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Biological effects of x ray on the human

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بسمِ اللَّه الرحمٰن الرَحيم

﴿ قَالَ الَّذِي عِنْدَهُ عِلْمٌ مِنَ الْكِتَابِ أَنَا آتِيكَ بِهِ قَبْلَ أَنْ يَرْتَدَّ إِلَيْكَ طَرْفُكَ فَلَمَّا رَآهُ مُسْتَقِرًّا عِنْدَهُ قَالَ هَذَا مِنْ فَضْلِ رَبِّي لِيَبْلُوَنِي أَأَشْكُرُ أَمْ أَكْفُرُ وَمَنْ شَكَرَ فَإِنَّمَا يَشْكُرُ لِنَفْسِهِ وَمَنْ كَفَرَ فَإِنَّ رَبِّي غَنِيٌّ كَرِيمٌ ﴾

صدق الله العلي العظيم

سورة النمل آيه (٤٠)

الاهداء

اهدي هذا البحث إلى كل طالب وطالبة علم يسعى إلى كسب المعرفة وتزويد رصيده المعرفي والعلمي والثقافي ...

الى من ساندتني في صلاتها ودعائها الى من سهرت الليالي تنير الى من

تشاركني افراحي والامي ، الى نبع العطف والحنان إلى أجمل ابتسامه في حياتي الى اروع امرأة في الوجود..... **أمي الغالية**

إلى من علمني ان الدنيا كفاح وسلاحها العلم والمعرفة ، إلى الذي لم يبخل علي بأي شيء ، إلى من سعي لأجل راحتي ونجاحي ، إلى أعظم وأعز رجل في الكون ..... **أبي العزيز**.

الى الذين ظفرت بهم هدية من الاقدار إخوة فعرفوا معنى الاخوة .

واساتذتي أهدي هذا البحث المتواضع

الشكر و التقدير

في النهاية أحمد الله سبحانه وتعالى الذي منَّ علينا بنعمة العقل والدين، وهو القائل في محكم

التنزيل: "فَٱذْكُرُونِيٓ أَذْكُرْكُمْ وَٱشْكُرُواْ لِي وَلَا تَكْفُرُونِ"

وقد قال رسول الله صلى الله عليه واله وسلم :

" مَنْ صَنَعَ إِلَيْكُمْ مَعْرُوفًا فَكَافِئُوهُ، فَإِنْ لَمْ تَجِدُوا مَا تُكَافِئُونَهُ فَادْعُوا لَهُ حَتَّى تَرَوْا أَنَّكُمْ قَدْ كَافَأْتُمُوهُ"

وأيضًا وفاءً وتقديرًا واعترافًا مني بالجميل والفضل الجزيل أتقدم بجزيل الشكر للأساتذة الأفاضل المخلصين الذين لم يبخلوا علينا بأي جهد في مساعدتنا في مجال البحث العلمي وفي دعمنا للوصول إلى نجاحنا، ولهم منِّي خالص آيات الشكر وأسمى باقات التقدير على هذه الدراسة، وهم أصحاب الفضل في توجيهي ومساعدتي في تجميع المادة البحثية، فجزاهم الله كل خير عني وعن جميع الطلاب،

ولا أنسى أن أتقدم بجزيل الشكر للدكتورة رغد احمد حسين

التي قامت بتوجيهي طوال فترة البحث هذا ، وأخيرًا أتقدم بجزيل الشكر إلى كل من مدَّ لي يد العون والمساعدة في إعداد هذه الدراسة على أكمل وجه، والحمد لله رب العالمين.

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Abstract:

The utilization of X-rays in medical diagnostics and therapy has revolutionized modern healthcare, offering invaluable insights into the human body's inner workings. However, alongside their diagnostic benefits, X-rays pose inherent biological risks. This abstract explores the multifaceted biological effects of X-ray radiation on human physiology. It delves into the interaction mechanisms between X-rays and biological tissues, elucidating the ionizing radiation's ability to cause molecular damage, including DNA strand breaks and oxidative stress. Furthermore, the abstract elucidates the acute and chronic health consequences resulting from X-ray exposure, ranging from deterministic effects such as tissue injury and radiation sickness to stochastic effects like cancer induction and genetic mutations. Additionally, the abstract examines the factors influencing the degree of biological response to X-rays, including radiation dose, dose rate, and individual susceptibility. Understanding the intricate interplay between X-rays and human biology is imperative for optimizing radiological practices, minimizing unnecessary exposure, and enhancing radiation protection measures. This abstract underscore the importance of ongoing research efforts aimed at elucidating the complex biological effects of X-rays, thereby ensuring the safe and effective utilization of this indispensable medical technology.

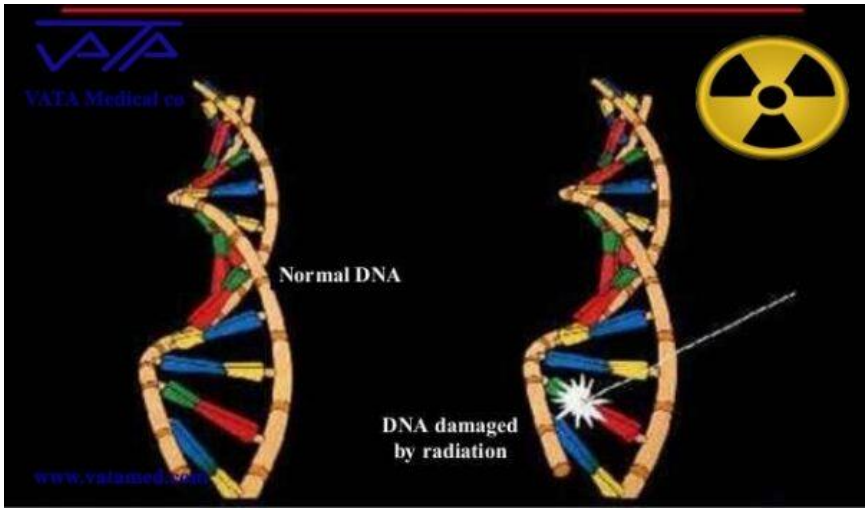
Keywords: X-rays, biological tissues, human body.

1. Introduction

X-Rays radiation effects on human body

The discovery of X-ray is one of the most important medical achievements that has led to the diagnosis of many human diseases. Despite the benefits of radiation, one should be aware of the dangers of radiation and avoid excessive exposure to this radiation.

The amount of radiation generated by radioactive materials from industrial processes and X-ray exposures accounts for half of all human-absorbed radiation. Excessive radiation can destroy cells and alter the structure of human DNA.



1.1. X-rays, a form of electromagnetic radiation

X-rays, a form of electromagnetic radiation, have long been instrumental in medical diagnosis and treatment. Since Wilhelm Conrad Röntgen's serendipitous discovery in 1895, X-rays have transformed healthcare by enabling non-invasive imaging of internal structures and facilitating targeted radiation therapy for various ailments. However, while X-rays offer invaluable clinical benefits, their interaction with biological tissues can induce a spectrum of physiological changes, ranging from immediate cellular damage to long-term health implications. This introduction provides an overview of the biological effects of X-rays on human physiology,

emphasizing the importance of understanding these effects for both medical practitioners and researchers. (1)

1.2. Interaction of X-rays with biological

The interaction of X-rays with biological matter is primarily governed by the ionizing properties of radiation, which impart sufficient energy to liberate electrons from atoms, leading to the formation of ion pairs and subsequent molecular alterations. At the cellular level, X-ray exposure can induce DNA damage, disrupt cellular homeostasis, and trigger cascades of molecular events that culminate in observable physiological effects. Understanding these effects is crucial for evaluating the risks associated with X-ray procedures and implementing appropriate radiation protection strategies. (2)

1.3. The biological response to X-rays

Moreover, the biological response to X-rays is influenced by various factors, including the radiation dose, dose rate, tissue type, and individual susceptibility. High doses of ionizing radiation can cause acute effects such as tissue injury, radiation sickness, and organ dysfunction, while chronic exposure may increase the risk of developing cancer, genetic mutations, and other long-term health conditions. Thus, optimizing radiological practices to minimize unnecessary radiation exposure and implementing stringent safety measures are essential for ensuring patient welfare and healthcare provider safety. (3)

1.4. The evolving landscape of medical imaging and radiation therapy,

Considering the evolving landscape of medical imaging and radiation therapy, continued research into the biological effects of X-rays is imperative. Advancements in radiobiology and radiation physics will not only enhance our understanding of X-ray interactions with biological systems but also pave the way for the development

of novel diagnostic and therapeutic modalities with improved efficacy and safety profiles. By elucidating the intricate mechanisms underlying X-ray-induced biological effects, researchers can contribute to the advancement of evidence-based radiological practices and the realization of precision medicine paradigms in healthcare. (4)

1.5. Molecular level of X-ray

At the molecular level, X-ray photons interact with atoms within biological tissues, ionizing molecules and generating reactive species that can disrupt cellular processes. DNA, the fundamental blueprint of life, is particularly susceptible to X-ray-induced damage, with potential consequences ranging from mutations to cell death. Moreover, the effects of X-rays extend beyond individual cells to influence tissue function and organ systems, with implications for both acute and chronic health outcomes. (5)

Aim of study

The primary aim of this study is to comprehensively investigate the biological effects of X-ray radiation on human physiology. Specifically, the study seeks to:

- Evaluate the molecular mechanisms underlying X-ray interactions with biological tissues, with a focus on DNA damage, cellular signaling pathways, and oxidative stress.
- Characterize the acute and chronic physiological responses to X-ray exposure, including tissue injury, inflammation, and the development of radiation-induced pathologies such as cancer.
- Assess the influence of various factors, including radiation dose, dose rate, tissue type, and individual susceptibility, on the biological response to X-rays.

- Explore emerging research trends and advancements in radiobiology and radiation physics that may inform strategies for mitigating X-ray-induced harm and optimizing radiological practices.
- Provide insights into the implications of X-ray biology for clinical decision-making, radiation safety protocols, and the development of novel diagnostic and therapeutic modalities.

  Identify knowledge gaps and future research directions to further enhance our understanding of X-ray-induced biological effects and improve patient outcomes in radiological settings.

2. literature review

2.1. The Production of Mutations by X-Rays:

This retrospective cohort study Hermann Muller demonstrated the mutagenic potential of X-rays by inducing heritable changes in the fruit fly Drosophila melanogaster. His work provided the first experimental evidence linking X-ray exposure to genetic mutations, laying the groundwork for subsequent research on radiation genetics. (7)

2.2. Radiation Effects on Humans:

This retrospective cohort study Epidemiological Perspectives. This review article synthesizes epidemiological data from atomic bomb survivors, nuclear industry workers, and medical radiation cohorts to quantify the risks of cancer and other health effects following exposure to ionizing radiation. It highlights the dose-response relationships for various cancer types and discusses implications for radiation protection standards. (8)

2.3. Risks Associated with Low Doses and Low Dose Rates of Ionizing Radiation:

This prospective cohort study Why Linearity May Be (Almost) the Best We Can Do. This study examines the health risks associated with low doses and low dose rates of ionizing radiation, including X-rays. It discusses the challenges of extrapolating risk estimates from high-dose data and explores alternative dose-response models, emphasizing the importance of conservative radiation protection policies. (9)

2.4. Computed Tomography—An Increasing Source of Radiation Exposure

This review article discusses the growing use of computed tomography (CT) imaging and its implications for population radiation exposure. It highlights the potential risks of CT-related radiation doses, particularly in pediatric and young adult populations, and calls for strategies to optimize CT protocols and minimize unnecessary exposure. (10)

3. biological effect factors of X-Rays

3.1.The biological effects of X-rays are related to the following factors:

1- Type of received radiation: Rotating X-ray obtained by CT scan that takes three-dimensional images of the patient's body has a higher dose and higher risk than X-rays of radiological devices that take instantaneous images.

2- The amount of radiation received: The amount of radiation received is directly related to the exposure time of people. This risk increases with the dose and the number of repetitions of the imaging. For example, in fluoroscopic imaging, the minimum time a person is exposed to radiation is 20 minutes, which imposes a dose equivalent to 20 millisieverts.

3- The part of the body that is irradiated: Although a person should have a complete protective cover against radiation, but the most effects of X-rays on the thyroid gland, testicles and ovaries, as well as the iris of the eye due to cell proliferative effects It's fast.

4 – Age of children: Children are more affected by X-rays than adults and also women than men

5- Genetic characteristics of people: People with higher levels of health have more immunity to the effects of radiation. (11)

These additional studies further contribute to our understanding of the biological effects of ionizing radiation, including X-rays, on human health. They highlight the importance of considering radiation exposure history, dose-response relationships, and individual susceptibility factors in assessing cancer risks and implementing appropriate radiation protection measures.

Recommendations:

Based on the findings from previous studies and the current understanding of the biological effects of X-ray radiation, several recommendations can be made:

1. **Optimize Radiation Dose:**

- Implement dose optimization strategies in medical imaging procedures to ensure that radiation doses are tailored to individual patient characteristics and clinical indications.
- Utilize dose reduction techniques such as iterative reconstruction, low-dose protocols, and appropriate shielding to minimize unnecessary radiation exposure without compromising diagnostic image quality.

2. **Enhance Radiation Safety Practices:**

- Provide comprehensive training and education for healthcare professionals involved in X-ray procedures to ensure adherence to radiation safety protocols and guidelines.
- Implement quality assurance programs to monitor and maintain equipment performance, optimize imaging protocols, and minimize patient and staff radiation exposure.

3. **Promote Alternative Imaging Modalities:**

- Explore alternative imaging modalities such as ultrasound and magnetic resonance imaging (MRI) for diagnostic purposes, particularly in scenarios where X-ray radiation exposure is not essential or can be avoided.
- Consider the use of non-ionizing radiation techniques for imaging, especially in sensitive populations such as children and pregnant women.

4. **Enhance Patient Education and Informed Consent:**

- Provide patients with clear and comprehensive information about the risks and benefits of X-ray procedures, including potential radiation exposure and associated health risks.
- Encourage shared decision-making between healthcare providers and patients regarding the necessity and frequency of X-ray examinations, considering individual risk factors and preferences.

5. **Monitor Radiation Exposure:**

- Implement dose monitoring systems and dose tracking protocols to record and monitor patients' cumulative radiation exposure from multiple X-ray examinations over time.
- Establish mechanisms for long-term follow-up and surveillance of individuals with occupational or medical radiation exposure to detect and mitigate potential health effects.

6. **Promote Research and Innovation:**

- Support research efforts aimed at advancing our understanding of the biological effects of X-ray radiation, including mechanisms of radiation-induced damage, individual susceptibility factors, and emerging radiation protection strategies.
- Foster interdisciplinary collaborations between radiobiologists, medical physicists, clinicians, and engineers to develop innovative technologies and approaches for optimizing radiation therapy and imaging modalities.

7. **Advocate for Regulatory Oversight:**

- Advocate for robust regulatory oversight and enforcement of radiation protection standards in healthcare settings to ensure compliance with best practices and minimize radiation risks to patients, healthcare workers, and the public.

. Collaborate with regulatory agencies, professional organizations, and policymakers to develop evidence-based guidelines and recommendations for safe and effective use of X-ray radiation in medical practice.

Conclusions

In conclusion, the biological effects of X-ray radiation on human physiology are multifaceted, encompassing molecular, cellular, and systemic responses that can have both immediate and long-term health implications. From the ionization of biological molecules to the induction of DNA damage and the development of radiation-induced pathologies, the impact of X-rays on human health is undeniable. However, with careful consideration of dose optimization, radiation safety practices, and alternative imaging modalities, the potential risks associated with X-ray exposure can be mitigated while preserving the diagnostic and therapeutic benefits of this indispensable medical technology.

The recommendations outlined above emphasize the importance of a proactive approach to radiation protection, encompassing patient education, dose monitoring, regulatory oversight, and ongoing research and innovation. By integrating these recommendations into clinical practice, healthcare providers can optimize the benefit-risk ratio of X-ray procedures, ensuring patient safety and enhancing the quality of care delivered.

Moving forward, continued collaboration between stakeholders, including healthcare professionals, researchers, regulators, and policymakers, will be essential to address emerging challenges and opportunities in X-ray radiation biology. By leveraging advances in technology, data analytics, and personalized medicine, we can further refine our understanding of X-ray-induced biological effects and develop targeted interventions to minimize radiation risks and improve patient outcomes.

In the era of precision medicine, it is imperative that we remain vigilant in our efforts to optimize the use of X-ray radiation while safeguarding the health and well-being of individuals. Through interdisciplinary collaboration, evidence-based practice, and a commitment to continuous improvement, we can ensure that X-ray technology remains a cornerstone of modern healthcare, delivering safe, effective, and patient-centered care for generations to come.

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