of the risk associated with a certain nuclear procedure[9].

People would appreciate that radiation has quiet and useful applications in our daily lives once they understand it. New difficulties in terms of worldwide levels of radiation exposure continue to emerge, new biological information on the impacts of radiation exposure is becoming available[11].

Sources of Radiation

As a part of living on earth, people are exposed to radiation from various sources every day. Radiation is the energy that travels through space, in the form of particles or electromagnetic waves such as radio, microwaves, infra-red, visible light, ultraviolet, alpha particles, X-rays and Gamma-rays etc[11]. According to [6] these sources of ionizing radiation could be from natural background radiation such as radon and thoron, cosmic and terrestrial radiation, or man-made radiation such as those from xray or nuclear medicine (NM) procedures.

Natural Radiation

The assessment of the natural radiation doses from natural sources in human is of particular importance because natural radiation is the largest contributor to the collective dose of world population[2]. The natural radiation sources are classified into:

- External Irradiation
- Internal Irradiation

External Irradiation

1. **Cosmic Radiation:**

   This is simply the radiation from the sun and stars. Flying based at high altitudes much frequently and for long duration will attract extra cosmic radiation exposure[4].

2. **Terrestrial Radiation:**

   This is the radiation due to the presence of radioactive materials such as uranium, thorium, and radium that exist naturally in soil, water and rocks. Essentially air contains radon, which is responsible for the dose from natural background sources, and all organic matter (plant and animal) also contains radioactive carbon and potassium[5]. However, the dose from these sources varies in different parts of the world, but locations with higher soil concentrations of uranium and thorium generally have higher doses. Therefore, the background radiation levels vary in certain areas due to geological differences and sometimes the exposure can be more than 200 times higher than the global average[8].

References

[1] Manuel D Cerqueira et al. *Recommendations for reducing radiation exposure in myocardial perfusion imaging*. 2010.

[2] United Nations Scientific Committee on the Effects of Atomic Radiation, B Annex, et al. "Exposures from natural radiation sources". In: *cosmic rays* 9 (2000), p. 11.

[3] FN Flakus. "Detecting and Measuring Ionizing Radiation- A Short History." In: *IAEA bulletin* 23.4 (1982), pp. 31–36.

[4] MA Hapgood. "Towards a scientific understanding of the risk from extreme space weather". In: *Advances in Space Research* 47.12 (2011), pp. 2059–2072.

[5] K Kovler et al. "Basic aspects of natural radioactivity". In: *Naturally Occurring Radioactive Materials in Construction*. Elsevier, 2017, pp. 13–36.

[6] Mary Alice Statkiewicz Sherer et al. *Radiation protection in medical radiography*. Elsevier Health Sciences, 2013.

[7] A Signore et al. "Molecular imaging of inflammation/infection: nuclear medicine and optical imaging agents and methods". In: *Chemical reviews* 110.5 (2010), pp. 3112–3145.

[8] Michalis Tzortzis et al. "Gamma-ray measurements of naturally occurring radioactive samples from Cyprus characteristic geological rocks". In: *Radiation Measurements* 37.3 (2003), pp. 221–229.

[9] René A de Vries et al. "The biological effects of radiation". In: *International Journal of Risk & Safety in Medicine* 4.2 (1993), pp. 149–165.

[10] Jin-song Wang, Hai-juan Wang, and Hai-li Qian. "Biological effects of radiation on cancer cells". In: *Military Medical Research* 5.1 (2018), pp. 1–10.

[11] Nasiru Imam Zakariya and MTE Kahn. "Benefits and biological effects of ionizing radiation". In: *Sch. Acad. J. Biosci* 2.9 (2014), pp. 583–591.