1st Human, Life and Radiation Conference (HLR-2006)

President Museum, Rafsanjan, Iran
October 29-31, 2006

Program and Abstracts

There are two kinds of greedy people who never satisfy:
First, the ones who look for learning,
Second, those who are following the world

Imam Ali (Peace be upon him)

The Message of Chancellor of RUMS

Over 110 years has passed since the discovery of X-Ray. During this time radiation technology with a great speed has been used in the fields such as diagnosis and treatment of disease, industry and agriculture. At this time in our lives we are in no way able to put aside this vast technology nor is it rational to do so. Today we live in an ocean of different radiations. From the minute we are born to the minute we leave this world we are surrounded with these rays. So it is important to thoroughly investigate the bio-effects and applications of radiation technology in our lives.

Although Rafsanjan University of Medical Sciences (RUMS) does not have a long history, in many scientific fields especially basic sciences, it has become an important base line in our country. Bio-chemistry and bio- physics department is one of those educational departments which besides having a strong scientific base, currently enjoys having three associate professors and four Ph.D scholarships and thus has been able to effectively cooperate with universities and research centers abroad and inside the country to approach its educational goals. This department has a very strong scientific history. In this light, establishing the 1st Human, Life, and Radiation conference by this department is a major opportunity for all scientists who work in related fields to learn and benefit from the latest scientific findings in the field of radiation research.

This scientific conference is also a great opportunity for the specialists in the other fields to learn about the different aspects of radiation and its application in the modern world. So, it is a great honor for me to welcome the distinguished guests of this conference. I pray to God for the success and higher achievement for all the participants.

H. Azin. MD
RUMS Chancellor

The Message of the Scientific Secretary

Today radiation and radioactive substances have a great role in the fields such as medicine, agriculture, and industry, and thus are effective factors in the life and social welfare of all the societies. The new advances of our country in the fields of nuclear energy and achievements in the field of nuclear fuel cycle show a bright horizon in the usage of nuclear energy as a safe and sustainable source of energy for all the generations.

Human, Life and Radiation conference is the first conference in its kind which has been organized by the cooperation of Rafsanjan University of Medical Sciences (RUMS) and Vali-e-Asr University (VAU) to promote the level of research in different radiation fields, and the organizing committee feels its duty and obligation to thank the following people for their help in organizing this conference. On behalf of this committee, I am proud to thank the great work of the international as well as local scientific committees for evaluating over 200 abstracts submitted to the secretariat office in a timely manner. Many thanks are also due to the high achievement of the organizing committee itself who made it possible to reach for the stars and organize a great scientific event such as this conference in such a relatively small city.

I also feel my duty to thank the following people whom organizing the 1st HLR conference would not have been possible without their aid and support. First and foremost Dr. Azin the chancellor of RUMS, and Dr. Ebrahim Nejad the head of VAU. Dr. SMA Sajjadi, the head of Rafsanjan Medical School, and RUMS vice chancellors Dr. A. Mozafari and Dr. M. Mahmoudi. The advices and support of Dr. SM Hossieni, the vice minister for logistics, who played a key role in organizing this conference is also much appreciated. MR. Rahmani, our faculty member and manager of the organizing committee also played a key role in organizing this great event. I would also like to thank the tireless work of Mrs Z. Hashemi the HLR-2006 secretary for international affairs. I should also thank other members of the organizing committee, especially Dr. MM. Aghaii, H. Delpasand, and M. Iranpour. Also the effective cooperation of Ave Sina conference organizers, especially Dr. H. Samavat and P. Manavi is appreciated.

In the end I feel that it is my duty to thank the participation of all the scientists, researchers and students who flew from far and near to be with us and present their great research works. Of course we admit that we have been unable to provide the accommodation worthy of their great status, but I ask for their forgiveness for any inconveniences or hardships that they have endured to be with us. I wish success and higher achievements for all.

SMJ Mortazavi, Ph.D
Scientific Secretary

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ACKNOWLEDGEMENTS

Special Thanks are extended to

- **DR. SM Hosseini**, Vice Minister for Logistics, Ministry of Science, Research and Technology for his support and advices
- **Dr. A Mozaffari**, RUMS Vice-Chancellor for Logistics, for his kind cooperation and technical advices

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دانشگاه علوم پزشکی رفسنجان

اولین کنفرانس

انسان پرتو و زندگی

۹ - ۷ آبان ۱۳۸۵

برنامه کنفرانس

1 st

Human, Life and Radiation

Conference

۹-۷ آبان ماه ۱۳۸۵

دانشگاه علوم پزشکی رفسنجان

دارای ۱۲ امتیاز بازآموزی

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۹-۷ آبان ۱۳۸۵ دانشگاههای علوم پزشکی و ولی عصر (عج) رفسنجان

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۱۰:۳۰–۱۰:۳۵	اهدای جوایز به پژوهشگران جوان
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Radioactivity in Nature, Adaptation to our Natural Environment and How to Attain Optimal Health

۱۱:۲۵ -۱۲:۰۰ سخنرانی پروفسور حسین مزدارانی ریاست افتخاری کنفرانس و ریاست انجمن فیزیک پزشکی ایران تحت عنوان:

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نشست موازی- تالار A (پرتوزایی طبیعی و Consumer Products)

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۱۴:۴۰-۱۵:۰۰ سخنرانی خانم دکتر زهرا قربانی (پژوهشگر جوان برگزیده) تحت عنوان:

^{226}Ra concentration in the teeth of habitants of areas with high level of natural radioactivity in Ramsar

۱۵:۰۰-۱۵:۲۰ سخنرانی آقای مهدی زهتابیان تحت عنوان:

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۱۷:۴۰-۱۸:۰۰	سخنرانی آقای دکتر مرتضی عالی قدری تحت عنوان: Measurement of Uranium concentration in water resources of Ardabil Province
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نشست موازی- تالار C (دوزیمتری و حفاظت در مقابل پرتو)

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Radiation protection requirement for high energy radiotherapy equipment and treatment rooms

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Gamma shielding design studies for Am-Be-Californium neutron sources

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دوشنبه ۸ آبان ۱۳۸۵ (جلسه صبح)

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هیئت رئیسه جلسه: پروفسور Jain و دکتر رضوانی

۸:۱۵-۹:۰۰ سخنرانی Keynote توسط پروفسور Nicolae Verga تحت عنوان:

The Biologic Channel, the Computational Biology and the Electromagnetic Biocompatibility

۹:۰۰-۹:۴۵ سخنرانی توسط پروفسور مهدی سهرابی تحت عنوان:

The impact of high background radiation studies on setting radiation protection regulations

۹:۴۵-۱۰:۰۰ استراحت و پذیرایی

برنامه کنفرانس انسان، پرتو و زندگی

۹-۷ آبان ۱۳۸۵ دانشگاههای علوم پزشکی و ولی عصر (عج) رفسنجان

دوشنبه ۸ آبان ۱۳۸۵ (جلسه صبح)

نشست موازی- تالار A (انرژی هسته ای و رآکتور)

هیئت رئیسه جلسه: دکتر محمود رضا آقامیری، دکتر کمال حداد

۱۰:۰۰-۱۰:۴۰ سخنرانی Keynote توسط دکتر آقامیری مدیر مسئول محترم Iranian Journal of Radiation Research تحت عنوان:

Do Modern Nuclear Power Plants Have any Threats for Residents of Nearby Areas?

۱۰:۴۰-۱۱:۰۰ سخنرانی خانم زهرا هاشمی دبیر روابط بین الملل کنفرانس تحت عنوان:

The Role of Nuclear Energy in Sustainable Development

۱۱:۰۰-۱۱:۲۰ سخنرانی آقای سید محمد شالچی (پژوهشگر جوان منتخب کنفرانس) تحت عنوان:

Assessment and Analysis of Exposed Doses Received By the Public Living Around A Sample Research Reactor In Occurrence Of A Design Basis Accident By Hotspot Code

۱۱:۲۰-۱۱:۴۰ سخنرانی خانم دکتر نویده آقایی تحت عنوان:

Radionuclide Emission Monitoring and Estimation of Dose and Risk For A Typical Research Reactor In Normal Operation By Cap88-Pc

۱۱:۴۰-۱۲:۰۰ سخنرانی آقای دکتر سید هادی طباطبایی تحت عنوان:

Selection and production of suitable fuel for usage in betavoltaic batteries

۱۲:۰۰-۱۴:۰۰ نماز و ناهار

برنامه کنفرانس انسان، پرتو و زندگی

۹-۷ آبان ۱۳۸۵ دانشگاههای علوم پزشکی و ولی عصر (عج) رفسنجان

دوشنبه ۸ آبان ۱۳۸۵ (جلسه صبح)

نشست موازی- تالار B (پرتوزایی طبیعی و Consumer Products)

هیئت رئیسه جلسه: پروفسور Jain، دکتر سماوات

۱۰:۰۰-۱۰:۴۰ سخنرانی Keynote توسط دکتر داریوش شهبازی تحت عنوان:

Dose Assessment And Radioactivity Of The Mineral Water Resources Of Dimeh Springs In Chaharmahal And Bakhtiari Province, Iran

۱۰:۴۰-۱۱:۰۰ سخنرانی آقای دکتر محمد مهدی آقایی (پژوهشگر جوان برگزیده کنفرانس) تحت عنوان:

Bio-positive Effects of Burned Radioactive Lantern Mantle Powder on the Wound Healing in Rat

۱۱:۰۰-۱۱:۲۰ سخنرانی خانم ساناز اثنی عشری (پژوهشگر جوان برگزیده کنفرانس) تحت عنوان:

Measurement Of Soil Inventories Of Natural And Anthropogenic Radionuclides In Guilan Province

۱۱:۲۰-۱۱:۴۰ سخنرانی آقای دکتر جباری وصال تحت عنوان:

Study of Radon Gas Level And Absorbed Dose In Staff And Visitors of Alisadr Cave

۱۱:۴۰-۱۲:۰۰ سخنرانی خانم سیما حافظی تحت عنوان:

Effective dose to the Public of Kerman Province from gamma emitter terrestrial radionuclides

۱۲:۰۰-۱۴:۰۰ نماز و ناهار

برنامه کنفرانس انسان، پرتو و زندگی

۹-۷ آبان ۱۳۸۵ دانشگاههای علوم پزشکی و ولی عصر (عج) رفسنجان

دوشنبه ۸ آبان ۱۳۸۵ (جلسه صبح)

نشست موازی- تالار C (دوزیمتری و حفاظت در مقابل پرتوها)

هیئت رئیسه جلسه: دکتر محمد علی عقابیان و دکتر فرشاد فقیهی

۱۰:۰۰-۱۰:۴۰ سخنرانی Keynote توسط آقای دکتر محمد علی عقابیان تحت عنوان:
The Application of Scatter Imaging Technique in Tissue Characterization

۱۰:۴۰-۱۱:۰۰ سخنرانی آقای پیمان حجازی تحت عنوان:
Virtual photon source definition in MCNP4C Monte Carlo code for dose calculation

۱۱:۰۰-۱۱:۲۰ سخنرانی آقای فتحی وند تحت عنوان:
DILs for foodstuffs consumed in Iran

۱۱:۲۰-۱۱:۴۰ سخنرانی توسط آقای دکتر رضا فقیهی تحت عنوان:
Design and implementation of a code to produce MCNP4C geometry input file from tomography images using MATLAB software

۱۱:۴۰-۱۲:۰۰ سخنرانی أقای اورنگی تحت عنوان:
Cardiologist's Hand Dose Measurements in Interventional Radiology

۱۲:۰۰-۱۴:۰۰ نماز و ناهار

برنامه کنفرانس انسان، پرتو و زندگی

۹-۷ آبان ۱۳۸۵ دانشگاههای علوم پزشکی و ولی عصر (عج) رفسنجان

دوشنبه ۸ آبان ۱۳۸۵ (عصر)

تور بازدید از جاذبه های توریستی استان کرمان

تور A

بازدید از خانه های صخره ای میمند شهر بابک شروع: ۱۴:۰۰ خاتمه: ۱۷:۰۰

تور B

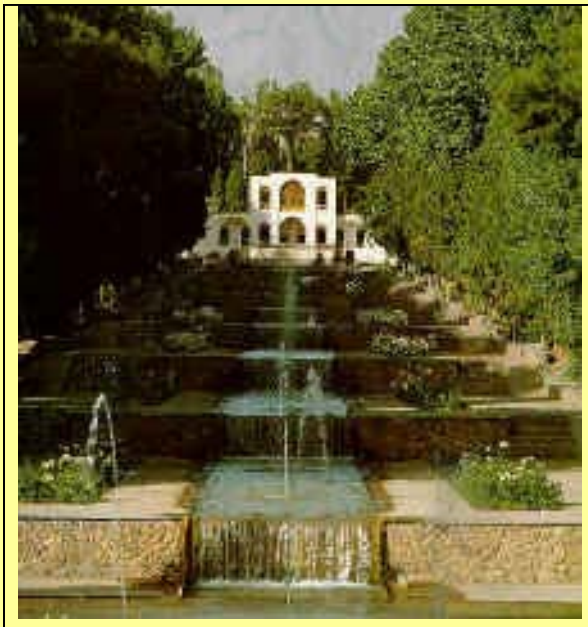
بازدید از بازار کرمان، حمام گنج علیخان، و آرامگاه شاه نعمت الله ولی شروع: ۱۴:۰۰ خاتمه: ۱۸:۰۰

ضیافت شام

ضیافت شام به میزبانی مقامات محترم استان کرمان در محل تاریخی باغ شازده، ماهان کرمان

شروع: ۲۰:۰۰ خاتمه: ۲۲:۰۰

بازگشت به محل اقامت: ۲۲:۰۰



تصاویری از باغ شازده

برنامه کنفرانس انسان، پرتو و زندگی

۹-۷ آبان ۱۳۸۵ دانشگاههای علوم پزشکی و ولی عصر (عج) رفسنجان

سه شنبه ۹ آبان ۱۳۸۵ (جلسه صبح)

نشست عمومی- تالار اصلی (A) مجموعه فرهنگی ورزشی رفسنجان

هیئت رئیسه جلسه: پروفسور Verga و دکتر رفعتی

۸:۱۵-۹:۰۰ سخنرانی Keynote توسط پروفسور Jain تحت عنوان:

Low level beta –exposure from HTO on the development of the cerebellum in mice

۹:۰۰-۹:۴۵ سخنرانی توسط دکتر Rashmi Sisodia تحت عنوان:

Modulation of Radiation Induced Biochemical Changes in Testis of Swiss Albino Mice By Spinacia Oleracia

۹:۴۵-۱۰:۰۰ استراحت و پذیرایی

برنامه کنفرانس انسان، پرتو و زندگی

۹-۷ آبان ۱۳۸۵ دانشگاههای علوم پزشکی و ولی عصر (عج) رفسنجان

سه شنبه ۹ آبان ۱۳۸۵ (جلسه صبح)

نشست موازی- تالار A (پرتوهای غیر یونیزان)

هیئت رئیسه جلسه: دکتر Mishra، دکتر مرتضوی

۱۰:۰۰-۱۰:۴۰ سخنرانی Keynote توسط دکتر صدیقی بناب تحت عنوان:

Possibility of Laser-Induced Transmutation of C-12 into C-11 for medical applications

۱۰:۴۰-۱۱:۰۰ سخنرانی خانم دکتر افسانه یزدی (پژوهشگر جوان منتخب کنفرانس) تحت عنوان:

Increased Mercury Release from Dental Amalgam Restorations after Brain Magnetic Resonance Imaging

۱۱:۰۰-۱۱:۲۰ سخنرانی آقای محمد رضا رحمانی تحت عنوان:

Significant Enhancement of Transdermal Transport of Insulin in Rats by Therapeutic Ultrasound

۱۱:۲۰-۱۱:۴۰ سخنرانی آقای دکتر جعفر احمدی تحت عنوان:

Prevalence of Subjective Poor Health Symptoms Associated with Exposure to Electromagnetic Fields among University Students

۱۱:۴۰-۱۲:۰۰ سخنرانی خانم دکتر طاووس رحمانی- چراتی تحت عنوان:

Association of Atherosclerosis in Carotid Artery with Elastic Modulus of Brachial Artery

۱۲:۰۰- ۱۴:۰۰ نماز و ناهار

برنامه کنفرانس انسان، پرتو و زندگی

۹-۷ آبان ۱۳۸۵ دانشگاههای علوم پزشکی و ولی عصر (عج) رفسنجان

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نشست موازی- تالار B (پرتوزایی طبیعی)

هیئت رئیسه جلسه: دکتر علی اصغر مولوی و دکتر اکبر علی اصغر زاده

۱۰:۰۰-۱۰:۴۰ سخنرانی Keynote توسط آقای دکتر علی اصغر مولوی تحت عنوان:

Measurement of the concentration of radon gas in waters of Klardasht area

۱۰:۴۰-۱۱:۰۰ سخنرانی آقای دکتر حمید سماوات تحت عنوان:

Radon and Lung Cancer

۱۱:۰۰-۱۱:۲۰ سخنرانی دکتر جباری وصال تحت عنوان:

Evaluation of Radon Gas and Absorbed Dose in Residents of Hamedan Houses

۱۱:۲۰-۱۱:۴۰ سخنرانی آقای دکتر مرتضوی تحت عنوان:

Dose-Response Relationship: Chromosome Aberrations In Residents at The High Background Radiation Areas In Ramsar, Iran

۱۱:۴۰-۱۲:۰۰ سخنرانی آقای دکتر وهابی مقدم تحت عنوان:

Study of Natural Background Radiation in Guilan Province

۱۲:۰۰-۱۴:۰۰ نماز و ناهار

برنامه کنفرانس انسان، پرتو و زندگی

۹-۷ آبان ۱۳۸۵ دانشگاههای علوم پزشکی و ولی عصر (عج) رفسنجان

سه شنبه ۹ آبان ۱۳۸۵ (جلسه عصر)

نشست موازی- تالار A (پرتوهای غیر یونیزان)

هیئت رئیسه جلسه: آقای حسینی پناه و خانم دلنواز فروردین

۱۴:۰۰-۱۴:۴۰ سخنرانی Keynote توسط آقای دکتر خاکی تحت عنوان:
Study of Effects of Electromagnetic Fields on Men Infertility and the Ways for Decrease of Its Harmful Effects

۱۴:۴۰-۱۵:۰۰ سخنرانی خانم فهیمه عبدالهی مجید تحت عنوان:
Hormonal Alterations Associated with Exposure to Radiations Emitted from Visual Display Terminals

۱۵:۰۰-۱۵:۲۰ سخنرانی خانم ساناز عبدالهی تحت عنوان:
Subjective Ill Health Symptoms Associated with Exposure to Radiations Emitted from Visual Display Terminals

۱۵:۲۰-۱۵:۴۰ سخنرانی دکتر حسن علی یوسفی تحت عنوان:
Effects of Occupational Exposure to Electromagnetic Fields on Mental Health

۱۵:۴۰-۱۶:۰۰ جمع بندی مباحث مطرح شده در کنفرانس و مراسم اختتامیه

توجه:

برنامه های سایر تالارهای کنفرانس در نوبت صبح و عصر (تالارهای B و C) سه شنبه ۹ آبان ۱۳۸۵ متعاقبا اعلام خواهد گردید.

FOREWORD

Professor Zbigniew Jaworowski
Past Chairman of the United Nations Scientific Committee on
the Effects of Atomic Radiation (UNSCEAR)

We are all immersed in a sea of ionizing radiation that penetrates biosphere, innermost parts of the Earth, and the whole Universe. This type of radiation was discovered very late in time, at the end of the 19th century, but it was always with us. It seems that treating ionizing radiation as essentially different from other forms of energy is not rational, and has rather non-scientific, philosophical and political roots (Taylor, 1980) stemming in part from our short acquaintance with it, and part from the lack of a specific radiation sensing organ. Living organisms apparently did not need such an organ, because radiation is one of the smallest risks they encounter almost anywhere in the biosphere. Its natural level is, and always was, well below lethal doses. The only exceptions were the insides of the natural, Oklo type underground nuclear reactors, phenomena of utmost rarity.

When life started on Earth about 3.9 billion years ago, the level of radiation was some five times higher than today. Living organisms adjusted to it, as to all other forms of energy. The adjustment was in two forms: one was using it for the benefit of organisms, as demonstrated by ubiquitous radiation hormesis and by experiments suggesting that ionizing radiation may be essential for life, and the other was the development of systems protecting against its noxious effects.

Life started when the level of oxygen in the atmosphere and oceans was extremely low. A dramatic rise of oceanic and atmospheric oxygen about 2.3 billion years ago was brought about by mass blooming of cyanobacteria, induced by a change from an extremely cold climate (a "Snowball Earth") into a warm one. The change from anoxic into oxidative conditions was probably the greatest catastrophe in the history of life; for the anaerobic organisms dominating the Earth before this event, oxygen was a deadly poison. It was at that time that organisms developed extremely efficient defenses against reactive oxygen species (ROS) which are the main culprits in radiation DNA damage. Probably even earlier they developed similar defenses against the damaging effects of thermal instability of molecules and enzymatic processes. Most of the anaerobic species that did not adjust to a new environment died out. Only a few survived the cataclysm by hiding in oxygen free niches.

Those that adjusted are exposed to an enormous stream of metabolic ROS formed in each cell at a rate of about 3 x 10^{16} per cell per year. This stream, together with thermal and enzymatic effects, causes about 70 million spontaneous DNA damages per year in each mammalian cell. Only if armed with a powerful defense system could living organisms survive such a high rate of natural DNA damage. It is only in the last two decades that we started to discover that extant oxygen-loving organisms acquired the sophisticated protective mechanisms against ionizing radiation for free, as a byproduct of defense against the toxicity of oxygen and noxious thermal and enzymatic effects.

The average level of ionizing radiation (about 2.4 mSv per year) contributes only a tiny fraction to the enormous rate of spontaneous DNA damaging events: about 5 events in one cell per year. Such small increment of DNA damage from such low doses of radiation does not impose significant health risk; it only becomes significant at high doses, when DNA repair capacity is exceeded. That capacity is far above the current dose limit for the general population of 1 mSv per year which, it now transpires, was coined to spare us from about 2 DNA damages per cell per year, out of about 70 million natural ones. Such disproportion between regulations and biological reality leads to disastrous practical consequences: mass scale radiophobia, lack of confidence in medical applications of radiation, virtual strangulation of development of nuclear energy in many countries, and the enormous wasteful costs of radiological protection. A tragic example is mass psychosomatic disorders, and the unnecessary relocation of 336 000 people after the Chernobyl accident, in areas where radiation dose rate from Chernobyl fallout is much lower than from natural background in many parts of the world, also other than in the "record" countries such as Brazil, France, India, or Iran. Relocation caused unspeakable sufferings, social degradation and impoverishment on these people. In the wake of the Chernobyl catastrophe we witnessed a mischievous use of the numbers game: calculations of the numbers of people who would die due to irradiation with doses not much different from the average global natural radiation dose, or even exposed to tiny fractions of this dose. The game was played both by individuals and by international bodies. Dr. Lauriston S. Taylor, the coryphaeus of radiological protection, defined such procedures as "deeply immoral uses of our scientific heritage" (Taylor, 1980).

The inadequacy of radiation standards for current needs is due to a vast discrepancy between their foundation, i.e., the genetic data and statistical assumptions supporting the linear no-threshold dose response (LNT) model, and current progress in genetics, radiobiology, toxicology and experimental oncology. The weakness of the more than 50 years old LNT model is of a "trans-science" character: one can never, with any finite experiment, prove that ionizing radiation, as any other environmental factor, is totally harmless (Weinberg, 1972). On the other hand, a great strength of the hormetic model is that it has the capacity to be tested experimentally and epidemiologically in the observable zone (Cook and Calabrese, 2006; Webster, 1993).

The outdated genetic experiments standing behind the LNT model and current regulations are in disagreement with the findings from Hiroshima and Nagasaki, where no adverse genetic effects were found in the children of highly irradiated survivors of atomic bombings (UNSCEAR, 2001). The "precautionary principle", reducing the exposures ever lower, and at any cost, proved to be not "cautionary" at all. It leads to unacceptable societal penalties, as clearly demonstrated in the aftermath of the Chernobyl catastrophe. The time has come to change the ossified LNT paradigm, and to base radiological safety and protection on modern knowledge. Conferences such as this may contribute to the harmonization of humans, life and radiation, perhaps more efficiently than the self-perpetuating official bodies.

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3. UNSCEAR, 2001. Hereditary Effects of Radiation. UNSCEAR 2001 Report to the General Assembly, with Scientific Annex, United Nations Scientific Committee on the Effects of Atomic Radiation, Vienna.
4. Webster, E.W., 1993. Hormesis and radiation protection. Investigative Radiology, 28(5): 451-453.
5. Weinberg, A.M., 1972. Science and trans-science. Minerva (London), 10: 209-222.

Section A
Invited Abstracts
(Foreign Participants)

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-5

RADIATION ADAPTIVE RESPONSES *IN VIVO*; IMPLICATIONS FOR RADIATION PROTECTION

Ron E. J. Mitchel

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Chalk River, Canada

Low doses *in vitro* and in *vivo* induce an adaptive response that reduces both radiation-induced and spontaneous risks. A single low dose of low LET radiation increased the latency (with no change in frequency) of radiation-induced or spontaneous cancer in both normal and cancer prone (Trp53 heterozygous) mice. A prior low dose given during the time of fetal organ development lowered the risk of radiation-induced birth defects, and a low dose prior to a high dose protected the offspring of male mice from heritable mutations produced by a subsequent large dose. Chronic exposures protected against age related ulcerative dermatitis in Trp53 normal (but not Trp53 heterozygous) mice. These observations challenge the Linear No Threshold Hypotheses and other principles and practices used for radiation protection. Dose thresholds for increased risk of cancer are apparent. Below those dose thresholds overall risk is reduced below that of the unexposed controls, indicating that dose rate reduction factors (DDREF) approach infinity. Different tissues have different thresholds for detriment, indicating that individual tissue weighting factors (W_T) are also not constant. Because risk from low LET radiation is not constant with dose, and dose responses from high LET are non-linear due to detrimental bystander effects, radiation-weighting factors (W_R) for high LET radiation cannot be constant at low dose.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-6

RADIATION-INDUCED TUMOR INDUCTION IN MICE AND ITS SUPPRESSION BY LOW DOSE IRRADIATION AND ANTIOXIDANTS: INVOLVEMENT OF ROS AND APOPTOSIS

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Ionizing radiation-induced tumour induction in thymus and its suppression by pre-exposure to low dose irradiation has previously been investigated in Swiss albino mice in our laboratory and these studies showed that a single dose of whole body gamma irradiation (3 Gy) induced thymic lymphoma (TL) after 3-4 months followed by shortening of the life span of tumour bearing animals. These findings have been extended to detailed investigations on the mechanisms of radiation-induced occurrence of tumour and its modification by antioxidants and low dose exposures prior to tumour causing radiation dose. The induced tumour has been found to exhibit sensitivity to therapeutic doses of radiation and concentration dependent anti-tumour drug, doxorubicin. Moreover, transplanted tumour growth was found significantly reduced by exposure to fractionated doses of radiation. Studies have further confirmed that pre-exposure of animals to low doses of radiation significantly suppressed the growth of the transplanted tumour. In addition, tumour cells exposed to 1cGy of radiation and transplanted to mice showed 30 % reduction in the incidence of tumour. The development of TL was found associated with the enlargement of spleen and induction of anaemia. Recent results have shown that whole body exposure of animals to sub-lethal doses (1-5 Gy) resulted in dose-dependent increase in reactive oxygen species (ROS) level in thymocytes from irradiated animals. I*n vitro* studies on thymocytes of irradiated mice showed increased percent apoptosis, as measured by annexin V fluorescence method, which was inhibited by antioxidants such as vit E and curcumin. This talk is designed to present a highlight of involvement of gamma radiation generated ROS in cell/membrane oxidative damage and the role of cellular apoptosis in the mechanism of radiation-induced lymphoma tumour in mice.

1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-7

RADIOACTIVITY IN NATURE, ADAPTATION TO OUR NATURAL ENVIRONMENT, AND HOW TO ATTAIN OPTIMAL HEALTH

Bruno Comby

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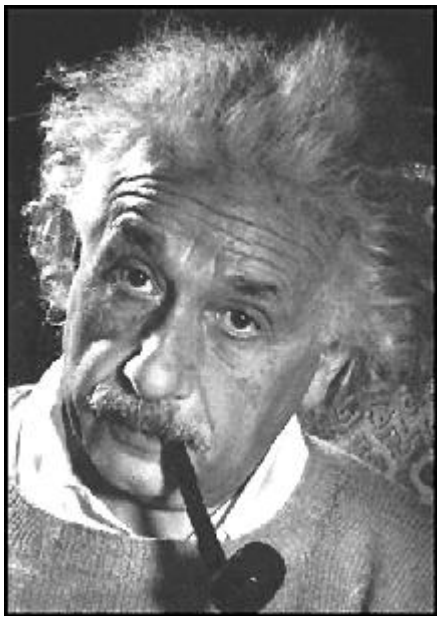
Radiation levels in nature vary greatly depending on the location, from about 0.5 microsieverts per hour of background radiation in some places, to about 1000 times more in other areas of the planet. The radiation levels have historically evolved over time, slowly decreasing ever since life appeared on our planet. The author has especially studied the HBRA (high background radiation area) of Guarapari in Brazil, as well as the beach of Espiguette in France. The effects on health of local inhabitants are discussed. The author is also a world famous specialist in natural methods for preventative health (non-smoking, nutrition, sleep patterns), and has shown that in these different sectors, a common approach can be scientifically described with the notion of "genetical adaptation to our natural environment" (GANE). This general theory (GANE) may in fact also be applied to life in relation with radiation levels. It then explains the positive effects that have been observed in several areas of HBRA's around the world and in radon-rich spas. In fact man is well adapted to the natural variations that can be encountered in nature even in the HBRA's. Because of the decrease of radioactivity over time, it appears that we are in fact adapted to levels of radiation higher than those that that can still be observed today in most locations. Epidemiological studies, as well as the study of cellular responses to radiation exposures indeed confirms the hormesis phenomenon and the existence of some beneficial effects of radiation on the immune system.
Positive results for public health can be obtained by a genetically more adapted lifestyle, namely more natural diets, genetically-adapted sleeping patterns, as well as by occasional or chronic exposure to increased levels of natural radiation. A new approach of how to attain optimal health by setting the important human biological parameters correctly : no smoking, no distilled alcohol, no artificially transformed foods, and. exposure to somewhat higher levels of radiation (higher than those usually encountered in large cities), are important ways to regain optimal health. By using these different "natural" therapeutics in conjunction with each other offers the best method to attain optimal health for healthy people, or to help regain better health in clinical therapeutics for the many people suffering from environmental diseases due to inadequate lifestyles, opening new pathways in medical research and treatments. When assessing the acceptability of risks regarding humanity's interactions with its environment, the naturality principle enounced by the author proposes a new approach. The

naturality principle is more precise and could well replace the precautionary principle often taken in consideration in policy making.

Notable people from radiation history

Albert Einstein



1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-9

RADIATION EXPOSURE AND EVOLUTIONARY PERSPECTIVES: NEUTRAL THEORY REVISITED

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Ubiquitous radiation and radioactivity have been unavoidable and would have taught life to evolve safely in a progressive not in retrogressive manner. Radiation reaches us from outer space and comes from radionuclides present in rocks, buildings, air, and even from our own bodies since time immemorial. At least a billion particles of natural radiation enter our bodies, every day. The truncated natural dose commitment for various periods since the assumed appearance of some of our ancestors may be calculated much higher than the present period. However, collective dose and dose commitment though do not have any biological meaning, yet if they have, it shows that life evolved in with the tendency for organisms to become progressively adapted to an environment with the advent of oxygen in the presence of radiation absorbed dose due to intense UV. Since background radiation has been a universal component of our environment, radiation adaptive response and possibly hormesis may be claimed to be an evolutionary expectation. It may also support the cause of the neutral theory of evolution which states that molecular polymorphism observed in natural population is due to neutral mutation under drift equilibrium. Molecular divergence between species is an extension of the process of radiation adaptive response or hormesis caused by neutral mutation which fix in one or the other species. Neutral theory introduced by the Japanese geneticist Motoo Kimura (1968) published in Nature in 1968, calculated the evolutionary rate of protein and found that it is much higher than expected by the result of natural selection. In the wake of findings of Human Genome Project, it would be worth investing to revisit the neutral theory which doesn't say that natural selection plays no role, but the selection intensity involved in the process is so weak that mutation pressure and random drift prevail in molecular evolution at DNA and protein levels. Since Mutations are selectively neutral, therefore long-term heterozygosity reflects only population history and the mutation rate! The Neutral Theory in fact considers that genes and proteins are so well-adapted because of past natural selection. The growing evidence of low level of radiation at the molecular level support the neutral theory and paves way to an adaptive response and if careful examined, to hormesis too. It warrants quests for the evidence for hormesis in the light of an evolutionary expectation.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-10

TRITIUM EXPOSURE: HORMETIC AND ADAPTIVE PERSPECTIVES IN RELATION TO NEUROMOTOR PARAMETERS

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Tritium a radioactive form of hydrogen is also produced in the reactor core. The released tritium replaces hydrogen in water. Tritium in water when gets ingested, causes continuous internal low-level beta radiation exposure over a long period. As internal radiation pulses never stop, impact is continuous by the ambient radiation atmosphere. The possibility of an adaptive response at a very low level may provide chance to heal at the molecular level with DNA repair can not be ruled out. When Swiss albino mice were continuously exposed to doses ranging from 11 to 111 kBq/ml through drinking water from 15th day p.c. and 1 day pp, no significant change was noticed in the body and brain weight. However RNA/DNA ratio and Protein/DNA ratios were significantly higher at different t intervals during the postnatal intervals. Variation in the learning ability of normal adult (pre-learned) Swiss albino mice in a Hebb William's maze after administration of 111 kBq HTO/gm body weight (amounting an initial dose rate 0.92 cGy/day) caused no significant decline in learning process. On the other hand, mice were found more active and regression curves showed a faster learning. It was further observed in such studies that frequency and amplitude in electro-corticographic wave do not show significant difference between normal and irradiated ones. Hence, it appears that the situation needs not be alarming with tritium exposure; the studies on radiation effect on some neuro-motor parameters indicate a positive trend of acclimatization to tritium exposure with the presence of radiation-induced repair mechanism. A very low level exposure may effect in positive ways not only human kind but also its evolving process which may or may not have visible and beneficial influence. They will act, not only on people but on those biological systems which support us because these changes may be beyond our notice and beyond the ability of scientists to judge in relation to very long period, and in so many disparate ways, we will not notice the change in the spiritual and physical quality of our world, if it happening due to constant low level exposure of radiation tritium.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-11

TECHNOLOGICAL DEVELOPMENTS IN MEDICAL APPLICATIONS OF X-RAYS AND RADIOACTIVITY

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Abstract: The years 1895 to 1898 were momentous for their impact on health and human well beings. First, Wilhelm Roentgen noted a glowing fluorescent screen, caused by invisible rays. This event subsequently led to the discovery of X-rays in 1895, and thus the birth of the "atomic age". Next Becquerel's investigations of these mysterious rays led to his experiments with uranium salt crystals. He thought that when these crystals are exposed to sunlight they could emit rays and cause exposure on photographic plates. This led to the discovery of radioactivity in 1896, with its full significance appreciated when the Curies discovered radium in 1897. The term "radioactivity" was first used by Marie Curie to describe this phenomenon that led to the birth of the "nuclear age". Shortly after, the medical applications of x-rays and radioactivity were recognized and widely disseminated.

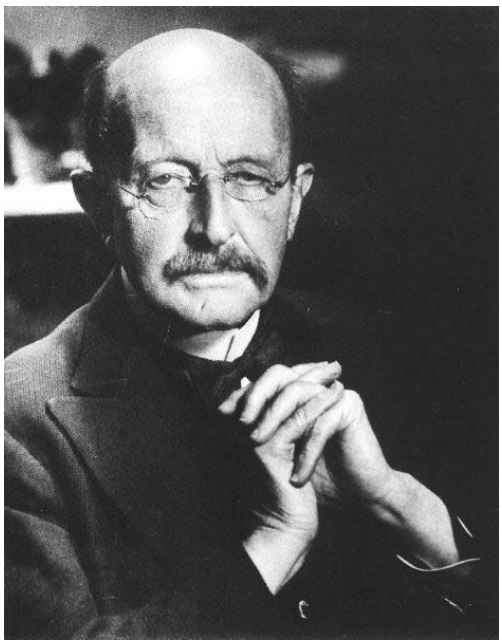
In the past 100 years, the technological developments in the production of x-ray beams along with the impact of the discovery of artificial radioactivity by Irene Curie and Frederic Joliot in 1930s, have revolutionized the practice of medicine. Currently x-ray imagings are being used, more than any other imaging modality, in diagnosis of diseases and abnormalities. In addition, over 50% of all cancer patients receive radiation treatments as part of their treatment plan. Despite significant advances in imaging technology and in production and delivery of x-rays and radioactivity, about half of these patients are successfully cured with 5 to 10 years local control. Reasons for treatment failure with radiation may be several including physical, biological, or both. For example, because of the imaging limitations, the exact extent of disease for many tumors is often unknown. Moreover, some tumors are able to "repair" radiation damage very effectively and some are radio resistant due to relative hypoxia.

In recent years, the major "challenge" of radiation treatment is to deliver large enough doses to the most resistant cancer cells to provide a high probability of local control while minimizing the dose to normal tissues and hence reducing complications. With recent developments in "imaging" the metabolic or functional status of cancers, the position of tumors relative to surrounding normal tissue can be more clearly delineated. The therapeutic dosage of radiation to the tumors can be escalated without exceeding normal tissues tolerances. These special techniques include: 3D "conformal" radiation treatment where the shape of the high dose region "conforms" to the shape of the tumor ("target"), intensity

modulated radiation therapy (IMRT) that uses combinations of radiation beams with varying spatial intensity across the fields (“intensity modulated”) in order to achieve an “ideal” dose distribution, image guided radiation treatment, and heavy charged particle radiotherapy. As such, it is expected to increase the success rate of cancer treatment significantly with this radiation treatment modality.

Notable people from radiation history

Max Planck



1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-13

RADIATION DAMAGE AND ITS TREATMENT

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Exposure to relatively high doses of radiation concerns patients receiving radiotherapy for cancer and populations subjected to accidental or intentional exposure to ionising radiation. At present there is not an approved method for the treatment of radiation-induced normal tissue lesions. A number of modalities with diverse modes of action have been used in post irradiation modification of normal tissue reactions. This diversity indicates an uncertainty on the mechanisms involved in the development of these lesions. Among many modalities suggested for intervention, treatment of radiation lesions with stem cells and antioxidants have been shown to be very promising. This presentation will consist of two sections to discuss the role of both modalities in the treatment of radiation injury.

Stem cell therapy:
According to accepted concepts of cellular radiobiology radiation injury is seen as a result of the sterilisation of clonogenic stem cells within that tissue. According to this concept tissue specific function is restricted to functional cells derived from clonogenic cells. Failure of clonogenic stem cells to replace the functional cells results in a gradual depletion of functional cells. When the number of functional cells reach a critical level the tissue cannot sustain its function and radiation-induced injury is expressed. Therefore, regeneration of lost tissue by stem cell transplantation can be a beneficial modality for the treatment of radiation-induced lesions. The influence of the transplantation of stem cells on the development of radiation myelopathy was examined in rats. Cervical spinal cord of five week old female rats was locally irradiated with a single dose of 22 Gy of ^{60}Co γ-rays. This dose of radiation is known to produce myelopathy in all animals within 180 days after irradiation. At 90 days after irradiation neural stem cells or saline (controls) were injected into the spinal cord of the animals. In a separate study mesenchymal stem cells (MSCs), isolated from bone marrow of rats and expanded in vitro, were transplanted via sublingual vein to spinal cord irradiated rats 90 days after irradiation. One advantage of using MSCs is their apparent uptake and incorporation into the damaged tissues following systemic *iv* injection. In both cases the incidence of radiation myelopathy was significantly lower in stem cell transplanted animals (67% vs 100%).

Antioxidant therapy:
Persistent oxidative stress has been suggested as a common pathway in the development of radiation-induced lesions. It was hypothesised that intervention with antioxidant substances

might bring beneficial effect in the treatment of radiation lesions. On the basis of this hypothesis an antioxidant based combination drug, that consists of diferuloylmethane and α-tocopherol, was developed. The drug, which has been designed as an adjuvant for radiotherapy and a post-exposure treatment for radiation accident victims, given as an oral gavage, reduced the incidence of radiation myelopathy by 30% in a rat model. In a radiation-induced oral mucositis model both the incidence and severity of the lesions were significantly improved. Using this model, dose modification factors (DMF) of 1.24 and 1.44 were obtained for single and fractionated dose irradiations, respectively.

It was concluded that both stem cell transplantation and antioxidant therapy significantly ameliorated radiation-induced normal tissue lesions.

Notable people from radiation history

Marie Sklodowska (Curie)
(1867-1934)

1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-15

PREVENTION OF HUMAN ERRORS IN NUCLEAR POWER PLANT, AND SYSTEMATIC RISK MANAGEMENT

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Chair, Union of Risk Management

In spite of great advantages of nuclear power plant as an energy source, over 20 accidents of nuclear power plants were reported in the world, including Japan, UK, USA, Russia, Ukraine, Spain, Turkey, Malaysia, Argentine, etc..

In 1957, Windscale Plant fire accident in the UK occurred due to human operation error in energy release process. In, 1958, Vinca Plant in Yugoslavia got criticality accident. In 1979, Three Mile Island Plant in the USA happened due to break of water pomp and wrong human operation. In 1986, explosion of Chernobyl Plant No.4 in Ukraine was the worst accident, which generated nuclear dust cloud over 2000 meter higher, and the radioactive damages were detected even in many European countries. In 1999, criticality Accident in Tokaimura Plant of Japan happened due to worker's moral hazard, and several workers died. Similar risky behaviors were found among fuel workers in several nuclear power plants in Japan. Wrong mine management, flue production error, accidental release, recycling process errors, wrong waste management and fuel transportation error generated serious health and ecological risks in the world.

Emergency preparedness center, manual and golden guideline for prevention and crisis management, hazard simulation and evacuation training are the fundamental tools to prevent the accidents and reduce the accidental damages.

Risk management is principally based on a man and environment (technological environment) system. Therefore, a system approach is useful to develop preventive procedures of nuclear power plant accidents. Human ergonomics, risk behavior analysis, risk perception, risk communication take great advantages to prevent and reduce nuclear power plant accident and the damages, likely other accidents, such as natural disasters (earthquake, tsunami, volcano, land heat, water hazard), traffic accident, and medical errors.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-16

REALITY OF LOW-DOSE EFFECT OF IONIZING RADIATION, REGARDING HEALTH CONSEQUENCES 20 YEARS AFTER THE CHERNOBYL ACCIDENT

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Common people have imprinted knowledge that radiation is carcinogenic even at a very small dose. Because the low dose effect of radiation was explained by " the linear no threshold (LNT) hypothesis", that is often confused with the reality.

Due to the Chernobyl accident in 1986 Apr. about 14 x 10^{18} Bq of radioactive materials were released from the atomic reactor and it resulted 10 – 50 mSv of individual accumulated radiation exposure respectively, to inhabitants of contaminated area during 1986 – 2006. While clear evidences obtained 20 years after the Chernobyl accident are:

1. Nearly 4000 cases of thyroid cancer have been diagnosed among children who were 0 – 18 years at the time of the accident in Belarus, Russia and Ukraine during 1992-2000. More than nine children (less than 1%) died and the rest were treated and survive.
2. There was no excess leukaemia among inhabitants of contaminated area.
3. In Belarus a slight increase of mammary cancer of women less than 45 was found.
4. The mental health impact of Chernobyl is the largest public health problem.
5. It is difficult to manifest a radiation-specific excess risk or increase of cancer statistically because the value is so small that it must be buried in the range of natural cancer background variation.

The above results tell us the fact of the effects of low dose of radiation through the bitter experiences with our human bodies in those countries.

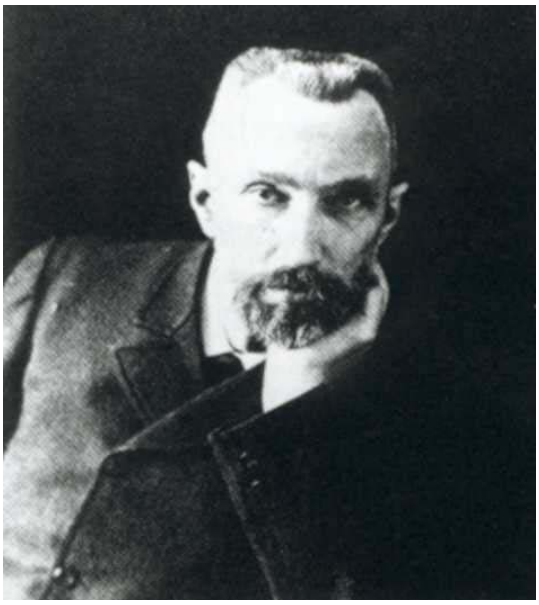
Since 1980s the author has obtained lots of data which manifests the animal has a protective power against radiation, i.e. increase of hepatic metallothionein (anti-oxidative function), increase of thymic apoptosis, and increase of spleen colony formation (immune function) after mice were exposed to radiation. It means that the animal possesses host-defense mechanisms against radiation. LNT hypothesis is only true if the animal has no protective power against radiation. Therefore the author deems that LNT hypothesis is not consistent with biological reality.

It is not easy to establish a threshold dose for cancer in human population because of the presence of a few sensitive people to radiation or other toxic substances based on genetic

heterogeneity and variation of lifestyles in the population. Important thing is that we must consider the biological reality, not superficial curve linearity.

Notable people from radiation history

Pierre Curie (1859-1906)



1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-18

WORLD HIGH LEVEL NATURAL BACKGROUND RADIATION AREAS: NEED TO HARMONIZED APPROACHES FOR CONSISTENCY IN DATA ON RADIATION HEALTH EFFECTS

Mehdi Sohrabi*

International Committee on High Levels of Natural Radiation and Radon Areas

From possibilities exiting to study health effect –dose response such as Japanese A-bomb survivors, radiation workers, medical exposure, and population exposure from environmental radiation, it seems that the radiation-induced cancer from the health effects observed in Japanese A-bomb survivors continues to serve as a major source of information for evaluating radiation health risks. This is due to the fact that the available information in other possibilities is either not sufficiently precise to form the sole basis for radiation risk estimates, or the magnitude of the radiation risk and the shape of the dose response curve for the outcomes are uncertain, or no consistent or generalized information is contained in some studies (BEIR VII, 2005). The studies on health effects of population chronically exposed to high level natural background radiation (HLNBR) areas while having provided some health effect data so far, it dose not seem to meet all criteria required for studies in such areas. On the other hand, most international organizations/committees such as UNSCEAR, BEIR, FAS, etc. and in particular the International Committee on High Level Natural Radiation and Radon Areas (ICHLNRRA) are recommending and expressing interest in studies in such areas as a possibility to assist in understanding the Health Effects of Ionizing Radiation at low doses. For example, the French Academy of Sciences (2005) has proposed mandatory research on epidemiological studies as a necessity to investigate the effect of very low doses (< 20 mSv) in regions where the natural radiation is high (> 10 mSv y-1). The need in fact has been emphasized over a decade ago through establishing the ICHLNRRA in order to harmonize scattered studies on the subject, to standardize approaches and to increase our knowledge on health risks from chronic low-level natural exposure to solve hopefully this dilemma of radiation protection. The efforts made by the Committee have been a success in enhancing the knowledge in this area. In particular, in addition to the conferences held in Brazil in 1975 and later in India in 1981, five periodic international conferences have been organized the since 1990 one of which is planned to be held in 2008 in Kerala, India. The complexity of the studies and the need to national and international efforts to adopt harmonized, guidelines, measurement protocols, biological, and epidemiological approaches to produce conclusive results has been highly recognized. This

paper, while reviews the international concern and the state-of-the-art on studies in HLNRAs in particular in Iran, will emphasize parameters of importance for harmonized approaches to be considered in studies in such areas.

*Presently at the International Atomic Energy Agency, P.O. Box 200, Vienna, Austria. The paper presents the author's views and no organization is responsible for it.

Notable people from radiation history

W C Roentgen

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-20

CELLULAR NUCLEOTIDE POOL AS A TARGET FOR RADIATION INDUCED OXIDATIVE STRESS

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8-Oxo-7,8-dihydro-2'-deoxyguanosine (8-oxo-dG), a general marker of oxidative stress, is one of the major products of interaction of ionizing radiation with DNA and the nucleotide pool of the cell. As 8-oxo-dG is highly mutagenic due to incorrect base pairing with deoxyadenosine, various repair mechanisms recognize and remove 8-oxo-dG. The repaired lesions are released from cells to the extracellular milieu (serum, urine and cell culture medium) where they can be detected as markers for free radical reactions with the nucleic acids.

Significant variations in background levels as well as in radiation induced levels of 8-oxo-dG in urine have been demonstrated in breast cancer patients. Two major patterns were observed: high background and no therapy-related increase vs. low background and significant increase during radiotherapy for the radiosensitive and non radiosensitive patients respectively.

We have also shown the major contribution of the nucleotide pool to the extracellular 8-oxo-dG levels. The results also implicated induction of prolonged endogenous oxidative stress in the irradiated cells. RNA "knock-down" experiments on the nucleotide pool sanitization enzyme hMTH1 further experimental evidence to this assumption.

In summary, our results confirm that extracellular 8-oxo-dG is a sensitive *in vivo* biomarker of oxidative stress, primarily formed by oxidative damage of 2′-dGTP in the nucleotide pool with a potential to become a clinical tool for prediction of individual responses to radiotherapy.

Section B
Contributed Abstracts
(Foreign Participants)

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-22

THE BIOLOGIC CHANNEL, THE COMPUTATIONAL BIOLOGY AND THE ELECTROMAGNETIC BIOCOMPATIBILITY

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The biological channel is the bio-geometric model that shows the way a self-adjustable and independent system functions and is being organized. Their characteristics: independence-homeostasis**,** continually building of the relationship through phenomenon of transportation, transformation, stocking, self-control and self-organizing, auto-reproduction represents the possibility to depict in mathematical manner the characteristics of biologically structure, their functions and the levels of biological memory.
Using this model we can clear the relation biochemical-biophysical, signal-message-structure - function and to permit the prediction in biotechnology, medicine and human ecology.
The application of the theory of biologic channel and the theory of transport in biological systems have as result the biological phenomena modeling and increasing the possibility to predict of effects, results of the messages transmitted to the biologically structures.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-23

DOSE DEPENDENT STUDY ON THE EFFECTIVENESS OF *GREWIA ASIATICA* ON THE SURVIVABILITY OF MICE AGAINST LETHAL GAMMA IRRADIATION.

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Abstract

Present study is an attempt to investigate the most effective and optimum dose level of *Grewia asiatica (*Phalsa; indigenous plant of Indian sub-continent) against Gamma irradiation. Swiss albino mice were administered different oral doses of Grewia *asiatica (*700,1000 and 1300 mg/kg of their body weight/day) for 2 weeks and then exposed to 10Gy of gamma radiation. Study was made on body weight, behavior and mortality. A correlation between doses of *Grewia asiatica* after irradiation and recovery interval in the body weights indicates the longer time interval at 700mg/kg b.wt. /day as an optimum dose level of *Grewia asiatica* against radiation induced oxidative stress the dose level 1000mg/ kg b.wt. /day, were found less effective. Higher dose (1300mg) was found to be toxic as noted by the mortality of animals where all the animals died within 18 days. Whereas in 1000 mg and 700 mg/ kg b.wt. /day dose group animals survived upto 22 and 30 days onward, respectively. Regression analysis of mortality data yielded $LD_{50/30}$ as 6.210 and 9.535 for control (irradiation alone) and experimental (drug + irradiation) mice respectively. On the basis of $LD_{50/30}$, *Grewia asiatica* pre treatment produced *a* dose reduction factor of 1.535. Radiation induced deficit in the body weights also got inhibited significantly in the drug pre-treated mice. The findings support the possible radio protective role of *Grewia asiatica* against Gamma irradiation.

Key Words: *Grewia asiatica*, Survivability*, DRF*, Radioprotection

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-24

EFFECT OF STATIONARY MAGNETIC FILED FROM MRI: A SURVEY ON THE EXPOSED PERSONNELS

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The scientific community and most health officials agree that more research is needed to provide a definitive answer as to the effects of extremely low frequency electromagnetic and radio-frequency radiation on our health before the recommendation on the prudent avoidance of equipment which generates non-ionizing radiation are made. Usually the intensity of exposure is low in the general population but can be greatly increased in the workplace. MRI spectroscopy is a special MRI method that identifies certain medical problems by looking for specific chemicals in body tissues. Magnetic Resonance Imaging (MRI) is an imaging technique using radiofrequency waves in a strong magnetic field mostly for inner human body examination. Widely used as a noninvasive diagnostic tool in the medical community, MRI is used to detect the early evidence of many ailments of soft tissues such as brain abnormalities, heart disease, coronary artery diseases and disorders of the ligaments, etc. The magnetic field used is 30,000 + times that of the earth's magnetic field. Its effect on the body, however, is claimed to be harmless and temporary. A survey of some personnels carried out with the help of local diagnostic laboratories (fitted with a field of 1.5 T) show some effects like skin or eye irritation due to iron pigments in tattoos or tattooed eyeliner, cause a burn with some medication patches, a slight risk of an allergic reaction if contrast material is used during the MRI. However, most reactions are mild were treated using medicine. The reduced eye hand coordination and visual contrast sesitivity were also some of the observed effects which might be thought more psychologically oriented. However, it has also showed some beneficial effects in elederly people suffering from gouts, euphoria and muscle relaxation. Though MRI provides image with better quality than regular x-rays and CAT scans for soft-tissues inside the body and uses very powerful magnet, there are no known alarming harmful effects. On the contrary its certain aspect on the magnewtotherapy may be explored.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-25

STUDY ON FLAXSEED OIL [*LINUM- USITATISIMUM*] AGAINST RADIATION INDUCED HEPATOTOXICITY IN MICE

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Abstract

It has been necessitated to develop potential drug of plant origin for the modification of radiation toxicity. Flaxseed (*Linum usitatissimum*), an annual herbaceous plant of Lineaceae family present all over the world is widely used for edible oil in many parts of India, Present study is an attempt to investigate the antiradiation and antioxidative potential of Flaxseed oil (FO). The optimum dose of flaxseed oil against lethal dose of radiation was determined 4ml/kg body weight. Swiss albino mice (6-8 weeks old weighing 23±3gm) selected from an inbred colony were administered orally FO for 15 consecutive days, once daily and were exposed to single dose of 5 Gy of gamma radiation at a dose rate of 1.07 Gy/min. Lipid peroxide, reduced glutathion and total protein were estimated in liver. In serum biochemistry; AST, ALT, acid and alkaline phosphatase were also carried out. Radiation induced augmentation in the levels of (LPO) lipid peroxidation, AST, ALT and acid phosphatase was significantly ameliorated by flaxseed oil pretreatment. Radiation – induced depletion in the level of GSH and alkaline phosphatase activities was checked significantly by flaxseed oil administration. The survivability in terms of life span showed a better picture in flaxseed oil pretreated and later irradiated mice in comparison to their respective control mice (irradiated alone). Statistically analyzed survival data yielded LD50/30 as 7.1 and 10 Gy for control and experimental (FO treated irradiated) respectively, and produced a dose reduction factor for flaxseed oil (DRF) = 1.40. Radiation induced deficit in the body and organ weight also checked and prevented significantly in the flaxseed oil pretreated mice. The results indicate that protection by flaxseed oil may be attributed by the content that are the main part of flaxseed oil like Omega 3 essential fatty acid, polyunsaturated fatty acid and lignan (a phytoestrogen) which appear to play an important role in free radical scavenger and singlet oxygen quencher.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-26

LOW LEVEL B-EXPOSURE FROM HTO ON THE DEVELOPMENT OF CEREBELLUM IN MICE

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Abstract

Tritiated water (HTO) exposure appears to impart significant but ambiguous effects on the cerebellum of Swiss albino mice during its prenatal, neonatal and postnatal developmental stages with respect to doses. Dose dependent reductions in the size and weight of the organ together with mild histopathological lesions and reduced number of cells were noticed. However, a dose dependent behavior clearly reflects that a continuous HTO-exposure at a dose level 11.1 kBq (0.3 μCi), though does not render an appreciable damage both qualitatively and quantitatively, it shows beneficial effect. Its detrimental impact gets intensified and causes lasting impairments in some of the studied parameters at a higher dose of 111.0 kBq (3.0 μCi)/ml drinking water. In cerebellum, where the cell renewal system is lacking, major cytoarchitectural changes occur mainly during the first three weeks after birth. This accounts for its high radiovulnerability *vis-à-vis* a capability to repair and recover from the rendered damage during the first half (1 week to 3 week) of postnatal development, whereas during the second half (4 week to 6 week of age) a tendency towards radioresistance is achieved. As the age advances and the animal approaches maturity, relatively lesser post- irradiation impairments become evident. With the advent of age after HTO-exposure many dark type Purkinje cells make their appearance along with the light type. The dark type Purkinje cells biochemically evaluated have been shown to possess more lipofuscin than the lighter ones only at higher doses. Radiotoxic effects of low doses of tritium on cerebellum are not consistent and apparently quite low with those expected from an equivalent absorbed dose from external X-irradiation. Therefore, the possibility of a hormetic effect of β exposure from HTO with regard to brain and especially cerebellum can not be safely ruled out.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-27

MODULATION OF RADIATION INDUCED BIOCHEMICAL CHANGES IN TESTIS OF SWISS ALBINO MICE BY *SPINACIA OLERACEA*

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Abstract

Increasing use of nuclear radiation for human welfare necessitates a new, safe and cost effective radio protector not only for personnel's charged with responsibility of testing or with radiations in laboratories, but also for the general public. Keeping this view, this study has been undertaken to find out the possible radio protective potential of the *Spinacia oleraea (*SE), its leaves have high content of carotenoids, proteins, minerals, vitamin C and high level of nutritionally critical amino acids lysine and methionine. For experimental study, healthy Swiss Albino mice were selected from an inbred colony and divided into four groups. Group I (normal) did not receive any treatment. Group II was orally supplemented (SE) once daily at the dose of 600 mg / Kg.b.wt / day for fifteen consecutive days. Group III (control) received distilled water orally equivalent to SE for fifteen days than exposed to 5 Gy of gamma radiation. Group IV (experimental) was administered orally (SE) for 15 consecutive days once daily and exposed to single dose of 5Gy of gamma radiation. Mice were sacrificed at different autopsy intervals viz. 1, 3, 7, 15 and 30 days and testis were removed for various biochemical estimations viz. LPO, protein, cholesterol and glycogen. Spinach extract pre - treatment renders protection against various biochemical changes in mice testis. Radiation induced augmentation in lipid peroxidation and cholesterol was significantly ameliorated by SE extract whereas deficit produced in protein content by radiation could be elevated.

Key words: *Spinacia oleracea*, Antioxidant, Testis, Radioprotection

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-28

ASSESSING INTAKE OF DEPLETED URANIUM USING GAMMA CAMERA

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Abstract

Depleted uranium (DU) is the waste product of uranium enrichment from the manufacturing of fuel rods for nuclear reactors. DU may also results from the reprocessing of spent nuclear reactors fuel. Potentially DU has both radiological and chemical toxicity. Due to its availability, low price, high specific weight, density and melting point as well as its pyrophoricity, it has a wide range of civilian and military applications. The most controversial use of DU is in the battle field. When DU bullet burns into tiny particles spreading out in the atmosphere, inhaled or ingested they would inter human bodies causing disastrous damage due to internal radiation exposure. Faced with DU ammunition used in our country and with the leak of appropriate instrumentation and calibration methods we were tested reliability and prepared gamma camera to be used for measurements of internal contamination of human body by DU. We supposed that gamma camera could be alterative for whole body counter (WBC). So properties and calibration way were reviewed and the results were compared with WBC results. Results obtained in this study indicate that gamma camera could be used for DU intake dosimetry in radiation accidents.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-29

ENZYMATIC ALTERATIONS IN RATS' BRAIN DUE TO LOW LEVEL MICROWAVE EXPOSURE

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Abstract

Enzymes are essential for many life processes. They are usually present in small quantities in living organism, but damage by any agent can cause a large scale perturbations in living beings. Of the enzymes investigated to date tow enzymes which are responsible for cellular growth have received increasing attention. We have selected two growth related enzymes such as ornithine decarboxylase (ODC), performs a rate-limiting step in the synthesis of polyamines and protein kinase C (PKC) is a key enzyme involved in the transduction of signals conveyed from membrane receptors to the intra-cellular region of action of hormones, growth factors and cytokines.

Present work describes the effect of low level continuous microwaves (2.45 GHz) on developing rat brain. 35 day old Wistar rats were used for this study. The animals were exposed 2 hr/day for 35 days at a power density of 0.34mW/cm^2 (Specific absorption rate 0.1 W/kg) in a specially made anechoic chamber. After the exposure, the rats were sacrificed and the brain tissue was dissected out and used for enzymatic assays. A significant increase in ornithine decarboxylase activity was observed in the exposed group as compared to the control. Correspondingly, a significant decrease in the calcium dependent protein kinase activity was observed. These results indicate that this type of radiation affects the membrane bound enzymes, which are associated with cell proliferation and differentiation, thereby pointing out its possible role as a tumor promoter.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-30

A UNIFIED BIOPHYSICAL MODEL DESCRIBE DIRECT INDIRECT ACTION OF IONIZING RADIATION

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Abstract

For a better description of survival curve to include all types of radiations at low, medium and high doses over a wide energy range, and to explain the model parameters in term of physical and chemical action. The idea of direct-indirect action of cell inactivation has been adopted and introduced into one of the most successful models, namely, the Repairable- Conditionally Repairable model **RCR**) after modifying the inactivation term to take into account the direct and indirect action, and the repair term is also modified to describe the repair process for each action.

The analysis of experimental data shows that the matching between the interaction along the track core and the spacing of the structure in the **DNA** to produce double strand breaks (maximum inactivation cross section) which confirms the domination of the direct damage mechanism. The attack of free radicals, produced by radiation; on the molecular targets represents single hit inactivation (single strand breaks **SSB** of **DNA**). The analysis has shown that this inactivation is a function of **LET** which refers to the indirect effects of radiation. The model has been investigated by comparing the experimental and theoretical values of direct indirect cross section $\sigma_{dir,and}$ σ_{indir}

Section C
Invited Abstracts
(Local Participants)

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-32

CURRENT APPROACHES TO MOLECULAR CYTOGENETIC BIOMARKERS TO DETECT RADIATION EXPOSURE

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Recent developments in genetics and molecular biology now allow detailed characterization of genetic alterations which are occurring in normal human tissues. Radiation induces a wide variety of DNA lesions, several of which may be converted into stable genetic alterations. Detection of a unique alteration caused solely by radiation presents a difficult problem. Thus it is of particular interest to develop molecular biomarkers that will be able to distinguish exposure to ionizing radiation from exposure to specific toxic chemicals, because the existing biomarkers are largely non-specific. There are several assays that are useful to detect radiation exposure. These assays primarily use peripheral blood lymphocytes as cellular surrogates for target tissues and can be used to detect many forms of DNA damages. Some of the assays that have been developed utilize cytogenetic techniques including the induction of sister chromatid exchanges, micronuclei, classical chromosome aberrations and premature chromosome condensation (PCC). Although classical dicentric and micronuclei assay produce a reliable estimation of radiation exposure, but are unstable with time after exposure and thus are not useful for biological dosimetry more than a few months after exposure or for assessing chronic or multiple exposures. Among available methods, PCC induced by fusion or chemicals, is an attractive method, alternative to metaphases to visualize the genomic material of the cells. Because the method is independent of the cell cycle, chromosomes can be condensed and visualized in any phase of the cell cycle; therefore, the sensitivity and the upper limit of radiation dose assessment with this method is higher than other cytogenetic techniques especially for biological dosimetry of highly irradiated individuals. However there are methods for biomonitoring of long term and protracted exposure, such as GPA, HLA and translocation assays. GPA and HLA are applicable to only 50% of the population and several other assays have not been sufficiently characterized to provide a reasonable estimate of their inter-individual variability. With the advent of fluorescence *in situ* hybridization (FISH) it is now possible to rapidly and accurately detect chromosome abnormalities such as stable reciprocal translocations in human cells. FISH is generally performed using a cocktail of DNA probes specific for the largest chromosomes which allow the detection of only 35% of all

translocations. However, scoring sufficient cells to enable accurate dose estimation is still a difficult task and can be accomplished only with appropriate automation. It is believed that comparative genomic hybridization (CGH) may be a potential candidate for identification of radiation specific aberrations. Specific locus assays may be developed to detect mutations in genes discovered using CGH. Another method under investigation and validation is the comet assay under neutral condition which allows detection of DNA double strand breaks and apoptosis. Linear dose response has been reported using this technique. Simplicity, rapidity and potential for automation are advantages of this technique over other routinely used or candidate methods.

Notable people from radiation history

Antoine Henri Becquerel (1852-1908)

1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-34

RADIATION PROTECTION REQUIREMENTS FOR HIGH-ENERGY RADIOTHERAPY EQUIPMENT AND TREATMENT ROOMS

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Medical applications of ionizing radiation are considered the largest man-made source of ionizing radiation exposure. Worldwide, about 2000 million diagnostic X- ray examinations and 32 million nuclear medicine procedures are carried out annually, and of about 10 million cancer patients 40-50 % receive radiotherapy (IAEA, 2002). The extensive use of Ionizing radiation in medicine is justified, as the benefits for patients are enormous and far exceeds the risks. However, in order to protect patients as well as radiation workers against harmful effects of ionizing radiation, several International organizations have established radiation protection guidelines.

In radiotherapy, the radiation emitted by high energy treatment equipment is extremely penetrating and the dose rates used are high. Despite their therapeutic value, the potential hazards of dealing with such ionizing radiations should never be underestimated. A key role of the Radiotherapy Physics Department is to provide advice to staff and patients about the risks and safe use of ionizing radiations. Instructions and procedures are prepared to be fully compatible with national and international guidelines. New radiation areas within the hospital, such as treatment rooms and radionuclide storage facilities must be carefully planned and regularly monitored. The safety standards relating to the safety of the use of radiation equipment and radioactive materials must be followed in designing buildings, parts of buildings, constructions and rooms. This work specifies the requirements for structural shielding, warning and safety arrangements, safety rules and equipment and radiation protection meters regarding accelerators, gamma beam therapy equipment, afterloading equipment and x-ray equipments in the range used in radiotherapy.

A key role of the Radiotherapy Physics Department is to provide advice to staff and patients about the risks and safe use of ionizing radiations. Instructions and procedures are prepared to be fully compatible with national and international guidelines. New radiation areas within the hospital, such as treatment rooms and radionuclide storage facilities must be carefully planned and regularly monitored. Careful control is kept of all radioactive materials kept on hospital premises At the same time, while new diagnostic equipment and techniques are bringing new benefits, some of the procedures involve the delivery of relatively high radiation doses to

patients. the International Commission on Radiological Protection (ICRP), however, there is considerable scope for dose reduction in diagnostic radiology and simple, low-cost measures are available for reducing doses without loss of diagnostic information. In addition, a number of radiation injuries in interventional radiology and accidental exposures in radiotherapy have been reported. These facts have focused attention on the need to improve the radiological protection of patients in diagnostic and interventional radiology, nuclear medicine and radiotherapy. One of the statutory objectives of the Agency is to seek "to accelerate and enlarge the contribution of atomic energy to health throughout the world". The Agency pursues that objective through, in particular, the Human Health programme of its Major Programme 2, "Nuclear Techniques for Development and Environmental Protection". This programme, with its predecessor Agency programmes, has made a significant contribution to the use of ionizing radiation in medicine by making the benefits accessible - through, inter alia, technology transfer - to large numbers of people, especially in developing Member States.

Structural Radiation Protection – Radiotherapy

Proposals for areas where irradiating apparatus and radioactive sources are to be used for radiotherapy purposes must be submitted to the Radiological Council for approval. The proposal must indicate the types of equipment or radioactive substances, the proposed workloads and work procedures, and where relevant, include detailed plans of building design and structural shielding. The proposal must show how this will ensure compliance with dose limits for staff and members of the public. For information relating to requirements for the structural protection of a premises (e.g. shielding of walls, doors, etc) containing radiotherapy equipment / radioactive substances, please choose the following link and then click "send" to email your request (the auto-generated subject line should indicate your request):

The safety standards relating to the safety of the use of radiation equipment and radioactive materials to be followed in designing buildings, parts of buildings, constructions and rooms. This Guide specifies the requirements for structural shielding, warning and safety arrangements, safety rules and equipment and radiation protection meters regarding accelerators, gamma beam therapy equipment, afterloading equipment and x-ray equipment in the range exceeding 25 kV used in radiotherapy. Despite their therapeutic value, the potential hazards of dealing with ionizing radiations should never be underestimated. A key role of the Radiotherapy Physics Department is to provide advice to staff and patients about the risks and safe use of ionizing radiations. Instructions and procedures are prepared to be fully compatible with national and international guidelines. New radiation areas within the hospital, such as treatment rooms and radionuclide storage facilities must be carefully planned and regularly monitored. Careful control is kept of all radioactive materials kept on hospital premises.

2. OBJECTIVE

To provide guidance on the application of radiation safety requirements to medical applications of radiation, i.e. exposure of patients, their comforters and volunteers exposed for biomedical research, as well as occupational and public exposure. This guidance is intended for regulators, users of radiation sources in medicine and experts in mission. Regulators are expected use it for reviewing applications for authorization and during the inspection of facilities. Registrants/licensees are expected to follow the guidance in order to comply with international safety requirements or equivalent national requirements. Experts recruited on IAEA missions to advise on the implementation of safety requirements are expected to use this document rather than their own national guidance.

3. BACKGROUND

During the review of the International Basic Safety Standards for the Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS), the current requirements on medical exposure will be reviewed in the light of recent developments in the medical area, such as the findings of the Malaga Conference in 2001 and the International Action Plan for the Radiological Protection of Patients, and the recommendations ICRP. In order to ensure an appropriate balance with the rest of the BSS, some of the BSS material on medical exposure may need to be moved to the new Safety Guide. The new Safety Guide will incorporate and update the material in the RSG- 1.5. Specific recommendations from the material provided in the three Safety Reports, Nos. 39, 40 and 38 on Applying Radiation Safety Standards to Diagnostic Radiology and Interventional Procedures using X rays, Nuclear Medicine and Radiotherapy respectively will also be incorporated into the Safety Guide.

4. OVERVIEW

The Safety Guide will provide recommendations on how to meet international radiation Safety Requirements in medical practices using ionising radiation. This will include advice to regulators on authorization, inspection and enforcement, as well as on the infrastructure and arrangements needed at national level to enable users to comply with these requirements, which go beyond the capability of individual users. Advice will be given to the users on strategies to meet the regulatory requirements, describing strategies to involve organizations, such as professional bodies, whose co-operation is essential to ensure compliance with the requirements for medical exposures. Examples, which to illustrate this point, will include the establishment of guidance levels for diagnostic medical exposures, acceptance testing processes for radiation equipment, calibration of radiotherapy units and reporting of accidental medical exposure. The Safety Guide will contain one part common to all medical applications and specific parts for each of the applications, which will be completed with more detailed advice, possibly in form of annexes.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-37

AN EVALUATION ON THE FRACTION OF NON-HIT CELL AND INTERPHASE DEATH

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The reason why RBE for cell killing fell to less than unity (1.0) with very high-LET heavy-ions (^{40}Ar: 1,640 keV/μm; ^{56}Fe: 780, 1,200, 2,000 keV/μm) was explored by evaluating the fraction of non-hit cell (time-lapse observation) and cells undergoing interphase death (calculation based on our previous data). CHO cells were exposed to 4 Gy (30% survival dose) of Ar (1,640 keV/μm) or Fe-ions (2,000 keV/μm). About 20% of all cells were judged to be non-hit, and about 10% cells survived radiation damage. About 70% cells died after dividing at least once (reproductive death) or without dividing (interphase death). RBE for reproductive (RBE[R]) and interphase (RBE[I]) death showed a similar LET dependence with maximum around 200 keV/μm. In this LET region, at 30% survival level, about 10% non-survivors underwent interphase death. The corresponding value for very high-LET Fe-ions (2,000 keV/μm) was not particularly high (~15%), whereas that for X-rays was less than 3%. However, reproductive death (67%) predominated over interphase death (33%) even in regard to rather severely damaged cells (1% survival level) after exposure to Fe-ions (2,000 keV/μm). These indicate that interphase death is a type of cell death characteristic for the cells exposed to high-LET radiation and is not caused by `cellular over kill effect'. Both NHF37 (non-hit fraction at 37% survival) and inactivation cross-section for reproductive death (σ[R]) began to increase when LET exceeded 100 keV/μm. The exclusion of non-hit fraction in the calculation of surviving fraction partially prevented the fall of RBE[R] when LET exceeded 200 keV/μm. On the other hand, the mean number of lethal damage per unit dose (NLD/Gy) showed the same LET-dependent pattern as RBE[R]. These suggest that the increase in non-hit fraction and σ[R] with an increasing LET is caused by enhanced clustering of ionization and DNA damage which lowers the energy efficiency for producing damage and RBE.

Key words: Over Kill Effect/ RBE vs LET Relation/ Heavy Ions/ Non-hit Cell/ Interphase Death

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-38

AN EVALUATION ON THE FRACTION OF NON-HIT CELL AND CELL DEATH AFTER EXPOSURE TO HIGH LET ACCELERATED HEAVY-IONS

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Abstract : The cosmic environment is considered to be a complicated mixture of high-energy photons and radiation particles such as iron ions. Highly energetic heavy-ions are known to contribute significantly to the estimated total radiation exposure during manned space missions. By attention to the ion clusters produced by high-LET radiation are not uniformly distributed, the possibility that such high LET radiation provides no ionization within the cell target (non-hit cells) and cells with multi hit events is higher.

The reason why RBE for cell killing fell to less than unity (1.0) with very high-LET heavy-ions (^{40}Ar: 1,640 keV/μm; ^{56}Fe: 780, 1,200, 2,000 keV/μm) was explored by evaluating the fraction of non-hit cell by observation of time-lapse photography and cells undergoing cell death by analyzing and calculation based on this and our previous data. CHO cells were exposed to 4 Gy (30% survival dose) of Ar (1,640 keV/μm) or Fe-ions (2,000 keV/μm). About 20% of all cells were judged to be non-hit, and about 10% cells survived radiation damage. About 70% cells died after dividing at least once (reproductive death) or without dividing (interphase death). RBE for reproductive (RBE[R]) and interphase (RBE[I]) death showed a similar LET dependence with maximum around 200 keV/μm. In this LET region, at 30% survival level, about 10% non-survivors underwent interphase death. The corresponding value for very high-LET Fe-ions (2,000 keV/μm) was not particularly high (~15%), whereas that for X-rays was less than 3%. However, reproductive death (67%) predominated over interphase death (33%) even in regard to rather severely damaged cells (1% survival level) after exposure to Fe-ions (2,000 keV/μm). These indicate that interphase death is a type of cell death characteristic for the cells exposed to high-LET radiation.

Key words: Heavy Ions/ Non-hit Cell/ Cell Death

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-39

SURVEY ON 20 YEAR ENVIRONMENTAL IMPACTS AND HEALTH EFFECTS THE CHERNOBYL NUCLEAR ACCIDENT

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Abstract
Explosions at the chemobyl Nuclear Power plant (Ch NPP) in the Ukraine early in the morning of April 26, 1986 led to considerable to radioactive materials externally from the radioactive could and from radionuclides deposited in the soil and other surface, and internally from inhalation during the cloud's passage and from re-suspended materials and consumption of contaminated food and water.
As the major health effect of chemobyl is an pain to the thyroid doses resulting from imtakes of ^{131}I, which were delivered within two months following the accident.

Key words: Nuclear accident, Chernobyl, Enviromental impacts, Health effect

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-40

RADIATION DOSE TO THE HANDS OF PERSONNEL WORKING WITH TC-99M IN THE ROUTINE CALIBRATION PROCEDURE AND USING AN AUTOMATIC RADIOACTIVE SEPARATOR (ARS) DEVICE

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In the course of preparation of syringe for applications in nuclear medicine, technologists are exposed to continuous doses of ionizing radiation, especially from Tc-99m gamma radiations. The increasing number of nuclear medicine examinations requires more attention of extremity doses of radio pharmacy staff members in nuclear medicine.

During Tc-99m syringes preparation the radio pharmacy has to be dispensed in to syringes after which the individual patient activity should be checked in the dose calibrator. During this routine calibration procedure, the hands of technologists are exposed to considerable amounts of radiation.

In this study to reduce this radiation we developed a calibration procedure using a device that we named it as the *Automatic radioactive Separator*. We tried to investigate the performance of this device comparing to the routine calibration procedure, regarding the absorbed dose to the hands of technologist, the precision of the calibration of the radio pharmacy activity and the time required to calibrate syringes. ARS device has two parts: mechanical module and a control module.

The empty syringe is inserted inside the mechanical part of the ARS device and this part is placed within the dose calibrator. Technologist can calibrate the syringes indirectly by control module.

Five experienced nuclear medicine technologists drew up syringes from an initial eluate of 9.25 GBq using the conventional technique and the new calibration procedure. All technologists had to calibrate syringes with 185 MBq, 370 MBq and 925 MBq. This procedure was repeated two times using the conventional technique and then using the ARS device. The equivalent dose to the hands was measured by Harshaw TLD-100 dosimeters.

The exact amount of radioactivity in the syringe and the time needed for the calibration procedure were also investigated. The reduction in equivalent dose using the new device compared with the routine procedure ranged from 2 to 10 time based on activity of the radio pharmacy and technologist's experience. Also upon the ALARA principle, ARS device can be recommended for syringe calibration in nuclear medicine because it reduces finger dose, improves the precision of calibration and reduces the filling time.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-42

INVESTIGATION AND MEASUREMENT OF RADON GAS WORKING LEVEL INDOORS OF RAFSANJAN BUILDINGS

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Abstract

Radon gas and its daughters are radioactive that radiate alpha particles with high energy. These particles if get into lungs, they can destroy the lung's inner tissue. This is one of the most important causes for lung cancer after smoking. In this paper, a report has been presented on the measurement of Radon's concentration by means of RWLM, based on EPA conditions in 68 houses which covers 0.23% of the houses in Rafsanjan city totally. The results of it, indicate the amounts of 0.35mWL and 33.43mWL as the least and most amount of concentration. Additionally, Radon's concentration in 5.12% of the houses is more than allowed measure.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-43

DOSE-RESPONSE RELATIONSHIP: CHROMOSOME ABERRATIONS IN RESIDENTS AT THE HIGH BACKGROUND RADIATION AREAS IN RAMSAR, IRAN

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There is not yet a solid dose-response relationship for chromosome aberrations induced by chronic exposure to elevated environmental levels of radiation in human. Among potential study populations, mostly occupationally exposed individuals, residents in areas with elevated levels of natural radiation may provide the most reliable information because more accurate dosimetry is possible and, unlike accidental exposures, non-radiation factors can be omitted. A linear relationship between the cumulative dose and the frequency of chromosome aberrations have been reported in residents at the high background radiation areas in China. People in some areas of Ramsar, a city in northern Iran, receive an annual radiation absorbed dose from background radiation that is substantially higher than the 20 mSv yr-1 that is permitted for radiation workers, and radon levels in some regions of Ramsar are up to 3700 Bq/m3 (over 100 pCi/L). For example, the residents of one dwelling in Ramsar, receive doses estimated to be at least 160 mSv yr-1, that is eight times higher than the dose limit for radiation workers. The people living in these high radiation areas are of considerable interest because they and their ancestors have been exposed to abnormally high radiation levels over many generations. Using chromosomal aberrations as the main endpoint, we carried out an experiment to assess the dose-effect relationship in the residents of high background radiation areas of Ramsar. A cytogenetical study was performed on 21 healthy inhabitants of the high background radiation areas and 14 residents of a nearby control area. Our preliminary results showed no positive correlation between the frequency of chromosome aberrations and the cumulative dose of the inhabitants. On the other hand, worldwide studies indicated that radon exposure is associated with human lung cancer. Investigations show that in some parts of Ramsar, indoor radon concentration is above the permissible levels. In this study lung cancer rate in all 8 districts that received the health services from 8 different centers was assessed. The results of this study surprisingly showed that lung cancer rate in a district with the highest level of natural radiation, was lower than the remaining 7 districts. It can be concluded that exposure to higher than normal levels of radon in dwellings of Ramsar does not result in increased lung cancer rate.

1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-44

STUDY OF MEAN GLANDULAR DOSE IN MAMMOGRAPHY IN YAZD AND THE FACTORS AFFECTING IT

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Backgrounds/Objective : The primary objective of this study was to determine the mean glandular dose (MGD) during diagnostic mammography in Yazd (a city of Iran) and compared with the other studies. The secondary objective was to evaluate some of the factors affecting MGD.
Patients and methods : The survey was conducted during May to Dec. 2005 to estimate (MGD) for women undergoing mammography and to report the distribution of dose, compressed breast thickness, glandular tissue content, and mammographic technique factors used. The clinical data were collected from 946 mammograms, of 246 women. These data included mammography from four modern units using a molybdenum (Mo) anode and either Mo or rhodium (Rh) filter. Exposure conditions for each mammogram were recorded. The breast glandular content was estimated from each of mammogram by the physicians colleague. The MGD was determined based on measured normalized entrance skin dose (ESD) in air, HVL, kv_p, mAs, of beam and thickness and glandular content of breast. The measurements of HVL, Kv_p and ESD accomplished by a solid state detector (Unfors, mult-o-meter). Instate of Dance or Wu conversion factors for calculation of MGD the analytical method of Wlad and et al was used.
Results: The mean MGD per film was 1.2 mGy and 1.67 mGy for the cranieocaudal and mediolateral oblique views, respectively. The mean MGD per woman was 5.57 mGy.
On the multivariate test two factors, namely half value layer of the X-ray beam and (CBT), had a significant effect on MGD per woman (p, 0.05). No significant relationships were seen between MGD per woman with respect to body mass index or age. The mean MGD per film of 1.45 that is almost lower than all of the references values but the mean MGD per woman is higher than the other references values.
Conclusion: we propose screening mammography for women in our city because dose per film is low, and accomplish quality control in diagnostic x-ray especially for mammography in other radiology centers of country.

Key words: mammography, MGD, Patient Dose, HVL,

Section D
Contributed Abstracts
(Local Participants)

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-46

RADON AND LUNG CANCER, SEARCH FOR A POSSIBLE ASSOCIATION?

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Radon exposure reperesent a significant cause of lung cancer which in most part of the world, after cigarette smoking is the second cause of cancer. High naturally occuring concentration of Radon in some parts of the world have risen the exposure to the inhabitance but with little or no harmful effects. On the other hand health effects in miners is well known.
Modern homes are quiet well seald against either air filtration or outflow of inside gases. In homes constracted in area with high concentration of Radon, one should logicly ask wether residents may or maynot face serious health problems. Since the cumulative radon progeny exposure is in related to lung cancer deathes in miners, exposure at lower level in homes, would carry some risk.
In assessing the risks of exposure to ionizing radiation, it is very important to estimate the level of hazards in different situations without over or understate the effects. The international standards have recommended a fairly concervative approach which can have both positive and negative concequences.
In summery, there is no questions about Radon carsinogenity in hummans. The point is whether the low Radon level in residential may increase the cancer risk or not? It seems this appear to remain hidden in the shadow.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-47

MICROWAVE RADIATION EFFECTS ON RADAR STATION WORKERS' HEALTH

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PURPOSE*: To evaluate the biological hazards of microwave radiation on radar station workers' health.*
BACKGORUND: Human use electromagnetic waves in several ways. However long-term exposure to these waves has potential hazards. Microwaves are non-ionizing electromagnetic waves, having a frequency range from 1 to 300 GHz and they have known biological hazards.
METHOD: A standard questionnaire for evaluating fatigue related signs, was distributed among 25 radar station workers, as the case group, and 18 administrative staff, as the control group.
RESULTS: Fatigue-related signs were significantly more common in workers group. Furthermore 8 out of 10 radar station workers were suffering from true fatigue.
CONCLUSION: This study is another evidence for relation between irregular fatigue and microwave. Regular measurement of radiation dosage and utilizing protecting procedures seem to be essential.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-48

RADIATION INDUCED APOPTOSIS IN HUMAN PERIPHERAL BLOOD LEUKOCYTES IN THE PRESENCE OR ABSENCE OF FAMOTIDINE AS ASSAYED BY THE COMET ASSAY

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Radioprotective effects of famotidine, an antagonist of H2 receptor clinically used for peptic ulcer treatment, was previously shown on radiation-induced micronuclei and chromosomal aberration in human peripheral blood lymphocytes and mouse bone marrow cells. This study was conducted to investigate radioprotective property of famotidine against radiation induced apoptosis in human peripheral blood leukocytes. Peripheral blood was obtained from 6 healthy volunteers including three males and three females. 12 µL of blood sample diluted in 1 ml RPMI-1640 supplemented with antibiotics and fetal calf serum was irradiated with various doses of gamma rays (4-12 Gy) generated from a Co-60 source at a dose rate of 1.27 Gy/min in the presence or absence of famotidine with different doses (50–200 µg/mL). After 48 h incubation in a 37 ºC incubator, cells embedded in low melting point agarose was transferred to a slide precoated with normal agarose. Cells were lysed and subjected to electrophoresis under neutral condition. Slides were then stained with ethidium bromide and analysed under a fluorescence microscope. 500 cells were analysed for each sample for presence of apoptosis. Data were statistically evaluated using Man-Whitney non-parametric and ANOVA tests. Results show a significant increase in apoptosis induction following 8 Gy γ-irradiation compared to controls ($p<0.001$). Presence of famotidine at 50 and 100 µg/ml did not show any protective effect against radiation induced apoptosis. But presence of famotidine at higher concentration (200 µg/ml) significantly deceased radiation induced apoptosis ($p<0.001$). This dose of famotidine was effective for all doses of radiation (4- 12 Gy) used in this study. These results suggest that famotidine suppresses radiation-induced apoptosis when used with different doses of gamma rays. The mechanism in which famotidine reduces radiation induced apoptosis might probably be via OH radical scavenging and an intracellular antioxidation mechanism. Furthermore, these observation show the involvement od DNA double strand breaks in the formation of apoptosis after irradiation. Famotidine appears to be a useful candidate for the future development of post-irradiation radioprotectors.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-49

SURVEY OF PATIENT DOSES FROM COMPUTED TOMOGRAPHY(CT) EXAMINATIONS IN THE AREA OF YAZD,IRAN

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CT is a diagnostic imaging device with higher patient dose in comparison with other radiological procedures.The reduction of exposures by requiring optimi- zation of CT procedures is principle concern in radiological protection.In this study, we apply European Commission Reference Dose Levels (EC RDLs) to CT exami- nations(conventional and spiral). The dosimetric quantities proposed in the European Guidelines(EG) for CT are Weighted Computed Tomography Dose Index(CTDI W) for a single slice and Dose-Lenght Product (DLP) for a complete examination .CTDI with an active lenght of 10cm was measured in 3 CT scanner by using UNFORS Detector(Mult-O-Meter 601) in a head and body phantom (PMMA) with 16 cm and 32 cm in diameter respectively.In STD mode,the CTDIW had a range of 15-31mGy for brain, 16-34mGy for neck, 9-15mGy for chest, 6-16mGy for abdomen and 6-16mGy for pelvis .The DLP had a range of 158-530mGy.cm for brain, 215-837 mGy.cm for neck,140-354mGy.cm for chest, 136-539mGy.cm for abdomen and 102-585 mGy.cm for pelvis.The mean values of ED were 0.8 mSv for brain, 2.5 mSv for neck, 3.1 mSv for chest, 4 mSv for abdomen and 5.4mSv for pelvis.In SPR mode, the DLP had a range of 115-240mGy.cm for brain, 222-656mGy.cm for neck, 100-164mGy.cm for chest, 126-312mGy.cm for abdomen and 126-338mGy.cm for pelvis. It was estimated that collective effective dose during the years of 2005-2006 was about 23138mSv- person.The results of listed above are lower than EC RDLs because of low mA selection and no large scan length in camparison with other departments. CTDI W and DLP for STD were signifantly higher than SPR.It is anticipated that manipulating in exposure parameter will reduce patient dose without considerable effect on image quality for example changing pitch factor from 1 to1.5 caused to 33% reduction in patient dose.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-50

BANDAR ABBASS OF GACHIN IS A AREA WITH HIGH BACKGROUND RADIATION BUT!!!!!?

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Ionizing Radiation is present in all environment of the Earth's surface, beneath the Earth and in the atomosphere. Human beings are expose to external Radiation and Radiation from the naturally occurring radionuclides. In their immediate surroundings and also to internal radiation from food, water and air they consume. Then it is important to measure background radiation.
We in this study for evaluation risks of radiation investigation in the out door and in door and hot spring in BandarAbbas of Gachin area.
Equipment used in this work is environmental radiation meter type 6-80.
Inorder to determine out door and in door dose rate, in door measurement in Gachin area were carried out inside 115 dwelling.
Measurements for hot spring waters were carried our at on meter above meter level.
Dose rate were recorded for one hour. Our results indicate the out door dose rate of Gachin area is higher than the global mean. Also upper Gachin has the highest out door background radiation (78.87 nGy/h) and lower Gachin has the lowest out door background radiation (71.62 nGy/h). Also in door dose rate mean of Gachin area is higher than the global mean.
Estimated in door dose rate mean for lower Gachin (110.58 nGy/h), upper Gachin (111.83 nGy/h), Ship industry dwelling (109.30 nGy/h) and Jamal Ahmad (107.84 nGy/h). The highest dose rate estimated for a dwelling in Jamal Ahmad (198.33 nGy/h). The highest dose rate above hot spring was obtaind from Chostane (1319.5 nGy/h). No relation between the location of dwelling with high dose rate and their distance from the uranium mine was found.

Key words: Gachin, Absorbed dose rate, Ionizing radiation

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-51

EVALUATION OF STATUS OF RADIOGRAPHY SECTIONS: RADIATION PROTECTION AND IMAGE'S QUALITY.

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An important goal in radiography is to obtain the best image by delivering the least radiation dose to the patient. There is no doubt that by implementing radiation protection regulations, the radiation dose which received by the patient can be controlled. Reduction of image quality may cause repetition of X-ray examination which in turn leads to extra and unnecessary radiation dose to the patient.

This study was an attempt to evaluate the status of 51 radiological centers according to some parameters affecting the quality of images and the radiation dose delivered to the patient. The concerning factors were X-ray department radiation safety, condition of dark room and operation of film processor according to standards, availability and proper use of safety shields and radiation warning signs, technician knowledge and practice of self and patient protection.

Our investigations showed that these centers had neither standard dark room nor proper warning signs. There was no record or any type of proper archive related to radiation protection of staff in 89% of these centers. About 82% of X-ray rooms and 77% of preventive covers had some faulty sections and 37% of them had radiation leakage.

This investigation has shown that a great number of X-ray departments throughout the country practice without proper supervision. On the basis of these findings regular monitoring of X-ray departments and implementing radiation protection regulation are recommended.

Key words: Radiation protection, Image quality, X-ray sections.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-52

^{226}RA CONCENTRATION IN THE TEETH OF HABITANTS OF AREAS WITH HIGH LEVEL OF NATURAL RADIOACTIVITY IN RAMSAR (1383-84)

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The level of natural radiation, in some regions of Ramsar –a northern coastal city of Iran- is known as one of the highest level of natural radiation in the world. ^{226}Ra, a radioactive element which exists in high concentrations in soil of region, is washed by underground waters and transferred to surface. In this way, ^{226}Ra enters into food-chain of residents and substitutes in hard tissues of human body. The objectives of this research were to determine the concentration of ^{226}Ra in teeth of people residing in high level natural areas, compared to control group and to assess "emanation system", as a method for measurement of concentration of ^{226}Ra compared to "liquid scintillation system". The method of research was sample collection. Samples were studied in five groups of cases and compared with five control groups. ^{226}Ra was separated from tooth tissue through chemical processes and determined by emanation and liquid scintillation systems. The average ^{226}Ra concentrations measured by liquid scintillation system in teeth of people residing in high level natural radiation areas, was 0.32 mBq/gr and in control group was 0.16 mBq/gr. Emanation system could not measure ^{226}Ra concentrations in both groups. ^{226}Ra concentration in teeth of people residing in high level natural areas is higher than that in control area and liquid scintillation system is capable of determining very low concentrations of ^{226}Ra in tooth.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-53

ADVANTAGE OF SLIT SLAT COLLIMATOR IN GAMMA CAMERA AND SPECT IMAGING

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Using conventional collimator, in gamma camera imaging, less than 2 in about 10,000 photons are typically detected. In other words we don't make sufficient use of gamma-rays emitted from the patient and to be able to acquire a good quality image we have to inject a considerable amount of radioactive material to the patient which in some special cases such as pregnant woman and children is not acceptable. Minor improvement in collimator performance can significantly affect the number of detected events and statistical noise in the image. Two most important factors in gamma camera and SPECT imaging are geometric efficiency and spatial resolution, but there is a trade off between these two factors. The aim of this study was to simulate a Slit Slat (SS) collimator and to evaluate the advantage of this collimator over the conventional parallel hole collimators while maintaining the quality of images, using these two different collimators, the same. SS collimator is made of parallel hole plates (slat) and provides collimation in the direction perpendicular to the slat and no collimation parallel to the slat direction. A gamma camera system with both parallel hole collimator and SS collimator was simulated by Monte Carlo method (MCNP). In this simulation parameters of the simulated system having 3/8 inch thick NaI(Tl) crystal for 140 keV gamma rays with parallel hole collimator were compared with practical results and a good correlation was found between the simulated and practical results. In this way the performance validity of our simulation code was confirmed. The simulated SS collimator consists of 50 led plates of 0.2mm thick, 60mm high arranged at 1.5mm spacing. The imaging was performed by rotating the SS collimator for 180 degrees in 73 steps. The physical parameters such as spatial resolution and efficiency of the gamma camera were evaluated. The value of these parameters were compared with the same system using parallel hole collimator. The efficiency of the system with SS collimator after background subtraction was measured to be 36 times higher than efficiency of the system with a conventional hexagonal LEGP parallel hole collimator for 140keV gamma ray imaging, whereas in this case the spatial resolution for the gamma camera with the SS collimator and the LEGP collimator was 9.6±0.5mm and

8.8±0.5mm respectively. The amount of increase in efficiency has two reasons: first, as mentioned above in the SS collimator there is no collimation parallel to slat direction. Second, the wide geometric acceptance of this collimator in the slat direction allows oblique gamma rays to have a longer path length in the crystal which will enhance the attenuation, and thereby raise the low detection sensitivity of the thin gamma camera crystal. The result of our simulation showed that using SS collimator has a profound effect in increasing efficiency while the spatial resolution was comparable with the system using the above mentioned conventional collimator. The higher efficiency can reduce the image noise considerably. Also due to this great efficiency, using alit slat collimator, we are empowered to reduce the scan time by a factor as much as the increase in the efficiency which can lead to reduction of patient motion and an increase in patient throughput. Alternatively we can give a much smaller amount of radiopharmaceutical to the patient and consequently reduce the patient and staff radiation dose. The results of this study showed that SS collimator have great advantage over the conventional parallel hole collimators in gamma camera and SPECT imaging. The only disadvantage of utilizing SS collimator is a need for addition of extra mechanical devices to the system for rotating collimator.

Key words: slit slat collimator, spect, monte carlo simulation, time of imaging, human dose.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-55

BONE MINERAL DENSITY MEASUREMENTS USING MRI RELAXOMETRY

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Osteoporosis detection has been done by Bone Mineral Density (BMD) measurements by an ionization method: Dual-energy X-ray Absorptiometry (DXA). Cortical and trabecular bone separation cannot be performed in DXA, so the results might lead to erroneous interpretation of BMD values. Magnetic Resonance Imaging (MRI) used non-ionization Radio Frequency (RF) pulses. The MRI relaxometry method derives R2 (=1/T2), R2* (=1/T2*) and R2' (=R2*-R2) transverse relaxation rates from MRI images. The aim of this study was to use MRI for the BMD measurements using standard pulse sequences. This study was performed by 1.5T GE-Signa MRI system at imaging center of Imam Khomeini hospital, Tehran, SNR phantom (1.25g/l $CuSO_4$, with T2=200ms for calibration), a body RF-Coil, 20 females (33-84yr) and Lunar DPX-MD DXA system at endocrinology and metabolism research center in Shariaati

hospital, Tehran. To determine R2* and R2, several Gradient-Echo (GRE) and Spin-Echo (SE) pulse sequences with different Time of Echo (TE)/Time of Repetition (TR) were analyzed. The calculated R2 and R2* using SNR phantom were compared with desired amounts. Then in coronal section of femoral-neck, relaxation rates were compared with BMD. Therefore, for R2* measurement dual-echo standard GRE pulse sequence with TE=8.4,16.8ms, TR=800ms, Matrix=190x256 and Slice-Thickness (ST)=8mm and for R2 measurement 4echo standard SE pulse sequence with TE=16.8,33.6,50.4,67.2ms, TR=800ms, Matrix=190x256 and ST=8mm were selected. R2* and R2' showed a significant positive correlation with BMD ($r=0.60$, $p<0.05$). Finally, in accordance with DXA values, the results showed that 4echo standard SE and dual-echo standard GRE are proper pulse sequences for BMD measurements in femoral-neck.

Key words: Osteoporosis, BMD, DXA, MRI, Relaxometry, GRE, SE

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-57

MAMMOGRAPHY QUALITY CONTROL FOR IMPROVING IMAGE QUALITY AND DECREASING PATIENT ABSORBED DOSE

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Breast cancer is one of the most common cancers in women above 40 years old. Film-screen mammography with high and good image quality have now almost completely replaced the other methods for breast disease diagnosis.
The primary goal of mammography quality control program is to ensure the consistent of prompt and accurate diagnosis of patients. This goal will be adequately met by setting a good QA program.
In this project we have done a series of standardized QC tests at 8 mammography centers. After detecting all changes and deficiencies we have tried to calibrate all part of those mammography systems.
QC tests in this project includes visual checks, image quality and contrast, kVp and mA accuracy, AEC accuracy, reproducibility, film-screen contact, HVL, compressor compression, mean glandular absorbed dose, developer and fixer temperature, Hypo replacement, and darkroom tests. Results show that all of those centers have some deficiencies at their darkrooms, 87.5% at their imagining equipment and 37% of those centers have height mean glandular dose.
After calibration at those could be optimized, image quality have been increased from 62.5% to 87.5%, image contrast from 12.5 to 62.5% and mean glandular dose was decreased up to 0.5 mGy. After evaluation of results we have found that by performing a regular quality control program, good mammograms with high quality images and low patient dose can be obtained.

Key words: mammography, quality control, Radiation protection, Image quality.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-58

ASTUDY OF CHROMOSOMAL ABERRATIONS IN RADIOLOGICAL TECHNOLOGISTS PERIPHERAL BLOOD LYMPHOCYTES IN YAZD STATE HOSPITALS.

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In this study a comparison was made between the chromosomal aberrations rate of 46 radiological technologists peripheral blood lymphocytes (31 males and 15 females) with an age average of 33.1 ± 1.4 and 35 native Yazd subjects of the control group (19 males and 16 females) with an age average of 35.4 ± 3.6 . The blood sample was transfered to cell culture (1640 RPMI) and then by adding fitohemaglutinine incubated at 37◦c with 5% co_2 for 68 – 72 hours .

Then by adding colcemid cell division was blocked in metaphase . After the preparatory stages the slides were obtained and stained with gimsa and using the standard Method of International Sociaty of Genetics (ISCN 1995) , 3564 & 2632 mataphase cells obtained from radiological technologists and controls were prepared , respectively . 108 cells of the experimentes subjeets and 46 cells of the control subjects showed chromosomal aberrations in cloding 3.03 % and 1.74% of the cells , respectively.

The rate was higher in the radiological technologists which was statistically significant . (P – Value = 0.001). There was a meaningful correlation between radiological profession and chromosomes aberrations.

Key words: chromosome , Aberrations , Radiological , Yazd

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-59

DETERMINATION OF ACTIVITY FROM ^{40}K IN FOODSTUFF AND CALCULATION OF ABSORBED DOSE IN THE HUMAN BODY IN ARAK IRAN

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potassium40 is a natural radionuclide with long half-life about 1.28 billion years and it's abundance is 0.012 percent in natural potassium. Potassium is an important constituent of soil, it is widely distributed in nature and is present in all plant and animal tissues. Potassium-40 is a naturally occurring radioactive isotope of potassium. Determination of activity in foodstuff is very important, Because potassium-40 after entrance in human body behave as a internal radioactive source that cause to destructive effect on the organism. in this experience we measured the activity of potassium-40 in different samples of foodstuff. Eating some foods that contain potassium can increase the mass of potassium-40 in human body for certain time. at least we calculated the amount of effective dose before and after eating food.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-60

IMPRESSION OF SIMULATED MICROGRAVITY CONDITIONS (CLINOSTAT) ON RADIATION-INDUCED CHROMOSOME ABERRATION

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PURPOSE: To present an evidence-based review of contemporaneous effects of microgravity and radiation on cells' nucleus.
DESIGN: Literature review of published articles in peer-reviewed journals and medical texts.
METHOD: Pre-Medline and Medline search of relevant English and French language articles from 1980 to present on the accumulative effects of radiation and microgravity on DNA mutation. Cosmic radiation has harmful biological effects (such as Development of cancer, Genetic risk and threat of foetus health), but its exact impression have not known yet. Some drug like bleomycin can mimic radiation's effects on biological systems. Microgravity also has undesirable influences (for example osteoporosis & muscle atrophy) on alive organisms. Clinostat or Random Positioning Machine (RPM) is a good simulated microgravity condition.
RESULTS: Under simulated microgravity conditions, the levels of both symmetrical and asymmetrical (dicentrics, rings) aberration, the ratio symmetrical:asymmetrical translocations, the number of cells bearing "complex" aberrations and hence the total numbers of aberrations induced by bleomycin & X-ray were significantly elevated. In addition, the 'fast component' of DNA repair, namely DNA double strand breaks (DSB) and single strand breaks (SSB) which are causing chromosome-type aberrations immediately after irradiation through mis-repair or mis-rejoining of DSB are affected. On the contrary, the 'slow component' of X-ray-induced DNA repair, namely excision repair caused by base damage and inhibited by ara-C is not affected by simulated microgravity.
CONCLUSION: With due attention to simulated microgravity conditions intensify radiation-induced chromosome aberration, it could anticipate that cosmic radiation and microgravity have similar interaction in real space environment and increase destructive impression of each other on DNA. Probably, these two factors strengthen their effect on alive cells in space, so we should protect them against these joint harmful effects.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-61

CARDIOLOGIST'S HAND DOSE MEASUREMENTS IN INTERVENTIONAL RADIOLOGY

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Abstract: An evaluation was performed to determine the distribution of the radiation dose received by vascular/interventional radiologists, henceforth called cardiologists, to their hands and arms during interventional radiology procedure. Measurements of the radiation dose to the hand were conducted using thermoluminescent dosimeters for individual interventional radiology cases to determine the distribution of dose to the hands and forearms. Measurements were made on a finger, the palm, wrist and the elbow of both hands and arms. Results suggested that a non-uniformity of dose with the maximum dose being measured on the hypothenar and elbow of both hands. The left hand receives a higher dose than the right hand due to positioning of the radiologist with respect to the patient. Due to variable hand positions during clinical examinations, fluoroscopy time was not found to be a good indicator of hand dose.

Key words: hand dose, exposure, radiation, x-rays

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-62

A MONTE CARLO DESIGN STUDY OF A SYSTEM FOR BORON NEUTRON CAPTURE THERAPY (BNCT) BY MCNP CODE

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Abstract : Boron neutron capture therapy (BNCT) is an ideal theoretical radiation treatment used for tumors. A ^{10}B compound is located in the tumor cells which must be irradiated with low energetic neutrons. The effect of the treatment is based upon the high linear energy transfer (LET) radiation, α particles with 2.3 (Mev) energy and recoiling ^{7}Li nuclei, released in the ^{10}B (n,α) ^{7}Li reaction in thermal neutron energies. The ionization energy released by the products of this reaction causes a high dose in the local area of the ^{10}B compound, which accumulates in the tumor cells. BNCT has been used experimentally for resistant brain tumor, liver tumor and melanoma treatments. The Monte Carlo code MCNP has been used to design a neutron system for BNCT consists of a ^{252}Cf neutron source, a moderator which is surrounded by a reflector and a shield. Neutron beams of different energies have been simulated and the dose distribution in the soft tissue, such as brain or liver, has been calculated with the MCNP simulation code. Furthermore, in order to obtain the optimal neutron energy spectrum, various moderator designs performed using MCNP simulations.

Key words: BNCT, MCNP simulation code, ^{10}B (n,α) ^{7}Li reaction, dose distribution.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-63

NON - IONIZING RADIATION EFFECTS OF ELECTROMAGNETIC FIELDS ON THYROID HORMONES IN GUINEA PIGS.

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Developing technology and industry and increasing application of electromagnetic fields in medicine, all days the fields with various intensities threaten the environment and human health. Biological effects of these fields depend on the field magnitude, time of exposure and physical characteristics of exposed tissue. In order to research the effects of electromagnetic fields on thyroid hormones, electromagnetic field generator was made with intensities of 0.013μT; 5 Hz, and 0.207 μT, 50 Hz. 36 adult male Guinea pigs used that divided to 6 groups.

Group A as control group exposed to nil electromagnetic field for two hours per day for 5 days duration , group B exposed to 0.013μT in 5 Hz to the Same duration period , group C exposed to 0.207 μT in 50 Hz in similar condition , group D exposed for Four hours per day for 5 days in 0.013 μT , group E tested in 0.207 μT as group D , group F used as controlled group exposed for Four hours per day in nil electromagnetic field .In fifth day blood samples from the Guinea pigs were taken. Blood samples were collected in plain tubes allowed to coagulate and the serum fraction was recovered .The concentration of thyroid hormones were determined by RIA and for statistical analysis we used a "one-way ANOVA test" and "Dunnet test".

The results showed that group B lead to decrease T_4 hormone for reason of increase inhibitors of bind T_4 to thyroxin binding globulin and E group lead to increase T_3 hormone because 5′ deiodinase enzyme increased.

Key words: Guinea pig –Thyroid hormones –Electromagnetic field

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-64

PATIENT DOSE MEASUREMENTS IN INTERVENTIONAL RADIOLOGY

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Abstract: The use of X-ray in cardiac interventional radiology has the potential to induce deterministic radiation effects on the patient's body and organs. An investigation was performed to determine the distribution of radiation dose received by the patients during the interventional radiology procedure. Measurements of the radiation dose to the patients were conducted using thermoluminescent dosimeters for individual interventional radiology cases. Measurements were made on thyroid, gonads and both anterior and posterior aspect of the heart. Results suggested a non-uniformity of dose with the maximum dose being measured on the posterior aspect of the heart which shows the Entrance Skin Dose (ESD). Results from these examinations using identical equipments show that the minimum dose is absorbed by the gonads which indicate that the absorbed dose varied inversely with the distances form the entrance dose area.

Key Words: patient dose, exposure, radiation, x-ray

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-65

EVALUATION OF ABSORBED DOSE TO INDIVIDUALS LIVING IN SHIRAZ FROM URANIUM CONTENT OF SOIL USING A DOSE CALCULATOR

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Abstract: Naturally occurring radionuclides (mainly Ra-226, Th-232, and their decay products and K-40) are sources of external and internal radiation exposure to man.Soil and building materials contain these radio nuclides and cause indoor and outdoor exposure to gamma radiation and inhalation of the short-lived daughter products of radon-222. Radionuclide content in building materials used in Iran has been determined previously by Mehdizadeh. Also the indoor and outdoor concentration of Rn-222 was studied by Mehdizadeh .In the present study ,using these data and "uranium in soil individual dose calculator " the radiation risk for an individual living in Shiraz was estimated.The result of this study indicates that annual effective dose of external exposure and annual effective dose from inhalation of radon to individuals were 73.3 μsv and 107.9 μsv respectively.

Key words: Radionuclide, dose, external exposure, dose calculator

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-66

DESIGN AND CONSTRUCTION OF A MEASUREMENT DEVICE FOR EXTREMELY LOW FREQUENCY (ELF) ELECTRIC AND MAGNETIC FIELDS

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Abstract

Nowadays, the electromagnetic waves play a vital and important role in human life and because of extensive usage in medical and industrial fields, their biological harmful effects produce some problems for human beings and environmental.

The ELF fields are an important part of non-ionizing electromagnetic waves. ELF electric and magnetic fields are produced in the vicinity of power plants, transformers, induction furnaces, magnetic particle testing devices (a method of non destructive test), and finally any plant or instrument using high current or high voltage.

Being sure of living or working safely in environments free of high levels of ELF electric and magnetic fields is necessary in Iran related to "Radiation Protection Act". So field assessment should be done, and it is needed to measure electric and magnetic fields intensities .For this purpose, designing and construction of the device has been performed.

This device has some specification as follows:

- Separate measurement of the electric and magnetic fields.
- Least perturbation of the fields.
- Exact measurement of the field intensities of all waveform.
- Possible construction with available equipments in market.
- Fast troubleshooting and high accuracy.

Electric field sensor, made of two parallel copper plates, produce a signal proportional to the electric field intensity and magnetic field sensor, made of a coil, produce another signal proportional to the magnetic field intensity and an LCD displays them separately. This device can measure the electric and magnetic fields of all wave forms and its monitoring circuit can be used for both electric and magnetic fields.

1st Human, Life and Radiation Conference
29-31 October 2006
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BIOLOGICAL EFFECTS OF RF RADIATION FROM GSM MOBILE TELEPHONE BASE STATIONS

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Abstract: There has been a proliferation of base station towers in recent years due to an expansion of mobile telephone networks. This has been accompanied by an increase in the level of community concern about possible health effects from the radio frequency (RF) radiation emissions from antenna mounted on the base station towers. In this paper, we study about of biological effects of RF energy; especially effect of base station transmitter/antennas for mobile phones, and other types of portable transceivers to human health. Mobile phone base stations are low-power multi-channel two-way radios and mobile phone (cell phone) is a low-power, single-channel, two-way radio. Because mobile phones and their base stations are two-way radios, they produce RF energy (that's how they communicate), and they expose people near them to RF energy. However, because both the phones and the base stations are low power (short range), the RF energy exposure levels from them are generally very low. At the extremely high frequencies characteristic of X-rays, electromagnetic particles have sufficient energy to break chemical bonds (ionization). This is how X-rays damage the genetic material of cells, potentially leading to cancer or birth defects. At lower frequencies, such as those used by mobile phones and their base stations, the energy of the particles is much too low to break chemical bonds. Thus RF energy is "non-ionizing". Because non-ionizing radiation cannot break chemical bonds, there is no similarity between the biological effects of ionizing radiation (x-rays) and RF energy.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
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EFFECTS OF OCCUPATIONAL EXPOSURE TO ELECTROMAGNETIC FIELDS ON MENTAL HEALTH

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Background & Objective: In psychological studies exposure to electromagnetic field is one of the hazardous factors, which has adverse effects on mental health. Exposure to electromagnetic field due to daily use of electricity makes this study so important.
The goal of this study was to determine the relationship between psychological symptoms and occupational exposure to electromagnetic field among workers at High Voltage Substations.
Method: Sampling included 103 workers exposed to electromagnetic fields. The prevalence of psychological symptoms was evaluated among electrical workers and the SCL90-R questioner completed during an interview .The control group was not occupationally exposed to electromagnetic fields or not residence of transmission line.
Results: This study indicates increased symptoms including depression; anxiety, hostility, paranoia, interpersonal-sensitivity, and obsession- compulsion were observed among exposed workers. A significant relationship was observed between the exposure of electromagnetic field and psychological symptoms($p < 0.05$).
Conclusion: - Exposure to electromagnetic field increased the risk of disorders in susceptible workers. For mental disorders, especially depression, the cognitive therapy is suggested.

Key words: Psychology, Electromagnetic fields, and Occupational Exposure

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-69

VIRTUAL PHOTON SOURCE DEFINITION IN MCNP4C MONTE CARLO CODE FOR DOSE CALCULATION

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Background: The major drawback of clinical uses of Monte Carlo dose calculation is the time that is needed for particle transportation through the Linac head, spatially generation of bremsstrahlung photon beam. Definition of virtual photon source can reduce time of dose calculation in Monte Carlo method. The verification of this source is depending on the accuracy of radial, angular and energy distribution photon fluence. Defined Virtual source must be efficient and provide accurate result.

Method: Virtual source is defined by isocenter circles with increasing distance from the beam central axis up to 3.5cm under target and primary collimator. Radial, angular and energy distribution of bremsstrahlung photon beam is computed after complete stimulation of particle transportation that is reached to scoring plates. Virtual source varieties are derived from the different intervals of any distributions then we introduced minor and major for each distribution. Radial distributions defined by two methods: one by area ratio and the other by influence ratio on each sub-source. Totally 16 virtual sources are defined for each scoring plates. The method that is used for verification of each source is based on absorbed dose comparisons of measured and calculated depth-dose and dose-profile curves. The influence of MCNP4C Monte Carlo code parameters for production of bremsstrahlung photon beam and accuracy of defined virtual source are also investigated.

Results: Depth dose and dose profile were affected by minor angular distributions than major spatially for source under target. Less influence was observed in depth dose profile or depth dose curves with respect to energy spread variations. Radial distribution that is defined by influence ratio is provided better result than area ratio. The accuracy of Monte Carlo results can be able to produce absorbed dose distribution with accuracy ±2% for depth dose curves and ±2mm for depth dose profile.

Conclusion: The findings in this study indicated that we can define phase space for MCNP4C with tally 1. we can use the resulted stimulation for defining of accurate and efficient virtual source.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
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CALCULATION OF BODY MASS ATTENUATION COEFFICIENT IN HWZPR CRITICAL REACTOR GAMMA SPECTRUM

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Abstract: Gamma ray mass attenuation coefficient is parametric that directly depend on absorbed dose gamma shielding specification. This coefficient include three phenomena of gamma reaction with elements such that photo-electric, Compton and pair production. HWZPR, heavy water research reactor with 100 W maximum powers in criticality, generate gamma and neutron ray from different reactions of reactor core. Neutrons from the core participate in different nuclear reactions by interactions with fuel, moderator, graphite and the concrete around the reactor. The results of these interactions are the production of prompt gamma in the environment. Reactor gamma ray spectrum has been gathered in different placed around the reactor by HPGe detector. Useful information is guided by the reactor gamma spectrum measurement from point of view of relative quantity and energy distribution of direct and scattered radiations. In this paper, the defining of body elements and weight percent them with reactor gamma spectrum (1 KeV up 11 MeV) for Xcom code, reactor prompt gamma mass attenuation coefficient values were been calculated for phantom body.

Key words: body mass attenuation coefficient, HWZPR research reactor, reactor prompt gamma, Xcom code

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
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STUDY ON THE PERFORMANCE OF RECOMMENDED STANDARDS IN THE DIAGNOSTIC RADIOLOGY UNITS OF THE HOSPITALS AFFILIATED TO THE MAZANDARAN UNIVERSITY OF MEDICAL SCIENCES

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Abstract : The aim of cleaving medical services to the public is to provide them their needs which are very important.
The sensitivity of such services is to such are extent that in case of lock of care, the hazardous in too high. In evaluation of health services the first thing is to evaluate the device used. Methods, efficiency, profits and their combination for prevention eradication of diseases. There fore to gain this goal, it is necessary the obtained results be compared with recommended standards. Purpose of this study was to study the conditions of radiology units and compare with the standards of ICRU NCRP and ICRP. Since radiology Unit is the most expensive for its instruments, manpower and space provided. Different variables have been considered to evaluate the condition of diagnostic unit radiology Unit. Referring to the latest standard, questionnaire was designed composing of there sections, first section for space provided, second about personal data and protective device for patients and staff and the third for radiology instrument and of dark room devices Also detective dose meter and thermometer were used. The collected data were compared with the standards, in this way, the instruments were evaluated qualitatively.Data were collected through, observation, interviewing and filling questionnaire. Results show that, the situations of the radiology units are for from international standard, to such an extent that it is matched clout 50%.The results showed that, none of the dark rooms are standard, and do not have proper alarm signal. In 63% of these units there no tiling system about staff protection from radiation.
Defects in radiography room, protective barrier and lack looking rays were 60%, 51% and 47% respectively. Referring to the obtained data, periodic supervision, and obeying of the standards are necessary.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-72

RADIONUCLIDE EMISSION MONITORING AND ESTIMATION OF DOSE AND RISK FOR A TYPICAL RESEARCH REACTOR IN NORMAL OPERATION BY CAP88-PC

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Abstract

Nuclear reactor facilities are the source of radiation that release radioactive materials through their exhaust ventilation stack to air. Therefore, radionuclide emission monitoring and estimation of radiological dose and risk should be evaluated for the protection of personnel, public and environment. These results should be confirmed compliance with standards.

In this paper, **CAP88-PC** computer code (based on EPA standards) has been used to radionuclide emission monitoring and estimation of dose and risk for a typical research reactor in normal operation. CAP88 uses Gaussian plume model to estimate the average dispersion of radionuclide release from emitting source. This code requires environmental and radionuclide data to calculate radionuclide concentration and public dose assessment in different distances from the reactor.

Key words: Nuclear Reactor, Gaussian model, Dose, Risk

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-73

ASSESSMENT AND ANALYSIS OF EXPOSED DOSES RECIVED BY THE PUBLIC

Living Around A Sampel Research Reactor In Occourance Of A Design Basis Accident By Hotspot Code

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Abstract

One of important factors for assuring of safety for nuclear reactors is the assessing of exposed dose recived by public in Design Basis Accident (DBA). In this regard, Gaussian diffusion model is a useful method in bioenvironmental study of industrial and power plant regions. This method is used to analysis of preliminary and formally and assessing of contaminated material's concentration and critical doses in the atmosphere and individual/ public doses estimation in nuclear power plants and research reactors regions. In this paper, Hotspot health physic code for analysis of values released and diffused of radioactive materials from exhaust ventilation stack of a sample research reactor in design basis accident simulated and individual dose for different age groups at different distance is calculated. Total exposure as a result of integrated internal and external radiation of inhalation, submersion and groundshine for persons living around the region have been calculated. Generally, developing of such methods for bioenviromental assessments in research reactors as regards keeping enviroment against nuclear radiotion in concern regions are important and necessary.

Key words: Dose Assesment, Research Reactor, Gaussian Diffusion Model

1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-74

SURVEY OF CONVENTIONAL AND SPIRAL CT DOSES IN YAZD, IRAN

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Purpose: While the benefits of Computed Tomography (CT) are well known in accurate diagnosis, those benefits are not without risk. CT is a device with higher patient dose in comparison with other radiological procedures. The reduction of exposures by requiring optimization of CT procedures is principle concern in radiological protection. In this study, we investigate the radiation dose for conventional and spiral CT and apply European Commission Reference Dose Levels (EC RDLs) to CT examinations (conventional and spiral).

Methods and materials: The dosimetric quantities proposed in the European Guidelines (EG) for CT are Weighted Computed Tomography Dose Index (CTDIW) for a single slice for axial scanning or per rotation for helical scanning and Dose-Length Product (DLP) for a complete examination. Patient-related data were collected for brain, neck, chest, abdomen and pelvis examinations for each scanner. For each examination, 10 average sized patients (in random) were included. CTDI with an active length of 10cm was measured in 2 CT scanner by using UNFORS (Mult-O-Meter 601) in head and body phantom (PMMA) with 16 cm and 32 cm in diameter respectively. CTDIW, DLP and Effective Dose(ED) were estimated for each type of examination.

Results: The CTDIW had a range of 15.8-24.7 mGy for brain, 16.1-30.6mGy for neck, 6.8-9.2 mGy for chest, 6.8-9.8mGy for abdomen and pelvis. The DLP had a range of 246.4-397.7 mGy.cm for brain, 104.6-262.2 mGy.cm for neck, 135-248.4 mGy.cm for chest, 187-298.9 mGy.cm for abdomen and 197.2-319.4 mGy.cm for pelvis. The mean values of effective dose were 0.7 mSv for brain, 0.9 mSv for neck, 3.1 mSv for chest, 3.7 mSv for abdomen and 5 mSv for pelvis.

Discussion: The results obtained in this study are much lower than EC RDLs and other studies, in other words, performance of all scanners was satisfactory as far as CTDIw and DLP are concerned. CTDIW and DLP for conventional CT were significantly higher than spiral CT. With regard to ALARA principle, for the establishment of reference dose levels, the radiation dose with spiral CT scanners should be taken into account.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-75

DOSE ESTIMATES DUE TO THE CONCENTRATIONS OF Rn-222 IN BOTTLED MINERAL WATERS IN IRAN

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Abstract

Radon is a radionuclide that has the main role in exposure .Radon in water causes exposure in whole body but the largest dose being received by the stomach, as EPA (Environmental Protection Agency) estimates that radon in drinking water causes about 168 cancer deaths per year: %89 from lung cancer caused by breathing released to the indoor air from water and %11 from stomach cancer caused by consuming water containing radon. Now days the consumption of bottled mineral waters has become very popular. As is known, some kinds of mineral waters contain naturally occurring radio nuclides in higher concentration than the usual drinking (tap) water. Surveys and reports on radon in most surface waters is low compared with radon level in groundwater and mineral water. In our work, the concentration of Rn(222) was determined in some bottled mineral waters available in iran , and in next step the dose contribution ; due to ingestion ; for 1 l d 1 − bottled mineral water consumption.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-76

SAFETY ASSESSMENT OF PRIMARY COOLANT AND MODERATOR CIRCUIT OF A TYPICAL RESEARCH REACTOR IN ACCOURANCE OF RADIOLOGICAL ACCIDENTS USING PROBABILITY SAFETY ASSESSMENT LEVEL 1(PSA 1) BY SAPHAIRE SOFTWARE

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Abstract

A Radiological accident is an event so that release potentially dangerous radioactive material into the environment. This release is usually in the form of a cloud or plume and could affect the health and safety of anyone in its path. Radiological accident can be occurred anywhere that radioactive materials are used, stored, or transferred. For instance it is very important to identify each accidents and safety assessment as a result of preventing and reducing accourance probability of undesired accidents to reduce radiological release to the environment and maintain the reactor staff's and public health. In this paper, application of the Probabilistic Safety Assessment level 1 (abbreviated by PSA1 so that is assessing the events that cause the reactor to severe core damage followed by release of radioactive materials into the environment) of the primary coolant and moderator circuits in a typical research reactor is studied. The PSA application involved: Familiarization with the facility, identification and selection of initiating events, identification of safety systems, event tree development and quantification, fault tree development and quantification, common cause failures, component failure data base development and human reliability. Each steps of the analysis mentioned above are discussed for selecting initiate events. Then, results of the PSA are compared to the International Atomic Energy Agency (IAEA) criteria. The analysis of developed results are investigated for safety assessment of so called research reactor to encounter radiological accidents and some alternations to preventing and/ or reducing accourance of the accidents. Quantification of the constructed models is done by SAPHIRE software.

Key words: Radiological accident, research reactor, Probabilistic Safety Assessment, PSA, Event tree, Fault tree, Saphaire code

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-77

RESEARCH ON RADIOACTIVE MATERIAL IN MANTLES THAT USED FOR HOMES LIGHTING IN IRAN AND THEIR HAZARDS

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Abstract

mantle is a device for generating bright white light when heated by a flame. Gaslights using the thorium mantle (typically a thumb-size cloth bag coated with a thorium compound) offered a big advantage: because the thorium could incandesce at extremely high temperatures without melting, they were far brighter than ordinary lamps. Thorium decays to alpha, beta and gamma. In a home or tent, the main danger in mantle use arises from thorium's first radiodaughter, radium 228 (Ra-228). Radium is a bone seeker, which means that it is biochemically analogous to calcium, and that the body will substitute it for calcium during periods of bone growth. Mantles present an obvious hazard to children who may be close by. Pregnant women and their unborn babies could be endangered, since Ra-228 (and Ra-224), which can be inhaled and ingested by the mother; it can be absorbed by the fetus. While the chief sources of danger are the alpha-particle-emitting daughters of Ra-228, beta radiation can also strike the body when a mantle is placed close to the skin. If it's carried in a shirt pocket, for instance, the breast and lung tissue will absorb radiation and if it is put in a pants pocket, a man's testicles would be exposed to some low-level radiation. A mantle even when it is new and still inside its packaging should never be placed in pockets, and children should never be allowed to touch or play with the devices. The thorium decay chain ends with an isotope of lead (208Pb), but passes through an isotope of radon (220Rn). Radon gas is a radiation hazard. Good ventilation of areas where thorium is stored or handled is therefore essential. Mantles are used in households in Iran as ligh during electricity cut off. Because of there aren't suitable ventilation in most houses in Iran, people breath this gas. most of people don't know about existing of thorium in mantle. Becase there isn't any lable on package of mantle for being radioactive. When a lot of mantles maintain in one place, it can be have hazards for workers that are there. Our aim of this paper is to measure activity of thorium of mantle used in households in Iran, how much volum shoud be maintained and what dangers threat users and workers.

Key words: mantle, thorium, bone seeker, (220Rn)

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-78

INVESTIGATION OF BIOLOGICAL EFFECT OF MICROWAVE MOBILE PHONE ON ANTIOXIDANT IN RABBIT

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Objective: Microwave is part of electromagnetic wave with 300 MHz to 300 GHz frequency and 1 mm to 1 m wave length. The use of microwave in variety industries –special wireless communication- ,medicine sciences, and exceeding use of it in mobile phone by many people in length time in countries and determination its thermal and non thermal effect cased that we study on microwave effect on antioxidant as part of immune system.
Material and Method: In this study , fourteen white male rabbit (3 months old, 1400-1700gr)were used. The animals were randomly divided into case and control groups (7 each).15 day exposure period for 8 hour daily was conducted for case group . animals were exposed whole body with 915 MHz microwave by a simulator device in radiation chamber . the average of power density of whole body was 0.68 mW/cm2 . blood samples by cardiac puncher carried out 12 hour after last day in case and control groups and oxidative stress measured by FRAP assay. The absorbance of TPTZ-Fe+2 was read at 593 nm in spectrophotometer .statistical analyses were carried out by t-test in SPSS statistical software. Probability value of less than 0.05 was accepted a statistically significant.
ResultAntioxidant level in case and control groups were 08 . 151 28 . 610 ± and 55 . 104 28 . 870 ± *lit mol* µ in plasma respectively. This result were significant (p) 003 . 0
≤ . Conclusion: The result from this study show that 915 MHz microwave in mobile phone is physical adverse agent that can produce a significant increase in antioxidant level and cased oxidative stress . therefore we suggest that reduction of power density in mobile phone and more use of antioxidant sources such as A and E vitamin sources can reduce oxidative stress .

Key word: oxidative stress, antioxidant , mobile phone, microwave.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-79

DERIVED INTERVENTION LEVELS FOR EDIBLE PARTS OF FOODSTUFFS CONSUMED IN IRAN

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Measures to protect the public following an accidental release of radionuclides to the environment will depend on the circumstances including the extent of the potential hazards. The projected levels of risk is an important precondition in emergency planning. This levels can be expressed in terms of concentration levels in the environment or in foodstuffs. These derived intervention levels(DILs) can be determined for the range of important radionuclides that could be released to the environment in the event of a nuclear accident. Derived intervention levels for ^{90}Sr, ^{131}I, ^{134}Cs + ^{137}Cs, and ^{238}Pu + ^{239}Pu + ^{241}Am radionuclide groups were calculated for mostly consumed foodstuffs in Iran. These nine radionuclides are expected to deliver the major portion of the radiation dose during the first year following an accidental episode of radiological food contaminations. Calculation for DILs were based on recommendations from international organization and average food consumption rate data by National Nutrition and food Technology research institute. From our research it was found that DILs for foodstuffs consumed in Iran for mentioned radionuclide groups are equal to 387, 250, 1023 and 2.8 Bq kg^{-1} espectively.

Key words: intervention levels; radionuclide groups ; foodstuffs; Iran

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-80

DOSIMETRIC COMPARISON OF AN ELEKTA "SYNERGY S" BEAM MODULATOR & RADIONICS MMLC USING MONTE CARLO SIMULATIONS & MEASUREMENTS

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Purpose: To compare dosimetric parameters of a new Elekta "Synergy S" dedicated stereotactic radiosurgery MLC, namely the beam modulator (BM), with Radionics mini-multileaf collimator (MMLC).
Methods and Materials: The Beam Modulator maximum opening is 16cmx21cm and consists of 40 pairs of Tungsten leaves of 4mm thickness at the isocentre, with no back up jaws. Radionics MMLC has a maximum field size of 9.6cmx12cm and 3.75mm leaf thickness at the isocentre. Leakage and transmission, percentage depth doses (PDD) and dose profiles were measured and calculated for different field sizes and depths and for different source to surface distances (SSD). Kodak XV films, photon diode detector (diameter of active area 2mm), CC13 Wellhofer ion chamber (cavity volume 0.13 cm3) and Wellhofer water tank were used for measurements. BEAMnrc code was used for the Monte Carlo (MC) simulations. All the data are for a 6MV photon beam.
Results: It is shown that the BM beams are slightly more energetic so that PDD at 10cm depth is 2% more for a 10.4cm x 9.6cm field, compared to Radionics MMLC. Dose profile results are generally comparable, except for the penumbra which is sharper for Radionics MMLC, especially in the leaf travel direction by up to 1.1 mm. Maximum and average leakage was 1.7 and 1.1 for BM and 1.2 and 0.9% for MMLC, respectively. MC calculation and measurement results for PDD and profiles agreed well to better than 1% and or 0.5mm. The uncertainty in simulation was less than 0.5%.
Conclusion: Elekta "Synergy S" beam modulator and Radionics MMLC have successfully been modeled for the first time using the BEAMnrc MC simulations. The MC results showed an excellent agreement with the measurements. BM has a wider penumbra, mainly due to the larger isocentric distance and rounded leaf ends.

Key Words: Radiotherapy, simulation, MMLC, Beam Modulator, Radionics

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-81

NATURAL RADIOACTIVITY OF DRINKING WATER IN IRAN

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{Topic classification: 6.2 Radon monitoring}

A nationwide study on the natural radioactivity of drinking water has been made in Iran. The study was directed mainly at drinking water distributed by water supply plants. Additional samples were collected from privet dug and drilled wells. The samples were analyzed for ^{222}Rn, ^{226}Ra, gross alpha and gross beta activity. The radon and radium were analyzed by liquid scintillation and emanation method respectively. The result of gross alpha and gross beta were less than detection limit of proportional counting system.

The radioactivity of drinking water distributed by the water supply plants was on the average low, the mean concentration being 23.57 BqL^{-1} for ^{222}Rn and 2.20 $mBqL^{-1}$ for ^{226}Ra and 20.49 $mBqL^{-1}$ (Well Water). The most radioactive water was found in drilled wells, in which the maximum concentration was 44.58 BqL^{-1} for ^{222}Rn and 217.24 $mBqL^{-1}$ for ^{226}Ra.

Key words: Radioactivity ; Radium; Radon ;Drinking water; Iran

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-82

FOOD, HUMAN AND RADIATION

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In recent years, application of ionization radiation has been developed. , in all branches of human knowledge.
Radiation sources and abundant necessity of human societies increase**d** the probability of human exposure.
Absorption control survey of human, because of harmful radiation is one important part of environment radiation protection.
In all countries, **especial Iran,** food radiation control and survey, based on international lows, **also** with high quality assurance.
The accepta**ble** level of food radiation in Iran is in the lowest level.
The most important bottlenecks for food import are port and harbor **specially Persian Golf**.
These mat**t**ers, **such** as wheat and corn, import in high tonnage **by ships**.
Modern technology and especial methods were used to **simplify** of import foods.
These samples are analyzed in our modern laboratory, in Tehran and important ports.
After insurance and trust on food samples, they have permit to distribute in Iran.
In this survey, our study is based on gamma spectrometry of food samples, as an important environment factor.
In response of complete study and survey on foods samples, we could prevent of some shady consignment. In this research we use some of spectrums.

Key words: Radiation, Radionuclide, Food.

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1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-83

CRITICALITY EVALUATION AND DOSE CALCULATION FROM FUEL PALLETS SINTERING IN AN FMP PLANT

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Safety and reliability of systems in industrial manufacturing is the utmost concern in designing criteria. Industries which may harm human directly are the highest concern in this regard. Therefore, the design of a fuel manufacturing plant (FMP) involves a throughout evaluation of hazards the may occur during operation and may endanger personnel and the surrounding environment. One of the major concerns is the criticality and release of energetic particles. Every section of an FMP plant where more than 700 *gr* of U-235 is processed should be evaluated for criticality in normal operation and accident. This is one of the design criteria and the dose evaluation and its comparison with ICRP or IAEA standards is essential. In this paper we have used MCNP nuclear code to model and evaluate both criticality and dose under normal and accident operation conditions. The results show that effective multiplication factor is 0.06001 in normal operation and 0.40448 when a water flooding accident occurs. The input cross section under different scenarios were generated using ENJOY code.

Key words: FMP, MCNP, ENJOY, Dose, Criticality

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-84

FEASIBILITY STUDY FOR APPLICATION OF PULSED ELECTROMAGNETIC FIELDS IN HEALING OF FRACTURED BONE

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Over the past decades, it has been increasingly evident that magnetic fields have definite stimulus effect on the biological tissue. Most of the previous studies were concentrated on the frequency, amplitude and duration of pulse in connection with the favorable response.
bone among other tissues has shown positive response to electric and magnetic fields at low frequencies which are believed to induce bone healing for certain untreatable conditions. However very little attention was given to the orientation of magnetic field vector with respect to the fractured bone surface and its influence on cellular growth. Certainly pulsed electromagnetic fields (PEMF) have been widely employed because of its non-invasive property.

This paper discusses about the application and suggests the possible use of the magnetic field stimulator for bone healing. The calculations for manufacturing such equipment are briefly reviewed.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-85

MAGNETIC RESONANCE SPECTROSCOPIC (MRS), NEW IMAGING TECHNOLOGY FOR BREAST CANCER

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Abstract

breast cancer after beast lungs is secondary mortality cause from cancers. Today breast cancer risk factor have increased .for example: women elderly, precocious Puberty and precocious menarche, life style in industrial society.

MRS is new imaging technique that with use of spectrum in magnetic resonance wave with measured key metabolites and their concentrations at short acquisition times. Analyses thousands of chemical components of cancer cell have a different identifiable place on the spectrum, a sort of color coded chemical signature: tcho (choline) concentration to be significantly higher in breast cancer. The MRS detected breast cancer with 94 % sensitivity and 95% specificity, may diagnose breast cancer without biopsy.

The most important prognosis is due to early diagnosis .MRS breast cancer earlier, more accurately, less invasively and is correct for young women, monitoring response to therapy.

We hope this technique will eventually be use to avoid unnecessary biopsy.

Key words: magnetic resonance spectroscopy, breast cancer

اولین کنفرانس انسان پرتو و زندگی
۹ - ۷ آبان ۱۳۸۵
Rafsanjan University of Medical Sciences & Health Services
1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-86

ASSESSMENT OF GAMMA BACKGROUND RADIATON IN DIFFERENT SEASONS IN ZANJAN

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Introduction: The measurement of natural environmental radiations is one of the most important subjects in health physics. The main sources of background radiation are cosmic, terrestrial and cosmogenic radiation produced by reactions with cosmic rays and atmospheric nuclei. Terrestrial radiation varies in different regions in the world. Generally the background dose rate from cosmic rays depends on the latitude and altitude. In resent years many different studies were performed about background radiation all around the world as well as in Iran. This study was carried out to provide a map of ambient gamma background radiation in Zanjan concidering to existence of lead and zinc minerals and granites sands in this region.

Material and Methods: To determine the dose rate from background radiation, 8 centers were selected in Zanjan. Measurements were accomplished using of Geiger-Muller detector (RDS-110) calibrated by Cs-137. For each selected point, 4 measurements in 4 seasons have been done. All the measurements were in the second month of each season in 8-12 AM since August-2005 to June-2006. Each measurements last approximately 30 minutes. 10 values were recorded in each time. The mean value was defined as dose rate in each season. Measurements were accomplished in flat areas, at least 5 meter far from every building and one meter above the ground.

Results: The mean value of equivalent dose rate were 120, 134, 127 and 125nSv/h in spring, summer, autumn and winter respectively. The mean value of equivalent dose rate in zanjan was determind as 126nSv/h or 180nGy/h.

Conclusion: The average dose rate in zanjan was lower than Baneh (in Kordestan province) and was higher than Mashad, Tabriz, Urmie, Esfahan and Yazd. The overall population-weighted mean outdoor dose rate was found 36nGy/h which was lower than world-wide average dose rate reported by UNSCEAR-2000 by 59nGy/h. The annual effective dose for outdoors was 0.04 mSv. The results showed that spring has the lowest and the summer has the highest equivalent dose rate in zanjan. The results of this study showed that the altitude and granite rocks may have a significant role in the level of background radiation in this region.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-87

GAMMA SHIELDING DESIGN STUDIES FOR AM-BE AND CALIFORNIUM NEUTRON SOURCES

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Abstract

The emitted gamma rays by common portable neutron-gamma sources form a major part of background gamma rays when using these types of sources. These sources have wide applications in laboratories, industry and medicine, because of their emitted neutrons. One of the major limitations when using these sources is the protection of users against the emitted gamma rays by them. Moreover, the disturbing effect of these rays discomfits the analysis of the prompt gamma spectrum due to neutron activation when using Prompt Gamma Neutron Activation Analysis (PGNAA) method. So, using suitable shields for these sources to reduce the flux of background gamma rays is unavoidable. Another point is the importance of needed time for analysis a sample when using PGNAA method. This needed time has direct relation with the flux of neutrons. So, the chosen shield should be in the form that doesn't reduce the flux of neutrons, which bombard the sample.

In present research the effect of type and thickness of shields on reducing the flux of background gamma rays due to Am-Be and Californium neutron-gamma sources has been simulated using Monte Carlo N-Particle transport code (MCNP). Moreover, the output neutron flux of different thickness of lead and bismuth shields has been investigated. At the end, some suggestions for choosing suitable type and thickness of shield when using different neutron-gamma sources have been offered.

Key words: background gamma rays, gamma shielding design, Neutron-Gamma sources, PGNAA method

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-88

Computational Design of Band-Pass Filters for Diagnostic X-Ray Tubes

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Abstract

The X-Ray spectrum extracted from a K-edge filter is simulated by MCNP4C Monte Carlo code and hand calculation. Filter material is assumed to be made from Sn-117 with K-edge of 29.2 keV. X-ray source is considered as rotating anode X-ray tube with 0.6mm focal spot and 40kV$_p$ anode voltage. After passing through K-edge filter, the X-ray spectrum at higher energy part is substantially suppressed. The width of X-ray spectrum is 60% narrower than the original one and concentrated on energy range 20-30keV. Hand calculation of the spectra is in good agreement with MCNP results.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-89

DISCOVERY OF THE SECOND HIGHEST LEVEL OF RADIOACTIVE MINERAL SPRING IN IRAN

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One of the high-level natural radiation areas (HLNRAs) in Iran is located in the south of Iran in the Hormozgan province. An unknown hypothermal mineral and radioactive spring was discovered in this research, which contains high-level radiation. Maximum equivalent dose around spring measured 42 $mSvy^{-1}$. The radionuclides ^{40}K , ^{226}Ra and ^{232}Th were detected with the maximum activity of 11.80 BqL^{-1}, 3.48 BqL^{-1} and 2.52 BqL^{-1} respectively. These radionuclides are the second highest in comparison with those in the Ramsar radioactive springs specially Ab-siah spring, which contain 146.5 BqL^{-1} activity. Analyzing results showed this spring falls into the sodic chloride category as well as radioactive springs.

Key words: Chestaneh; Mineral spring; Radioactivity; hot peak

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-90

EFFECTIVE DOSE TO THE PUBLIC OF KERMAN PROVINCE FROM GAMMA EMITTER TERRESTRIAL RADIONUCLIDES

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Concentration of the most important terrestrial radionuclides ^{238}U. ^{232}Th and ^{40}K in surface soil samples (0-5 cm) of different stations in Kerman province in Iran have been measured by gamma spectrometry. The gamma radioactivity of the natural radionuclides in 35 soil samples was measured and the corresponding gamma absorbed dose rate in air at 1 meter above the ground level has been calculated. The mean concentration of ^{238}U. ^{232}Th and ^{40}K throughout the province were found to be 23.8 ± 3.6 Bq.kg^{-1}, 28.8 ± 4.3 Bq.kg^{-1}, 489.6 ± 48.9 Bq.kg^{-1}, respectively. Based on these values, the mean value of calculated terrestrial gamma absorbed dose rate in air at 1 meter above the ground level was 45.4 nGyh^{-1} correspond to an annual effective dose equivalent of 59.4 μSv.

Key words: effective dose, exposure, terrestrial, radionuclide.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-91

THERMOLUMINESCENCE DOSIMETER RESPONSE

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Purpose: A major application of thermoluminescent dosemeters (TLD) is measuring the scattered dose. Wide energy range of x-rays may contribute the cumulative dose and studies confirmed the quality dependency of the TLD's respose. Purpose is to model the quality dependency of TLD response to make its clinical use more robust.

Method and materials: Fourthy LiF:Mg:Ti (TLD-100) chips with sizes of 3.1 x 3.1 x 1mm^3 and density of 2.64 g cm^{-3} were used. To produce beams with different energies Cesium-137 (Cs-137) source, Co-60 and orthovoltage therapy machines were used. TLDs were irradiated for different air kerma dose (0-100 cGy). Effective correction coefficient for each chips and air kerma calibration factors (CF) for different beams qualities were obtained. The ratio of TLD dose to air kerma was also obtained to compare the measured calibration factor with calculated one. The error percent in case of using Co-60 energy calibration factor instead of each own energy was shown.

Results: CFs of TLDs at different x-ray qualities (120,180,200,250,300 kVp,662 and 1250 keV) were 0.00773- 0.00957, respectively. Air kerma dose response of TLDs at different x-ray qualities showed a good linearity with irradiation dose ($p<0.001$, $R^2>0.99$). Maximum deviation between calculated air kerma based on Co-60 calibration factor was for 120 kVp beam. The error percent decreases with increasing the energy of incident beam. The minimum value of fluctuations was seen for 662 keV. The trend of errors was decremented in confidence interval of 95% and P-value< 0.02. The change of air kerma response curve follows the equation $R= E + a (1-e^{-bx})^c$ where R, E are the air kerma response and the energy of interest, respectively. a, b and c are the constant coefficient.

Conclusion: Air kerma response of TLD-100 shows a relatively linear change in the low energy part of the quality dependence curve which indicates the relationship between response and the x-ray quality. Whenever, the sensitivity of the detector (e.g. in scattered field) is important, the variation of the response curve and calibration factor should be considered. However, using the data of the curve over the low energy range based on the above equation can lead to the more precise results.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-92

CORRELATION BETWEEN DEPTH DOSE OF CRITICAL ORGANS OF THYROID AND UTERUS OF PHANTOM BASED ON SURFACE DOSE EXPOSED WITH DUAL X-RAY ABSORPTIOMETERY WITH PENCIL BEAM: *IN VITRO* STUDY

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Introduction: Dual X-ray absorptiometery (DXA) is one of the most widely used techniques for non-invasive assessment of bone status. Radiation dosimetry is well established for DXA with pencil beam and fan beam by detection of surface dose, but there are not measurements for estimation of depth dose in critical organs. In this study, we measure surface dose and depth dose of critical organs to assess of correlation between depth dose and surface dose. Then absorbed dose are compared with background and radiographic examinations dose.

Material and Methods: In this study, the Lunar DPX-MD system with pencil beam and designed anthropomorphic phantom (Thickness of 22cm in pelvic and 8cm in neck, 70 Kg, soft tissue density of 1g.cm^{-3}, and bone density of 7.2gr.cm^{-3}) were used. In AP spine and femoral scanning modes, we measure surface and depth dose of thyroid left and right lobes and uterus in various deeps and scan centers. TLDs-400 were placed at the entrance surface, near the source and also inserted at different depths in thyroid and uterus of the anthropomorphic phantom. Absorbed dose was measured on the phantom for PA spine and femoral scanning. The phantom was scanned 4 times, on the same condition. Correlation

*

between surface dose and different depth dose are analyzed and regression functions and significant level are estimated.

Results: In AP spine scanning, average absorbed dose of thyroid left and right lobes and uterus were 1.28, 1.18 and 1.21 μGy, respectively. Central dose in this scanning mode was 6.15±1.19 μGy. In femoral scanning, average absorbed dose of uterus was 2.52 μGy. Central dose, 7.38±2.27 μGy was estimated. There is significant correlation between of surface and depth dose of thyroid and uterus in both scanning mode therefore, regression functions were calculated between surface dose and depth dose. But there is no significant correlation between depth dose and scan central dose except in femoral scanning. By reason of depth dose is due to scattered radiation, therefore this results were expectable. PA spine effective dose were calculated as 0.064, 0.059, 0.061 and 0.242 μSv for thyroid left, right lobes, uterus and ovary. Also femoral effective dose were 0.126 and 0.504 μSv for uterus and ovary. These results are very lower than effective dose of chest and abdominal X-ray radiography.

Conclusion: It is concluded that there are significant correlation between surface dose and different depths dose. The Lunar DPX-MD with pencil beam has very low radiation doses, similar to background doses.

Key words: Dual X-ray absorptiometry, Dosimetry, Phantom, Depth dose, Correlation, Critical organs

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-94

DOSE ASSESSMENT AND RADIOACTIVITY OF THE MINERAL WATER RESOURCES OF DIMEH SPRINGS IN CHAHARMAHAL AND BAKHTIARI PROVINCE, IRAN

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Introduction: One of the main sources of public exposure from natural radioactivity is radium and radon and its short lived decay products. The aim of this study is focused on determining the concentration of mentioned radionuclides in the mineral water resources in one of the highest altitude regions (Zagros Mountains), Chaharmahal and Bakhtiari province, in the south west of Iran, namely Dimeh springs.

Materials and methods: Eighty drinking spring water samples were taken from Dimeh springs (ten samples for each spring) to determine of Radium-226 (^{226}Ra) and Radon–222 (^{222}Rn) concentrations using the emanation method and using a liquid scintillation counting method, respectively.

Results and Conclusions: The results of this study showed that the effective dose from consumption of drinking water of Dimeh springs (6.4 μSv y^{-1}) is not comparable to the other annual effective dose such as inhalation of radon and its products in cosmic and terrestrial rays which published by author previously. Also, the annual effective dose measured here is much less than the world-wide mean value of 0.45 mSv which reported by USCEAR, 2000 and is also low enough and below the proposed limits in other countries.

Key words: Radium-226, Radon–222, Radioactivity, Dimeh springs, Chaharmahal and Bakhtiari.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-95

EVALUATION OF THE EFFECTS OF COBALT 60 GAMMA RADIATION (WITH LOW DOSE) ON GROWTH FACTOR AND PRODUCTS OF VARIOUS PLANT SPECIES

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The recent researches showed that there is difference between the effect of low dose rate and high dose rate Gamma-rays .The goal of this research is determining the amount of dose for raising the rate of budding and yield of Apium petroselium (apiaceae) Triticum aestivum(Av.Arvand and Av.Sabalan) and Lycopersicon esculentum to maximum level. At first 1800 Apium petroselium ,1874 Triticum aestivum(Av.Arvand) ,2407 Triticum aestivum(Av.sabalan) and 400 Lycopersicon esculentum seeds with similar phenotype were provided and exposed with CO-60 machine in Tabriz Emam Khomeyni Hospital (Theraton-1000, Field Size=10×10cm, SSD=80cm and Dose Rate=155cGy/min). Then seeds were exposed in 5 groups (one control group and 4 groups with daily dose respectively 0, 100,250,500 and 750 cGy) for 10 days. Then 25 seeds from each group were planted inside the vase. Budding seeds were counted daily and in Apium petroselium after 2 month had measure dry and wet weath of stem. In Triticum aestivum after 6 month number and weath of seeds had measured and in Lycopersicon esculentum after 1 month the length of roots and stems and among of Chlorophyll and number of leaves were measured for each seed in each vase and then planted in the field of Tabriz University and after 3 month the number and weath of yield were measured. Statistical analysis was performed with SPSS in Random Complete Blocks Design. The results showed that significant difference between the control group and test groups. We hope we can increase agriculture crops by the results of these researches, helping to have agricultural independence of our country.

Key word: Gamma ray, Cobalt60, Apium petroselium, Triticum aestivum, Lycopersicon esculentum

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-96

EFFECT OF ULTRAVIOLET RADIATION ON AQUATIC MICROORGANISMS: A REVIEW STUDIES

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Aquatic environments are key components of Earth's biosphere. Aquatic ecosystems differ tremendously in their transparency and thus the depth of solar UV penetration. In addition to inorganic particulate matter, dissolved and particulate organic carbon (DOC and POC) and various humic substances contribute considerably to the attenuation of short wavelength radiation. Bacteria and small planktonic organisms (nano- and pico plankton) overcome the stress of solar UV by fast cell division and growth. However bacterioplankton in the top layers of the clear oceanic waters are affected in the way that growth and survival are impaired, and the activity of enzymes is inhibited. Solar UV damages the bacterial DNA mainly through the formation of pyrimidine dimmers which may cause mutagenesis and cell death. The number, physiological and biochemical processes of cyanobacteria as prominent constituents of marine ecosystems can be affected by UV radiation, resulting in reduced overall productivity germination and differentiation. However, cyanobacteria have several protective strategies such as production of photoprotective compounds, escape from UV radiation by migration into habitats with reduced light exposure and repair mechanisms. There are also another microscopic life (phytoplanktonic or zeoplanktonic) in marine and freshwater environments which are all exposed to both UV-A and UV-B radiation. But understanding the effect of UV irradiance on all these small living organisms in water ecosystems require more broad information of other environmental factors and their complex interaction with UV radiation.

Key words: UV radiation, aquatic environment, microorganisms

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-97

THE SHIELDS DESIGN FOR X-RAY IN DIAGNOSTIC RANGE

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In this paper application of Multi-layer thin shields for X-ray in diagnostic range are studied. The High attenuation coefficient in k-edge region is utilized. For photon, with energy less than k-edge, a layer of material with lower atomic number is added. The k-edge of this layer appears at energy less than first layer. With this technical method, the high attenuation coefficient of k-edge is achieved over a wide energy range. It is shown that thickness and weight of the shield is reduced remarkably. Specification of material such as price, availability in market, specific gravity and mechanical flexibility are considered in shield design. Calculation and Computation shows that the shield is used in 30keV –130keV range.

In this design curve attenuation of elements was used.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-98

LASER HAZARDS AND ACCIDENTS, AND HOW TO REDUCE THEM

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Lasers are light sources, emitting high intensity and low divergence coherent light. These properties of laser light as well as its energy concentration in very small spot, makes it appropriate for very different applications, in medicine, technology and army. On the other hand laser light may injure eyes and skin seriously. These injuries are sometimes irreversible, but even at the conditions of reversible effects, they can be very painful.

Off course laser damages are not restricted to injuries resulted from light exposure of eyes and skin, but non beam hazards like chemical airborne contaminants, ignition and explosion are considered as ancillary hazards of lasers.

In this paper some laser accidents are reviewed and statistic results are prepared. It is showed that in most cases irreversible damages are consisted of eyes and especially retina injuries. Other ocular injuries like vision loss, temporary blindness, blurred vision and cataract, as well as skin damages and fire and explosion are reported too.

It is concluded that for reducing laser accidents, laser workers should be able to recognize the dangers of laser light and they shall know the administrative safety precautions. In this way it is necessary to implement regulations and standards for high risk laser centers, and to consider proper obligatory training programs for the laser workers as well as controlling the usage of personal protective instruments by laser workers in controlled area.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-99

POSSIBILITY OF LASER-INDUCED TRANSMUTATION OF ^{12}C INTO ^{11}C FOR MEDICAL APPLICATIONS

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Ultra intense laser-plasma interactions lead to the production of very intense beams of fast electrons, γ rays, protons, neutrons and ions. The acceleration of such particles in this case is ~1000 times more than that of common accelerators.
This article describes one of the important applications of high power lasers in medical radioisotopes production. ^{11}C, one of these radio isotopes with very short half-life of 20/3 minutes has many applications in Positron Emission Tomography (PET).
Because of its short half-life, providing of this radioisotope from foreign countries is impossible for our treatment centers. So, possibility of production of ^{11}C by ultra fast high power lasers is evaluated.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-100

KNOWLEDGE AND ATTITUDE TOWARD NUCLEAR ENERGY AMONG STUDENTS OF MEDICINE IN NORTH OF IRAN

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Introduction: The using of nuclear energy seems to have become faster in recent decades in the world. Iranian people want to have nuclear energy for peaceful purposes. This study was carried out to investigate the knowledge and attitude of students of medicine toward nuclear energy in the universities of medical sciences in Mazandaran province in north part of Iran.
Material & methods: All of the Students of medicine in basic science course (175 Students) were asked to complete a questionnaire for determining their knowledge about physical and technological basis of nuclear energy and also for their attitude toward using of nuclear energy. The filled questionnaires were scored and analyzed.
Results: Results showed that 171 students (98.8%) believe that nuclear energy in Iran is a necessity for development and therefore the nuclear technology should have native setting up in the country. The findings also showed that knowledge about physical and technical basis of nuclear energy in 121 students (69.9%) were in acceptable range. 2 questionnaires were excluded because of incomplete filling.
Conclusion: Nuclear energy supports many fields of science and technology such as biology, medicine, engineering, etc. On the other hand comfortable life needs new sources of electric energy which can not be met without use of nuclear energy. The above results indicated that although, almost all of students have very positive attitude toward nuclear energy, their knowledge about physics, technology and various kinds of its applications need to be intensified. It is suggested that a specific course for nuclear energy and its application consider as a part of the education program in the universities of medical sciences in Iran.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-101

UV RADIATION EXPOSURE AND MELANOMA

Introduction: Ultraviolet Rays are categorized in the non-ionization radiation and have adverse effects on human health. welding, construction work and farming, sunbathing, boating and vacations spent in the sun increase Risk of adverse effects due to exposure to Ultraviolet Rays .

The goal of this study was study of frequency distribution of skin cancer at patients refer to hospital at 4 years period (1999 to 2004).

Method: A population-based study of 280 patients with malignant melanoma, conducted in i sfahan over a 4-year period, included an evaluation of the relationship of UV-light exposure to melanoma risk. Data collected with the questioner.

Results: Significantly increased risk was associated with UV-light exposure in welding, severe sunburn in construction work and farming. A significant decrease in risk was associated with occupational exposure in males (34.6%)and in female (34.4%). The result show that an association between duration of exposure and melanoma.($p<0.05$)

Conclusion: Our finding relatively corresponding with results of other researches. These findings were independent of the effects of constitutional risk factors (naevi, freckles and light hair color).No association was found between the risk of cutaneous melanoma and exposure to artificial UV-light but more research needs. No significant difference was found between superficial spreading melanoma and nodular melanoma with regard to any of the sun exposure variables, while long-term continuous exposure does appear to be risk factor in workers.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-102

ANALYSES OF ^{7}BE CONCENTRATION AND ^{210}PB MEASUREMENTS WITH SURFACE OZONE OBSERVATION AT TEHRAN STATION

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Measurement of gross β activities and cosmogenic beryllium-7 (^{7}Be) concentrations were made both daily and weekly during 2001, 2002, 2003 and 2004 from samples of atmospheric aerosols filtered from the air at Tehran Nuclear Research Center (35^{o} 41' N).
Measurements and analyses of ^{210}Pb and ^{7}Be can provide useful information about the movement of air flow in the atmosphere. For example, high ^{7}Be concentrations with respect to low ^{210}Pb concentrations detected at the surface station could indicate a strong subsidence of air from upper altitudes that would increase surface ^{7}Be, since ^{7}Be is mainly produced in the upper troposphere and lower stratosphere. The analyses of variances of ^{210}Pb and ^{7}Be measurements, hopefully, will help in deeper understanding the changes and transport processes of ozone that are occurring in the atmosphere.
In this paper we report on four years of continuous measurements of gross β activities and concentrations of ^{7}Be in surface air (Arkian, Amidi, 2005). The present research was undertaken with the following principal goals:

a) Analyses of surface ozone measurements
b) To find correlation between ^{210}Pb , ^{7}Be and surface ozone.

Our study revealed the validity of the relationship for gross β and ^{7}Be and ozone.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-103

STUDY OF EFFECTS OF ELECTROMAGNETIC FIELDS ON MEN INFERTILITY AND THE WAYS FOR DECREASE OF ITS HARMFUL EFFECTS

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Background and Objectives: Men beings are unavoidably exposed to ambient electro magnetic fields (EMF) generated from various electrical gadgets and from power transmission lines because of their situation of job. So the protection is important controversy exists about the EMF effects on various organs. One of the critical issues is that EMF may adversely affect the reproductive system and also prostate.

Materials and Methods: To examine this, rat parents 50 male and 50 female 15 weeks age were mated in animal house of Tabriz University of Medical Sciences. Later on rat pups (30 numbers) were exposed to 50 Hz EMF (non-ionizing radiation) during in utero development (approximately 3 weeks) and postnatal life (5 weeks). The materials were processed and observed under light and transmission electron microscope.

Results: Prostate is an important glands of male genital organs. It is made up 30-50 small glands. In this study we found that secretory epithelial cell were inactive and cuboidal generally. Their nucleus were dense. Corpus Amylace were move than normal. Smooth muscle sibers pread out in different directions with heterochromatic nucleus.

Conclusion: Based on this study it is suggested that human's staying under EMF exposure not safe for spermatogenesis process and prostate gland's normal activities. So it can increase the risk of sterility in men.

Key words: electromagnetic field, prostate, rats.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-104

THE EMF LEUKEMIA RISK

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Introduction: The exposure to electric and magnetic fields (EMFs) are likely associated with leukemia . The average field exposures in the high-voltages facilities are typically several folds greater than background or residential levels. Our hypothesis was leukemia risk link to electromagnetic fields.

Method: In the present study 79 workers exposed in High- voltage facilities were compared to 110 control subjects who were not occupational or residential exposed to electromagnetic fields. Worker's blood samples were collected in the worksite and determined CBC and blood cell morphology. The strength of electric and magnetic field was determined by field meter.

Results: The laboratory findings show two leukemics (ALL, L2, AML, and M2) and ten normochrom normocytic anemic among exposed workers. Mean RBC count and the Hematocrit decreased significantly compared to controls‘($p< 0.05$), but the MCHC increased. The Neutrophile counts increased but Lymphocytes decreased significantly among workers considering their work history ($p< 0.05$)

Conclusion: This study indicates an increased prevalence of leukemia among exposed workers was related to electromagnetic fields .

Key words: ALL, AML, leukemia ,BLOOD CELL,EMFs

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-105

EVALUATION OF DOSE EQUIVALENT TO THE PEOPLE ACCOMPANYING PATIENTS IN DIAGNOSTIC RADIOLOGY

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Abstract

X rays used in diagnostic radiology contribute a major share to population doses from man-made sources of radiation. In some branches of radiology, it is necessary to immobilize the patient to carry out radiological operation. ICRP 70, recommends that this should be done either by parents or accompanying nursing or ancillary personnel and not in any case by radiation workers .This paper attempts to measure the dose equivalent of the people accompanying patients during radiological examinations in a section of emergency in one of Shiraz hospitals .Exposure measurements were carried out for 10 types of different types of radiological examinations such as pelvis ,chest ,abdomen ,etc ,using four element TLD-cards and Harshaw TLD reader model 4500 .About 50% of the people accompanying patients were young women . For a group of 100 examinations, the dose equivalents ranged from 0.099 μsv to 0.13 msv with the average of 0.05 msv

Key words:diagnostic radiology,ICRP, radiation,dose

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-106

EXAMINATION FREQUENCIES AND PATIENT DOSE FROM CT EXAMINATIONS IN IN YAZD, IRAN

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Background/Objective: With the introduction of computed tomography in diagnostic radiology a new and fundamentally different imaging modality become available. Meanwhile, it become clear that absorbed doses to patients during CT were relatively high compared with those from other diagnostic radiology techniques. The aim of this survey was to determine the average dose to the Yazd province population from CT examinations and survey of potential risk of inducing per year from these examinations.

Methods: This study was conducted in Yazd city between the years 2005-2006, the examination frequencies from 3 CT scanners were collected from all type of examinations. Effective whole body dose were determined by CT Dose program (ImPACT CT patient dosimetry calculator). For use of this software it must be measured $CTDI_{air}$ and be added mAs , thickness and number of slice in each type CT exams [(17)]. $CTDI_{air}$ was measured by pencil diode detector (Unfors mark)

Results: It was estimated that the collective dose and caput dose was about 32.48 person-Sv, and 0.038 mSv per year respectively for the Yazd population, which is lower than the many of countries.

The number of examinations per 1000 people of yazd was 18 that is about of many countries such as UK, New Zealand. The man effective dose of each CT exams were lower than that of it's in the many of countries.

Conclusion: Using the ICRP risk factors, radiation dose from CT could be inducing about 1 fatal cancer per year in Yazd. So selection of CT imaging must be completely justified.

Key words: CT dose, CTDI, Effective dose, caput dose, DLP

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-107

ASSOCIATION OF ATHEROSCLEROSIS IN CAROTID ARTERY WITH ELASTIC MODULUS OF BRACHIAL ARTERY

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Introduction: Common carotid arterial stiffness can be assessed during carotid arterial ultrasonography, but its association with brachial stiffness, a well-defined cardiovascular risk factor, has not been clarified. The aim of the present study was to examine the relationship between common carotid artery and brachial artery stiffness.

Materials and methods: Static pressure-strain elastic modulus of common carotid and brachial artery were evaluated in 40 men, including 15 healthy, 15 mild carotid stenosis and 10 severe carotid stenosis, (mean age of 64±10yr) by B-mode and Doppler ultrasonography. Local elastic modulus was estimated by measurement of arterial strain, also static pressure based on peak systolic and end diastolic velocity in each artery.

Results: The elastic modulus of brachial artery increased linearly with growth of atherosclerosis in right common carotid artery from 2639±1096 for healthy to 5587±1592 for severe stenosis. There were significant differences in static pressure-strain elastic modulus of right common carotid artery and right brachial artery in three groups. Pearson correlation analysis showed a significant correlation between elastic modulus of right common carotid artery and brachial artery ($r= 0.56$, $P<< 0.01$).

Conclusion: Thus, brachial artery elastic modulus is moderately associated with common carotid elastic modulus. In summery, this study showed that atherosclerosis is a generalized process that may involve the entire vasculature. But, there appear to be fundamental differences in the dynamic behaviour of the brachial artery when compared to elastic arteries, such as the common carotid artery. \

Key words: static pressure-strain elastic modulus, Carotid artery, Brachial artery, Atherosclerosis

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-108

PREPARATION FOR AND INITIAL MEDICAL RESPONSE TO NUCLEAR INCIDENTS

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Most medical providers feel that they will never be faced with the possibility of serious radio active incident while radiation is a fact of our life, all round us, all the time!
We live in a naturally radiation world. But how much do physicians, nurses and medical technicians who may have to respond in a radiation emergency?
This article is intended to inform us on the properties of radioactive materials and their effect on human life, and we will answer: how to protect against it? What should we do in radiation incidents? What is the mechanism of damage? What are the clinical radiation syndromes? How to recognize and initially respond to an accidental radiation injury?
Radioactive phenomenon discovered by French scientist HENRI BECQUEREL in 1896.since the discovery of ionizing radiation, knowledge of its detrimental effects has accumulated .despite considerable safety; accidents may happen which might injure people .radiation sources are widely used in medicine, industry, agriculture and research. They might be out of proper control and this can lead to injuries to persons who came into contact with them.
Lack of knowledge about the consequences of exposure to radiation is one of the main reasons why many accidental injuries are not recognized early enough for the most effective time treatment.

Radiation

Radioactive material release energy in the form of electromagnetic waves or energy particles. There are three types of radiation:

1. alpha particles
2. beta particle
3. gamma rays

Radiation and living tissue:

Injury to living tissue results from the transfer of energy to atoms and molecules in the cellular structure of the tissue. The radiation can do the following:

- produce free radical
- break chemical bonds
- produce new chemical bonds
- cross-link molecules
- Damage molecules that regulate vital cell processes (such as DNA, RNA, and proteins).

What are the types of radiation exposure that might arise from an accident?

The exposure can be

- External to the body, in which case it may be to the whole body or limited to larger or smaller parts of the body.
- Internal due to contamination with radioactive materials, if ingested, inhaled or deposited in wounds.

Expose can be acute, protracted or fractioned .it can occur alone, or combined with other injury, such as trauma, thermal burn,…

Protection from contamination:

The most important point is: the emergency of radiation casualties depends upon the type of exposure and the amount of exposure.

Protection from the immediate effect of the nuclear explosion is possible by sheltering from the blast, heat, light and shock waves and then quickly moving to or remaining in well sheltered locations to protect from fallout radiation and keeping away from contaminated areas. Protection from radiations involves four elements which will be described completely in full text.

Decontamination and goals of it:

The necessity and principles of decontamination are well known to all medical providers. There are conflicting purposes and goals in decontamination:

- Prevention of personal contamination.
- Prevention of contamination of the responder's equipment and workplace.
- Patient care
- Protection of the environments
- Satisfaction of legal requirements

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-110

STUDY ON INVIRONMENTAL RADIATION (TRR) AT TEHRAN RESEARCH REACTOR'S CONTROLLED AREAS BY USING RADOS MONITORING SYSTEM

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According to ALARA philosophy, it is required to minimize radiation exposure to radiation workers and public As Low As Resonably Achievable.
To achieve this goal recognition of radiation sources, measurement of radiation exposure to works and reasons of exposure are important.
In this study , which is a part of the project " measurement and study of personnel dose and invironmental radiation of TRR's controled areas" , invironmental dose of TRR's controled area by using Rados monitoring system and for a period of 6months time had been measured in 8 selected location.these selected locations are as follows:
control room, pump room, stack, bridge, bhf or down section of reactor, west section of reactor, north section of reactor, hall. The measured amount of dose had been compared with national and international standards.
Final results show invironmental exposure of Gamma is comparable to the international standard limits and variation in dose is directly associated to TRR power and releasing the irradiated samples.

Key words: reactor, invironmental dosimetry, radiation protection, monitoring, Rados

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-111

DETERMINATION OF ATTENUATION COEFFICIENT OF CO-60 GAMMA RADIATIONS IN BARITE CONCERT

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Introduction: Because of develop in the use of high energy x-ray in Iran radiotherapy centers and lack of skill in the bunker design in Iran, this research with subject of optimization in mixture of barite in concrete was designed for MSc student project. Determining of the barite aggregation for maximize radiation attenuation and minimize wall thickness bunker was our aim.

Material and Methods: For increase of concrete density, the barite stone of Ardakan mines was used. Barite aggregation variations with ratio of cement and water were examined. The dimensions of cubic concrete specimens for compressive strength were 15×15×15 cm. The concrete rectangular cubic with cross section of 10×10 cm and the thicknesses of 5 to 40 cm were used to examine attenuation properties of barite concrete. The concrete specimens were irradiated by gamma narrow beam of Phoenix Theratron Cobalt and radiation measurements were done by the Farmer ionization chamber (FC65P) in Shahid Ramazanzadeh radiotherapy center of Yazd.

Result & discussion: The barite concrete specimen with ratio of water to cement (W/C = 0.45), cement amount (350 kg/m^3) and equal fine and coarse aggregate had the least H.V.L. and the maximum compressing strength. Then, this characteristic sample has selected as the best conditions. Because of exist of rich barite mines in Iran and use of the liter thickness of barite concrete wall relative to general concrete wall; use of the barite concrete in cobalt and Linac bunker is proposed**.**

Key word: Barite concrete, half value layer, 60-cobalt, protection

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-112

APPLICATIONS OF CRYOTHERAPY IN MEDICINE & SPORT MEDICINE

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Abstract

Cryotherapy called cryosurgery, cryoablation or targeted cryoablation therapy, refers to the application of extreme cold to destroy diseased tissue, including cancer cell. The purpose of this study is to determine applications of cryotherapy in medicine and sport medicine. We study several review articles to introduce its comprehensive applications. Results of this study will be presented in full text article.

Key words: cryotherapy, application, medicine, sport medicine

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-113

BONE DENSITOMETRY A TOOL TO DIAGNOSE OSTEOPROSIS

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Bone densitometry is most often used to diagnose osteoprosis, a condition that often affects women after menopause but may also found in men. This exam also assess risk for developing fractures, is effective in tracking the effects of treatment for osteoprosis or for other conditions that cause bone loss. In this document we review characteristics of this procedure to know limitations of bone densitometry and the benefits vs. risks.

Key words: Bone densitometry, Osteoprosis, Benefits, risks

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-114

RADIOLOGICAL STUDIES IN THE ELEVATED NATURAL RADIATION AREAS OF RAMSAR (IRAN)

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The potential annual effective doses of the public in Ramsar and its elevated level natural radiation areas (ELNRA) from cosmic ray, environmental gamma exposures and Radon were determined. This paper reports the potential annual effective doses from the external and internal exposure, the rate of which was measured in 1000 locations outdoors and in 800 locations indoors, 200 in ENLRA and 600 in low level natural radiation areas (LLNRA). An SPP2 Scintillometer, a Reuter-Stokes pressurized ionization chamber and a SAPOS system of an environmental early warning network were used for measuring the exposure rates and radon is measured by using a passive method during different seasons in a year. The exposure rates in the air outdoors range from 0.011 to 2 mR h^{-1} with occasional higher values up to 10 mR h^{-1} over some hot spots. The isodose and topological exposure rate maps of the region were drawn. The cosmic ray dose rate of 32 nGy h^{-1} was measured over the Caspian Sea using the pressurized ionization chamber. The exposure rates in the air indoors range from 0.011 to 3 mR h^{-1} with occasional higher values up to 10.5 mR h^{-1} on the wall of one room in a house in Talesh Mahalleh. The mean absorbed dose rate in the air outdoors and indoors calculated as 1153/77±3728/94 $nGh^{-1}$and 765/26±1397/47 nGh^{-1} respectively. The potential annual effective doses of the public in ELNRA range from 0.66 to 130.82 mSv with a mean value of 5.99±۱۸.00 mSv, and in LLNRA, these range from 0.6 to 1.5 mSv with a mean value of 0.7 mSv. The mean potential annual effective doses in ELNRA are about 10 times higher than those in ELNRA, but some individual effective doses are about 200 times higher than the mean of LLNRA. By considering the internal exposure due to ^{222}Rn, the potential annual effective doses in ELNRA range from 2/54 to 281/5 $mSvy^{-1}$ with a mean value of 14/61±39/14 $mSvy^{-1}$.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-115

STUDY OF WAVELET TRANSFORMATION IN MEDICAL IMAGING

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Abstract

Wavelet transforms and other multi-scale analysis functions have been used for compact signal and image representations in denoising, compression and feature detection processing problems for about twenty years. Numerous research works have proven that this family of analysis functions provided a very efficient framework for signal or image data. This tool has very extended applications in medicines and biophysics. A multiresolution analysis gives a zoomed vision of a signal at different scales in such a way that disposal of different signal versions each of them characterized by a different detail level, is possible. One of the very important applications of this tool is denoising of signal and image that can be useful in medical imaging and denoising of them. On the other hand this tool is dependent on many variables such as Wavelet function, steps of image decomposition, Threshold and shrinkage function. Therefore they have different effects on image denoising. In this paper, at first introduction of this new tool and principal of denoising are explained, and then different stats of it are studied. It is shown that how this tool can be used in medical image denoising. Finally, using of this tool, the noisy image has been reconstructed with computing of different Thresholds and shrinkage functions. Optimal Threshold value and shrinkage function are recognized.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-116

IMPROVEMENT OF DOSE CALCULATION ACCURACY FOR PROMPT-Γ IVNAA SYSTEM-PHANTOM USING MCNP

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Abstract

Prompt Gamma *In Vivo* Neutron Activation Analysis (prompt-γ IVNAA), has been known as the most appropriate method for the measurement amount of body elements; and its main applications in nuclear medicine, are the measurement of small-mass body elements e.g. chlorine and potassium, or body certain elements which are unique constituents of body components e.g. nitrogen in protein and calcium in skeleton. For this aim, a prompt-γ IVNAA facility has been installed at Monash Medical Centre (MMC) Melbourne Australia, for the measurement of TBPr (Total Body Protein) in adults (Stroud *et al*, 1990; Borovnicar *et al*, 1991) and then applied to measure simultaneously TBN (Total Body Nitrogen) and TBCl (Total Body Chlorine) in children for diagnosis of CF (Cystic Fibrosis) disease (Borovnicar, 1996). This facility includes a paraffin-wax block (40cm × 40cm × 60cm) mingled with boric acid (%5 H_3BO_3 by weight). A collimator within this block makes an inverted, rectangular pyramidal void cast with aperture measuring 40cm (length) × 20cm (width) at a level of bed. A 0.2 GBq ^{252}Cf neutron source is positioned at the apex of this inverted pyramid. The Aluminium bed is located 50cm above the source as the trunk of patient exposure the neutron directly in vicinity of aperture of pyramid. Two pairs of NaI(Tl) detectors, located on both sides of the scanning bed, to detect the prompt gamma rays induced from the capture of neutrons by atomic nuclei in the body.

The most important quantity that must be considered, especially for children, is the absorbed dose of patient. As desired, the diagnosis should perform in at least time, absorbed dose of patient and with high accuracy. Therefore the IVNAA facility must be simulated to optimize the system by changing its parameters. The most accurate method to estimate absorbed dose and other interest quantities is the use of Monte-Carlo codes. So we used MCNP4C code to simulate this prompt-γ IVNAA facility, and also instead of patient, we used mathematical anthropomorphic phantoms. Theses phantoms are designed by ORNL (Oak Ridge National Laboratory) in six age groups, with different body organs that we simulated them by MCNP code. Replacement of these phantoms in compare with rectangular phantoms contain of water, causes fundamental reduction in error of total body dose estimation; and also we can calculate

absorbed dose of any organs separately. According to this point that in different organs amount of maximum of allowed absorbed dose is different, so desired effect of mathematical phantoms simulation is reduction of undesired effect on patient.

Capture of neutron's cross-section in all elements, has a reverse relevance with its velocity. So increasing in thermal neutron flux reduce the time of exposure and irradiation and it's followed by reduction of patient absorbed dose. Decrease of background radiation, and detector shielding from source's neutron and gamma cause increasing precision in measured prompt-γ spectrum and reduce the time of irradiation.

In this project, with simulating the system above, in addition to minimization of patient absorbed dose, maximization of thermal neutron flux in patient's body in order to increasing prompt gamma and decreasing the time of exposure has done; and finally we minimize destruction of detectors against neutron and gamma radiation.

Key words: prompt-γ IVNAA, Monte Carlo, Cf-252, TBPr

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-118

BENCHMARKING OF THE MCNP CODE FOR DOSE ESTIMATION ACCURACY FROM INTERNAL PHOTON SOURCES IN ORNL ANALYTICAL PHANTOMS AT VARIOUS AGES

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Abstract

In external or internal irradiation either diagnostic or therapeutic nuclear medicine, estimation of absorbed dose in each organ is very important. Most accurate way for this estimation is the use of Monte Carlo method in which many processes, physical systems and phenomena are simulated by statistical methods employing random numbers. Computerized anthropomorphic phantoms can either be defined by mathematical (analytical) functions or digital (voxel) volume arrays. Because these results could be used for some quantities' determination for different patients, such as time of scan, power of source, dose of radionuclide and etc. we chosen analytical phantoms that more general than voxel phantoms and on the other hand the prediction bone cancer risk, required estimation of absorbed dose in "bone surface" that can't be calculated in voxel simulation. Then we simulated modified Cristy and Eckerman's heterogeneous, hermaphrodite and anthropomorphic phantoms designed in six age groups, by MCNP4C Monte Carlo code. In these phantoms we modified the thyroid and neck models. The results of calculations of Specific Absorbed Fractions (SAFs) from internal photon sources, in most cases are in agreement with Eckerman's results but because of adding the neck, in some organs such as thyroid and brain, differences appear. Also some disagreements occur in large intestine wall.

Key words: SAF, Dosimetry, MCNP

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-119

EFFECTS OF CIMETIDINE ON WBC OF SYRIAN MICE IRRADIATION WITH GAMMA RAYS

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Introduction: Although natural possibility of cancer can occur during human life is 25 percent, it can be changed and increased by using environmental factors such as radiation. Using ionized radiation in medicine for diagnosis and treatment as well as in research and industrials, causes to damage and increase biological and genetic disorders in human. Understanding the effects of radiation on the human body and methods of preventing radiation damage is not only important for radiation workers, but also for public. Because of tumor no response to the low dose radiation, cancer treatment with low dose is not suitable. Since three decades ago researchers suggested to use radio protectors in combination with radiation treatment. The aim of this study is to introduce a type of drug with very low side effects.

Materials and methods: One hundreds and fifty male mice at the age of four weeks were purchased. Before irradiated they were kept in well condition. Mice divided into four main groups, two groups for test and two groups for control. Cimetidine solution was diluted in physiologic serum and administrated at a concentration of 15mg/kg body weight I.P. A few hours before irradiation, one group of mice was injected with cimetidine and its treated was continued for 30 days after irradiation. Mice were irradiated at dose rate of 0.67Gy/min with various doses such as 1,3,5,7 Gy, using a therapy unit Co-60 gamma ray machine. Mice were anesthetized with ether after 1, 5, 10, 20 and 30 days post irradiation. Blood sample was collected in a tube with heparin inside tube and samples were counted using an automatic cell counter. Analyzed data were carried out using one way and two ways analyzed variance by counting variations in number of WBC.

Results: Results were obtained with counting of variation in the number of WBC using one way and two ways analyzed variance. The results show that; in mice groups were irradiated only with gamma rays, the number of WBC of mice has P-Value<0.024 and for those treated with radiation and drug together, P-Value<0.0001. The effects of time factor on both groups have P-Value<0.181 and P-Value<0.005. The mutual effects of radiation and passing time shows P-Value<0.41, P-Value<0.004for radiation alone and treated with drug.

Discussion: Using one way and two ways of analyzed variance showed that no significant differences between two control groups, but in two groups of test were significant. In according to results were obtained from P-values in WBC we can conclude that cimetidine can modify the effects of radiation on WBC in mice.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-120

STUDY OF RADON GAS LEVEL AND ABSORBED DOSE IN STAFF AND VISITORS OF ALISADR CAVE

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Radon is a colorless, odorless radioactive gas which is found in every place, such as soil rocks, water natural gas, inside buildings and cave. Radon is a family member of the natural radioactive chain's of uranium-238 with half-life of 3.825days. Due to a very widely distributed element of Uranium-238 in the earth's crust, uranium often moved from one place to another place by underground water and deposited in Limestone and Dolomite materials. After cigarette smoking, radon is the second causes to lung cancer in the most parts of the world, which reported 2500 dead due to radon gas among in UK residences each year. Ali-Sadr cave is one of the most famous caves in the world, which is covered of water inside cave and with more than of 500000 tourists were visited from cave every year. The aim of this study is to determine radon concentration in Alisadr water show cave in order to estimate the radiation dose received by tourists and staff. Radon measurements were obtained, using CR-39 solid state nuclear track-etch detectors (SSNTDs). Detectors were placed at different location inside cave and outside of water surface of Ali-Sadar water show cave. Twelve detectors were placed at different distance of cave which far from 100 meters distance of each other. After 60 days all detectors were collected from inside cave and put inside the electrical batch for etching, and then put into scanner machine that directly connected to computer. The data ranges were from minimum counts of 494Bq/m^3 to maximum counts of 4317Bq/m^3. The median of the radon concentrations was 2280.42 Bq/m^3. The amount of dose received by visitors, who's spend more than four hours for queue and traveling inside the cave by boat was 0.0698mSv/day and 0.181 mSv/day for staff. Hence, the mean annual dose received by staff is 28.79 mSv/year.A new health concern of increasing risk of lung cancer for occupations areas of radon have been estimated based on studies of underground miners.Results showed that radon level is increased with increasing distance from main entrance. Due to lake of ventilation at the end of cave the radon level is increased with distance toward end of cave. Hence, existing in high level of radon concentration for a long times, may be caused the probability of inducing lung cancer increased. Therefore in area with high radon level, remediation work is necessary to reduce radon concentration. These remediation works can be create by ventilation or decrease time work for staff.

1st Human, Life and Radiation Conference
29-31 October 2006
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STUDY OF PATIENT DOSES RECEIVED IN CHEST X-RAY EXAMINATIONS

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Abstract

Medical radiation exposures have become an important component of the total radiation exposure of populations and diagnostic x-ray examinations represent the main source of exposure in this respect. X-ray examinations should be made using techniques that keep doses 'as low as reasonably practicable' (ALARP). The idea of diagnostic reference levels (DRLs) in diagnostic radiology have been introduced by the International Commission on Radiological Protection (ICRP) as an aid to restricting doses from medical exposures. Patient dose assessments are of crucial importance in the establishment of DRLs. Patient dose is often described by the entrance skin dose (ESD), which might be reasonable in cases such as quality control measurements, but it is not sufficient for comparing doses and techniques because ESD is not directly related to the radiation detriment. Another quantity, the effective dose, has been introduced to express a radiation detriment-related dose, which is defined as a weighted average of the doses to radiosensitive organs. However, knowledge of organ doses is necessary if the risk is to be evaluated with a greater detail than allowed by effective dose. Radiation doses in the various organs or tissues in the body cannot be measured directly in patients undergoing X-ray examinations, but they can be calculated with a reasonable accuracy on the basis of measured ESDs as well as required data on the X-ray examination technique. This study involved ESD measurements on more than 160 patients who went through chest X-ray examinations in GUMS hospitals in Rasht using thermoluminescent dosimeters (TLDs). Calculations were followed to estimate internal organ doses by employing PCXMC software, a PC-based Monte Carlo program developed by Radiation and Nuclear Safety Authority of Finland. TLD measurements were carried out using LiF: Mg, Cu, P chips, which are approximately tissue equivalent. Measured ESDs are in the range of 0.04-0.77 mGy with a mean of 0.21±0.09 mGy. Calculation results show that estimated doses for internal organs, especially those inside the exposure field, mostly follow the trend in measured ESDs. However, this does not apply to those organs outside the exposure field and the deviation from ESD trend strongly depends on the applied kVp and exposure field size.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-122

FREQUENCY OF ANEUPLOID CELLS IN 8-CELL EMBRYOS GENERATED FROM γ-IRRADIATED MALE COMPARED WITH PREOVOULATORY STAGE IRRADIATED FEMALE MOUSE

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The effects of exposure of male NMRI mice with γ-rays on numerical chromosome abnormalities in 8-cell embryos generated after mating with non-irradiated female mice in comparison with preovoulatory irradiated female mice mated with non-irradiated male mice was investigated. The 8-11 weeks male NMRI mice were whole body irradiated with 4 Gy γ-rays. After 4 days, they were mated at weekly intervals with superovoulated (by using 10 iu PMSG followed by 10 iu HCG injection), non irradiated female mice in successive 6 weekly periods. Female mice were also irradiated before ovoulation induction with 4 Gy gamma rays. About 68 h post coitous (p.c.), 8-cell embryos were fixed on slides using Dyban method in order to screen for numerical chromosome abnormalities. Results show that in control embryos, 8% of metaphases were aneuploid where as in embryos generated by irradiated mice, the frequency of aneuploidy increased dramatically at all post irradiation sampling times ($P < 0.001$). However more chromosomally abnormal emberyonic cells were obsereved in groups of 4-6 weeks after irradiation ($p<0.05$). Embryos generated by females irradiated with gamma rays also showed a high frequency of aneuploid cells compared to non irradiated control ($p<0.01$). However, this increase was not as significant as was observed in irradiated males. Data indicate that γ-irradiation affects spermatogenesis at all stages and causes DNA alterations in sperms that may lead to chromosome abnormalities in subsequent embryos. Lower frequency of chromosomal aberrations induced following maternal irradiation might be due to the repair cpacity of oocytes to repair radiation induced DNA damages. Chromosomally abnormal embryos usually do not survive to pass the full term of pregnancy.

1st Human, Life and Radiation Conference
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FREQUENCY OF MICRONUCLEI IN 4-8 CELL EMBRYOS AFTER MATERNAL GAMMA-IRRADIATION OF MICE IN THE PRESENCE AND ABSENCE OF VITAMIN C

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The objective of this investigation was to evaluate the rate of chromosome aberrations expressed as micronuclei (MN) in 4-8 cells embryos after maternal irradiation in NMRI mice. Female NMRI mice were whole body exposed with 4.0 Gy gamma-radiations after PMSG injection (10 iu, ip). Two days after, HCG was injected (10 iu, ip) and mated with non-irradiated NMRI male mice. Presence of vaginal plaque was considered as pregnancy on the day after mating. Pregnant animals were sacrificed by cervical dislocation and embryos flushed out from the oviducts and fixed on slides using standard methods to observe MN in embryonic cells at interphase stage. To investigate the protective effect of vitamin C (ascorbic acid) on the frequency of MN, 100 mg/Kg ascorbic acid was injected intra-peritoneally one hour prior to gamma irradiation. Results show that the rate of MN observed in embryos generated from irradiated mother compared to control group (non-irradiated male & female mice) increased dramatically ($P<0.001$). Administration of vitamin C 1 hour before irradiation significantly reduced the frequency of radiation induced micronuclei, compared to control irradiated group ($P<0.001$), while vitamin C alone did not produce significant increase in MN compared to control ($P>0.05$). The way in which vitamin C reduces clastogenic effects of radiation in embryos generated from irradiated female mouse is not fully understood but it might be due to antioxidative effects or free radical scavenging properties of vitamin C.

1st Human, Life and Radiation Conference
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ASSESSMENT OF USING NEW SCINTILLATION CRYSTAL ($LABR_3$) IN PET SYSTEM BY MONTE CARLO METHOD

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PET (Positron emission tomography) is a powerful and sensitive technique for functional imaging in the field of nuclear medicine. Inorganic scintillator crystals are the most commonly used detectors for PET systems. The choice of the scintillator is a fundamental element of a PET design. The current generation of conventional whole body PET and also dedicated PET scanners tend to use BGO (bismuth germinate), LSO (Lutetium oxyorthosilicate) and GSO (Gadolinium oxyorthosilicate) detectors. Recently cerium doped lanthanum bromide (LaBr3: Ce), under development by Saint Gobain (France) has been suggested for using in PET systems.

The advantages of $LaBr_3$ in comparison of BGO, LSO and GSO are: its high light yield (more than 2.4 times of LSO and more than 7 times of BGO and GSO), its excellent energy resolution (2.9%) which is about 30% of other mentioned scintillation crystals. The shortcomings of $LaBr_3$ in comparison of BGO, LSO and GSO are: its photo-fraction is about half of the LSO and GSO and one third of BGO, its density and effective atomic number of it are about 70% of above mentioned crystals. In this research, a currently available conventional WB-PET system (GE Advance, GEMS, Milwaukee WI,) whose performance characteristics were available to us, was studied when its crystals are one of the BGO, LSO or $LaBr_3$ in each study. For this research we used a NEMA standard Lucite cylindrical phantom and the Monte Carlo simulation programming package: PETSIM.

The results show the $NECR_{max}$ (Noise Equivalent Count Rate) of WB – PET system with $LaBr_3$ crystal were about 1440, 1108, 784, 620 (Kcps) in comparison with LSO which their $NECR_{max}$ were 1312, 1054, 781, 628 (Kcps) for coincidence window of 1, 2, 4, 6 (ns) respectively. The $NECR_{max}$ of WB-PET with BGO crystal and 12.5 (ns) coincidence window was 250 (Kcps). These results promise, $LaBr_3$ can potentionally lead a significant improvement in WB- PET performances especially for narrow coincidence window.

1st Human, Life and Radiation Conference
29-31 October 2006
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EFFECTS OF CIMETIDINE ON WBC OF SYRIAN MICE IRRADIATION WITH GAMMA RAYS

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Introduction: Although natural possibility of cancer can occur during human life is 25 percent, it can be changed and increased by using environmental factors such as radiation. Using ionized radiation in medicine for diagnosis and treatment as well as in research and industrials, causes to damage and increase biological and genetic disorders in human. Understanding the effects of radiation on the human body and methods of preventing radiation damage is not only important for radiation workers, but also for public. Because of tumor no response to the low dose radiation, cancer treatment with low dose is not suitable. Since three decades ago researchers suggested to use radio protectors in combination with radiation treatment. The aim of this study is to introduce a type of drug with very low side effects.

Materials and methods: One hundreds and fifty male mice at the age of four weeks were purchased. Before irradiated they were kept in well condition. Mice divided into four main groups, two groups for test and two groups for control. Cimetidine solution was diluted in physiologic serum and administrated at a concentration of 15mg/kg body weight I.P. A few hours before irradiation, one group of mice was injected with cimetidine and its treated was continued for 30 days after irradiation. Mice were irradiated at dose rate of 0.67Gy/min with various doses such as 1,3,5,7 Gy, using a therapy unit Co-60 gamma ray machine. Mice were anesthetized with ether after 1, 5, 10, 20 and 30 days post irradiation. Blood sample was collected in a tube with heparin inside tube and samples were counted using an automatic cell counter. Analyzed data were carried out using one way and two ways analyzed variance by counting variations in number of WBC.

Results: Results were obtained with counting of variation in the number of WBC using one way and two ways analyzed variance. The results show that; in mice groups were irradiated only with gamma rays, the number of WBC of mice has P-Value<0.024 and for those treated with radiation and drug together, P-Value<0.0001. The effects of time factor on both groups have P-Value<0.181 and P-Value<0.005. The mutual effects of radiation and passing time shows P-Value<0.41, P-Value<0.004for radiation alone and treated with drug.

Discussion: Using one way and two ways of analyzed variance showed that no significant differences between two control groups, but in two groups of test were significant. In according to results were obtained from P-values in WBC we can conclude that cimetidine can modify the effects of radiation on WBC in mice.

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29-31 October 2006
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COMPARISON ON URANIUM REMOVAL EFFICIENCY OF ION EXCHANGE AND ADSORPTION PROCESSES FROM WATER

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Uranium chemical and radioactivity specification caused deferent problems (various cancers) in environment, especially with water consumption (nephric diseases), therefore it's removal from water is an essential task from a scientific, as well as , water supply with special quality for industries. The main objective of this research was to determine the efficiency of ion exchange and adsorption processes in uranium removal from water. The research was carried out on the basis the anionic resins(Dowex – X8 and Amberlite CG-400) and two kinds of GAC (synthesized in Iran and Germany) selection, uranium solution preparation (synthetic) determine of optimum pH and contact time, capacity of resins and adsorbents, and absorption curve. Moreover, Laser Fluorimetry (LF) were used for measurement of uranium concentration. Maximum uranium (absorption/adsorption) by the resins and Adsorbents were respectively in range of 2.5–3and1.5–2(Absorption/ Adsorption) capacity of Dowex , Amberlite, GAC(Iranian) and GAC(Merck) were respectively 22.50 , 16.90 , 6.10 and 4.58 [mg.U/ mL.(R or A)]. In the fixed time, uranium absorption for Amberlite, Dowex , GAC(Merck) and GAC(Iranian) were respectively 94% , 84% , 27% and 23%.In comparison with variables of the study, uranium removal efficiency of ion exchange process was more than that of adsorption process.

Key words: Uranium, Water, Ion exchange, Adsorption

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29-31 October 2006
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HLR-P-127

PREPARATION OF $CASO_4$:DY (TLD-900) ,AND ITS APPLICATIONS IN ENVIRONMENTAL DOSIMETRY

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Abstract

Today, using of TLD in dose measurements is widespread field in helth physics. $CaSO_4$:Dy (TLD-900) is a good material for environmental dosimetry. It has a high sensitivity and linear dose dependence in a sufficient range of radiation doses for environmental monitoring.In this investigation, I purpose a metode for preparation and I survey thermoluminescent properties of $CaSO_4$:Dy sake to environmental dosimetry of gamma rays and high energy electron beem. $CaSO_4$:Dy is one of the most sensitive TLD . This TLD can measure doses in very low levels($2\,\mu Sv$) and it is very suitable for environmental dosimetry of UV rays.But it don't have produced yet in IRAN.

1st Human, Life and Radiation Conference
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HISTOLOGICAL STIMULATORY EFFECTS INDUCED BY TOPICAL APPLICATION OF RADIOACTIVE LANTERN MANTLE POWDER ON RATS' NECK WOUNDS

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Abstract

Background: Wound healing is a complex and dynamic process that its different aspects have long been investigated by many researchers around the world. Some lantern mantles contain low levels of radioactive thorium for maximizing the light output, while non-radioactive mantles contain yttrium. Burned mantle is being used as a wound healing powder to prevent the bleeding and infections caused by injuries. Considering hormesis concept that is the stimulatory effect of small doses of a toxic substance which is inhibitory in larger doses, low doses of ionizing radiation evoke a biopositive effect while high doses usually produce detrimental effects. The main purpose of this study was to assess the possible induction of histological hormetic effects by topical application of radioactive lantern mantle powder on rats' neck wounds.

Materials and Methods: In this study, 36 male rats randomly divided into two groups of 18 animals each. Full thickness excision wound (314±31.4 mm^2) was made on the dorsal neck in all animals after inducing general anesthesia. For the first 3 days, cases received topical application of the radioactive lantern mantle powder while controls received non-radioactive lantern mantle powder. Three, seven and fourteen days after wounding, 6 rats were chosen by random in each group for wound sampling. In order to perform our histological study, four criteria were considered including fibrinoid necrosis and exudate neutrophilic, granulation tissue formation, superficial epithelization and collagen fiber synthesis. Samples were scored

and classified based on the existence and severity of each criterion. After collecting data, the statistical analysis was performed by SPSS software.

Results: The results of this study showed a significant statistically difference between cases and controls with respect to fibrinoid necrosis and exudative neutrophilic at the days 3 and 14. Considering the existence of granulation tissue, a significant difference was observed between case and control groups at days 3 and 7. No difference was observed in superficial epithelization and collagen fiber synthesis at all days.

Conclusion: Based on the results of this study, it can be concluded that the radioactive lantern mantle powder is capable of decreasing inflammatory reactions and enhancement of wound healing. These results confirm the findings of other investigators who showed a wide variety of hormetic effects in human and laboratory animals after exposure to low levels of ionizing radiation.

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EVALUATION OF RADON GAS AND ABSORBED DOSE, IN RESIDENCE OF HAMEDAN HOUSES

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Introduction: Lung cancer is one of the most founded of cancer in Iran. There are two main important factors in producing lung cancer, which radon is the second one after cigarette smoking. Radon is a colorless, odorless radioactive gas which naturally occurring through decay of Uranium series. Whether or not exposure to radiation will cause cancer depends on a variety of factors such as radon concentration in environment. The aim of this study is measuring radon concentrations at dwellings of Hamedan and determine absorbed dose in occupations.

Materials and Methods: Radon measurements were carried out, using CR-39 solid state nuclear track-etch detectors (SSNTDs) in residences' houses of Hamedan, which is located in west of Iran. The CR-39 detectors were placed at sitting room and bed room inside of house for about of 90 days. After collecting all detectors they were put in etching bath with 32% weight of NaOH solution and then measured with automatic scanner.

Results: The median radon concentrations during winter and summer seasons were $152 Bq/m^3$ and $25.1 Bq/m^3$ respectively. Dose absorbed of radon gas by residences were measured in SI units and was 1.44mSv and 0.20mSv in winter and summer respectively. The total absorbed dose for whole year was approximately 2mSv.

Discussion: Analyzed data show that the median level of radon gas in winter is more than in summer. This differences is due to lack of naturally and artificially ventilation system during winter seasons. In winter because of cooling weather and closing all windows, in addition heavier of molecular weight of radon gas in compared with air, the concentration of radon gas increased and this caused more dose absorbed in occupations.

Key word: Radon gas, Absorbed dose, residence of Hamedan

1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-131

INCREASED MERCURY RELEASE FROM DENTAL AMALGAM RESTORATIONS AFTER BRAIN MAGNETIC RESONANCE IMAGING

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Abstract

Background: The introduction of magnetic resonance (MR) technology as a clinical imaging method has caused a substantial increase in patient exposure to static, gradient and radio frequency electromagnetic fields. Early experiments on undersea welders showed that electromagnetic fields might alter the evaporation of mercury from dental amalgam restorations. The aim of the present study was to assess the release of mercury from human dental amalgam restorations after exposure to electromagnetic fields produced by conventional MR imaging.

Materials and Methods: Studied population consisted of individuals with at least 4 teeth with amalgam restorations. The time passed from the last restoration was not more than one week. Thirty persons, who met the **inclusion criteria** for our research and were referred to magnetic resonance imaging (MRI) department of Ali-ebn Abitaleb Teaching Hospital, were investigated. For each patient a questionnaire was filled out and basic information regarding their possible sources of exposure to electromagnetic fields, occupation and life style recorded. Then 5cc stimulated saliva was collected just before and after MR imaging. The magnetic flux density was 0.23 T, and the duration of exposure of patients to magnetic field was 30 minutes. Collected saliva samples were sent to laboratory and mercury level was measured by using cold-vapor atomic absorption method.

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Results: Minimum concentration of mercury in saliva before MRI was 0.5 $\mu g/dl$ and its maximum level was 1.5 $\mu g/dl$ (its average was 0.86 ± 0.3 (mean ± SD)). Minimum and maximum concentrations of mercury in saliva after MRI were 0.5 $\mu g/dl$ and 2.5 $\mu g/dl$ (the average 1.13 ± 0.5 [mean ± SD]). Data analysis by using pair t-test showed a statistically significant difference between the concentration of saliva mercury before and after MRI.

Conclusion: According to the above mentioned results, in present study a significant relationship was observed between the mercury levels in saliva before and after MRI. This finding confirm previous reports regarding the increased release of mercury from dental amalgam restorations in undersea welders, although the amount of released mercury is not sufficient for causing a toxic effect in body. In this research, it is emphasized that MRI as an electromagnetic field can causes alteration in dental amalgam.

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1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-133

MICROCOSM MODULATION FOR DEGRADATION OF ENVIRONMENTAL POLLUTANTS USING COMBINATION OF ENHANCED ULTRAVIOLET RADIATION AND GENETICALLY ENGINEERED MICROORGANISMS

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There are documents and research papers on the effects of enhance UV radiation on carbon and mineral nutrient cycling in terrestrial and aquatic ecosystems and also on exchange of radiatively and chemically important gases between the biosphere and the atmosphere. Moreover several researchers have shown changes in microbial communities associated with decomposing litter following exposure to enhanced UV. It assumed that observed changes in microbial respiration measured during the controlled decomposition of litter in microcosms are a result of UV-induced changes in the microbial decomposer community. Therefore in this research proposal, design of a soil microcosms has been modulated which can be exposed to UV enhanced radiation and inoculated with consortia of wild type and genetically engineered microorganisms. Soil microcosms will contain certain amount of selected soil from 25 gr to 50gr adjusted to pH=7. Soil characteristics including matic potential, water content, organic and inorganic content could be determined prior to experiment. Then microcosms could be contaminated with a range of known pollutants. Microbial inocula will be added to soil in time 0 and micorocosms in whole exposed to enhanced UV radiation. Soil sampling will be performed in time intervals, survival of microorganisms and the rate of pollutant degradation can be measured using colony counting and spectrophotometery.

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THE 1ST QUALITY CONTROL PROGRAM FOR ASSESSMENT OF THE STATUS OF RADIATION PROTECTION IN RAFSANJAN INTRAORAL RADIOGRAPHIC FACILITIES

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Background: Intraoral radiographies are the most frequent X-ray examinations in humans. Due to the large number of intraoral radiographies, the collective does to the population is significant. According to International Commission on Radiation Protection (ICRP) recommendations, the selection of a diagnostic reference level (DRL) should be specific to a country or region. This quality control program was performed to assess the status of radiological protection in Rafsanjan intraoral radiographic facilities and also to contribute to the establishment of diagnostic reference levels for intraoral radiographies.

Materials and Methods: This study performed in 32 dental clinics in Rafsanjan, Iran in 2005. The quality control program consisted of recording the main characteristic data of dental radiographic machines (manufacturer, model, year of installation, and workload), irradiation parameters (kVp, mA, irradiation time, focus to skin distance, field size, collimation type, filtration, entrance surface dose)and overall compliance with radiation protection regulations (education , shielding , and personal monitoring). Entrance surface doses were measured using thermoluminescent dosimeters (TLD). Three TLD chips were placed on the skin of each patient. The doses were averaged for each for each radiography and mean ESD of all patients calculated.

Results: 12 out of 32 dentists (37.5%) had successfully passed radiation protection courses. In all 32 facilities, collimators had circular apertures. The radiographic machines examined covered a very wide range of brands, models and years of installation. Three facilities (8 %) were operating at 50 kVp, 3 at 60 kVp (8 %), 8 at 65 kVp (22%), and the remaining 18 units were operating at 70 kVp. Only 1 out of 32 clinics (4%) used personal monitoring devices for occupational dose measurements. Lead aprons for protecting the patients were available in only 8 clinics (25%). Thyroid and gonad shields were available in 8 (25%) and 6 clinics (18.8%) respectively. The mean ± SD entrance surface dose at the center of the beam on the patient's skin in intraoral radiography was 0.73 ± 0.57 mGy (ranged from 0.12 to 2.18 mGy).
Conclusion: Considering compliance with the radiation protection legislations, most dental facilities showed poor performances. Diagnostic reference level values of 2.5 and 7 mGy are proposed for intraoral radiographies by UK and International Atomic Energy Agency (IAEA) respectively. In this study, entrance surface doses measured in all clinics were within the acceptable range. The calculated third quartile value for ESD in intraoral radiographies was 0.9 mGy that could be adopted as a local diagnostic reference level. This is much lower than the above mentioned suggested DRLs.

QUALITY CONTROL DEVELOPMENT OF CUSTOM

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BLOCK MAKING IN RADIATION THERAPY IN SHOHADA HOSPITAL.

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Custom blocks are the most commonly used field shaping device in radiotherapy to make individual shields for patients while there is no multi leaf collimators device. They offer many advantages in daily clinical use. Care must be taken with their use, as with all accessories used for patient treatments. To check block cutting accuracy, a quality control program is recommended as a routine part of their clinical use. We have developed a three step method for checking custom blocks before they are used for patient treatment. These steps include: a static light check, a parallel opposed film check, and a block check involving the patient. By completing these three steps, we feel that we have improved the overall accuracy of our custom block making system which has resulted in more accurate treatments for our patients.

1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-137

EVALUATION OF THE HERMES QUALITY CONTROL PHANTOM IN SHOHADA HOSPITAL

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HERMES quality control system was designed for quick daily quality assurance (QA) tests of Medical Linear accelerator which is a major tasks of the medical physicist to verify that patients receiving proper radiation treatment every day. Different parameters could check by HERMES system such as beam output constancy, beam energy, beam flatness and symmetry. This device is accompanied by software generating the reports of all measured data, keeping track of day-to-day data, and plotting the results. The accuracy, reproducibility, and linearity of the QC phantom were evaluated in this project. Also, the user friendliness of this device for morning warm-up of linear accelerators was tested.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-138

CONSIDRATION OF AIR POLLUTION FALLOUT AT TEHRAN RESEARCH REACTOR

Z. Khorasani, H. Heidary, R. Salartash, N. Aghaei , M Zarrin

With progress of Nuclear Technology and global request for it, the research in the field of environmental contamination around of these Centers is necessary.
In this project the air pollution fallout is considered around theTehran Research Reactor.
The air pollution activity increase / decrease with air contaminant stability (Aerosols) and air condition is also studied.
Techniques and Methods: Air samples were obtained at several stations around the Reactor. 6-7 hour time intervals is considered as an optimal sampling time periods for determination of the air pollution.The Alpha counter, sodium iodide detector and Giger Moler detector are used for alpha, beta and gamma determinatiron. The above counters were used in conjuction with a 220V main power supply and a high voltage unit.
Results: The results indicate that during the stability condition of the air, the increase or decrease of the activity level in the stations were very close to each other. The level of Radon concentration in the samples depend on temperature and humidity of the air, after raining. The increase of the particles in the air, can increase the level of the radioactivity of the samples, due to the absorption of radioactive elements on the surface of the particle.

Key words : air pollution, Aerosol, fallout, air acetector

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-139

THERMOLUMINESCENCE DOSI METRY OF CAF2:DY

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Thermoluminescence (TL) is one of a family of processes collectively known as Thermally Stimulated Phenomena. This Penomena may be described by two fundamental stage : Stage 1 the perturbation of the system from equilibrium into a metastable stege ; and Stage 2 the thermally stimulated relaxation of thesystem back to equilibrium .Stage 1 necessitates the absorption of energy by the material in order to perturb it into a non- equilibrium state and in the case of TL the external energy source is ionizing radiation or UV light.the central objective of TL dosimetry is to determine how much energy per unit mass of material (dose) was absorbed by material during this process.this done by following the thermally stimulated release of the absorbenergy during the heatingphase via the measurement of the intensity of emitted light. The light emission (luminescence) is a result of the relaxtion of electron charges from ecited, metastable state to ground state. Thermolurninescent dosimeters (TLDs) cannot be used as absolute radiation detectors as there is no direct method to relate the thermoluminescence released from an irradiated sample to the amount of radiation received by the dosimeter material. Hence, al1 TLD systems must be calibrated by exposing the dosimeter to known amounts of radiation. As absolute dose measurements are usually only made in standards laboratories, secondary standards must be used. However, for many clinical measurements, it is often only necessary to have a cornparison of the radiation exposures at different spatial locations at different times, and hence relative measurements are adequate. Relative dose measurements have many advantages.it can be used over a large dosimetric range from 1 mR to10^5 R. These materials have high precision and many are tissue equivalent. After annealing they can be reused and will retain the information after irradiation for a long time. Rapid retrieval of this information is possible using on-site readers. TLDs are also found to have goodenvironmental stability. Applications of TLD :personnel dosimetry , environmental dosimetry, clinical dosimetry, high dose. CaF_2:Dy used over a renge from 600 R to 5×10^4R . the sensitivity of CaF_2:Dy (TLD-200) is approximately 30 times higher than for Lif (TLD-100).annealing of CaF_2:Dy is 10 min at 115°C also can be reduced sensitivity . fading of CaF_2:Dy 11% in one day ,14% in two day and 25% in one month.the fading rate can be significantly reduced by post irradiation thermal treatmaent.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-140

SAFETY ASPECTS OF THE CARGO CABINET X-RAY CONTROLLER

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Abstract

Nowadays the cargo cabinet X-ray controller is used as security equipment in the airports, shipping ports, private centers, governmental centers and post offices. This equipment identifies explosives materials, dangerous articles and other articles by using X-ray and radiographic imaging. This study is refereed to the safety aspects of cargo cabinet X-ray controller so the implementation of these guides resulted in negligible dose of ionizing radiation received by the operators of equipment and the general public with consideration of as low as reasonably achievable (ALARA) principle.

The cargo cabinet X-ray controller that belongs to Atomic Energy Organization of Iran (AEOI) was inspected in the research.

The results of this detailed study show that the amount of measured dose on the inside, surface, and one meter away from the equipment is far less than the registered standards of IAEA and ICRP.

Key words: cargo cabinet X-ray controller, X-ray, radiographic, explosives, safety.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-141

MEASUREMENT OF URANIUM CONCENTRATION IN WATER RESOURCES OF ARDABIL PROVINCE

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Abstract

Uranium is most important radioelements in earth's crust have heavy mass. Water resources especially groundwater's by geology characteristics contain the dissolved compounds of this radionuclide. Uranium chemical and radioactivity specification caused different problems (various cancers) in environment, especially with water consumption (nephric diseases). Maximum Containment level (MCL) determined by United States Environmental Protection Agency (USEPA) for uranium in drinking water is 20ppb. This research was accomplished in order to measure uranium concentration in water resources (surface and underground) of Ardabil province. This research was conducted on the basis of information collecting regarding water resources of Ardabil province, sampling with standard methods and uranium was measured using Laser Fluorimetry(LF). Uranium concentration in groundwater's (48 sample) were in the range of 0.35-17.50 ppb , in surface waters(4 sample) were in the range of 1.12-33.35 ppb and mineral waters (20 sample) were in the range 0.28-1.10 ppb. Uranium concentration in all drinking waters of Ardabil province was found less than MCL of uranium in drinking waters. But, concentration of uranium in Shorabil lake of Ardabil city for uses of nonpotable was more than 20 ppb.

Key words: Uranium, Water resources, Laser Fluorimetry, Ardabil.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-142

RADIONUCLIDE EMISSION MONITORING AND ESTIMATION OF DOSE AND RISK FOR A TYPICAL RESEARCH REACTOR IN NORMAL OPERATION BY CAP88-PC

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Nuclear reactor facilities are the source of radiation that release radioactive materials through their exhaust ventilation stack to air. Therefore, radionuclide emission monitoring and estimation of radiological dose and risk should be evaluated for the protection of personnel, public and environment. These results should be confirmed compliance with standards.

In this paper, CAP88-PC computer code (based on EPA standards) has been used to radionuclide emission monitoring and estimation of dose and risk for a typical research reactor in normal operation. CAP88 uses Gaussian plume model to estimate the average dispersion of radionuclide release from emitting source. This code requires environmental and radionuclide data to calculate radionuclide concentration and public dose assessment in different distances from the reactor.

Key words: Nuclear Reactor, Gaussian model, Dose, Risk

1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-143

EFFECT TI DOPANT FOR THERMOLUMINESENE PROPERTIES IN KBR-LIBR CRYSTAL AND INVESTIGATION CHARACTERISTICS LINEARITY TL RESPONSE IN KBR-LIBR :TI CRYSTAL

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Abstract

In this investigation mixed-single crystal pure KBr-LiBr dopant were grown by czochralsky metod.

In order to determinate thermoluminsence properties , crystal cleaved in standard size (3.5*3.5*1 mm), then irradated with Co-60 gamma-ray at room tempreature at dose range of a few mGy to 100Gy . The glow curve of KBr-LiBr:Ti crystal indicate that lithium caused traps and titanium caused luminescence center. For improvement the TL response of KBr-LiBr:Ti consentration of Ti crystal was decreased. Also in this dosimeter linearity characteristic of TL response in KBr-LiBr:Ti was studied.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-144

EVALUATION OF CS-137 LEVEL IN SOIL OF FARS PROVINCE AND ITS CORRELATION WITH ALTITUDE

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Abstract:
The present work aims to radiological assessment for Cs-137 as an important artificial radionuclide in the soil of Fars province, with the ultimate aim of establishing a baseline map of radioactivity background level in the Fars environment for this radionuclide. The baseline map will be used further as reference information to assess any changes in the radioactivity background level of Cs-137 due to any artificial influences on the Fars radiation environment especially the establishment of Boushehr Nuclear Power plant.
The activity concentrations of Cs-137 in soil, expressed in Bq.Kg-1 dry weight for the 126 samples were collected from different regions of Fars province. The samples were analyzed by direct gamma spectrometry using on HPGe detector.
The average, maximum and minimum values for Cs-137 has been 9.8 Bq.Kg-1, 50.6 Bq.Kg-1 and 1 Bq/Kg respectively. The maximum value has been reported from Shoul, North-west of Shiraz.The average value for Cs-137 and the maximum is comparable with common range of this radionuclide concentration in the soil of world. There is also a good correlation between Cs-137 and altitude of the sampling location.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-145

POSSIBLE ALTERNATIVE PHYSICAL TREATMENTS FOR VIRAL DISEASES

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Abstract

Viral diseases are serious and ever-increasing threat to the humankind. As days goby, we hear more and more about HIV, Ebola, Bird Flu and other dreadful viruses which were unknown a few decades ago. Unfortunately, in both detection and fighting viral diseases ordinary methods have come across some basic and important difficulties. This is a generally accepted term in medical science that 'we can not destroy viruses directly, only can help the immune system to fight them, or decrease their harmfulness'. For the time being, the most considerable 'hints and helps' that we can give the immune system is vaccination. The vaccination is by a sense introduction of the virus to the immune system before the occurrence of the real case. It is very successful against some viruses (e.g. Poliomyelitis), while totally ineffective against some others (e.g. HIV or Hepatitis-C). On the other hand, Antivirus drugs are mostly some tools to control and not to cure a viral disease. This could be a good motivation to try alternative treatments.

In this study, we present some key features of possible physical-based alternative treatments for viral diseases. Concepts of this multi-disciplinary study are: - Viruses are animate, therefore mortal, however we should find the most efficient way to eliminate them. You can not tear a stone or break a rubber. In contrary you can break a stone or tear a rubber. If typical treatments (e.g. chemical therapy with antibiotics) are disable to kill viruses, why should not we try alternative cures? - Generally, energy fields and waves affect all the objects, animate or inanimate, that conduct with. However the how of the effects depends on the physical characteristics of the object. - Since a hundred years ago several studies have reported on effects of acoustic waves, modified light beams, and electrical currents on micro organisms such as viruses.

- Physical characteristics such as dimension, weight, chemical and atomic structure, electrical properties (e.g. charges, conductivity, etc), and electromagnetic properties (e.g. magnetic polarization) of a type of virus can be considered and evaluated. The main approach of this study is to find a suitable energy field, with appropriate parameters that be able to kill or deactivate viruses. For instance: - Transmitting an acoustic signal to an infected area of the

body, using a adjusted acoustic signal with particular magnitude, wave shape, frequency, and phase, to affect a particular type of virus - Electrification of body parts or fluids (especially blood) with micro electric signals again with adjusted current, frequency, and so on.

- Using a particular sort of radiation to kill a particular type of virus. This would be a lengthy, heavy, and multi-disciplinary research which needs the contribution of virology, physics, and signal processing experts. As the first step, we are going to start with the computer simulation of a few viruses such as HIV to evaluate their physical characteristics and the possible effects of physical attacks on them.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-147

TH-232 AND K-40 RADIOACTIVITY CONTENT OF SOIL IN THE FARS PROVINCE AND THEIR CORRELATION

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Abstract

Fars province with about 4500000 population is located between Boushehr,Esfahan and Yazd provinces, where different nuclear sites are being established in Iran. To evaluate The impact of these establishments, studies on radiation level and radionuclide distribution in Fars province were undertaken. The purpose of this study, was determination of the concentrations of Th-232 and K-40 as the two natural radionucliodies in the soil and evaluation of their correlation. The measurements were made for 126 samples by a γ-ray spectrometry system using an HPGe detector surrounded with shielding material to reduce the background counting rate. The measured concentration of Th-232 varied between 4 to 43.1 Bq/Kg. With the maximum value of 43.1 Bq/Kg in Sepidan.

The activity concentration of K-40 varied in the range of 90 to 660 Bq/Kg . The maximum value has been reported from Sepidan located at the west of Shiraz. A good correlation was seen between Th-232 and K-40, with a correlation coefficient (R2) of 0.7.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-148

MACROSCOPIC BIO-POSITIVE EFFECTS OF BURNED RADIOACTIVE LANTERN MANTLE POWDER ON THE WOUND HEALING IN RAT

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Background: Poor educated people in some parts of Iran use burned mantles as a wound healing powder to prevent the bleeding and infections caused by injuries. Some lantern mantles contain low levels of radioactive thorium for maximizing the light output, while non-radioactive mantles contain yttrium. Although radioactive lantern mantles present a minimal radiation health hazard, it is generally believed when inhaled or ingested, thorium containing mantle powder, will be dangerous. To evaluate the effect of burned radioactive lantern mantles on wound healing this study was conducted.

Materials and Methods: Twenty rats were divided randomly into two groups of 10 animals each. After inducing general anesthesia, full thickness excision wound (314±31.4 mm^2) was made on the dorsal neck in all animals. The 1st group received topical burned radioactive lantern mantle powder at 1st-3rd day after making excision wounds. The 2nd group received non-radioactive lantern mantle powder at the same days. Accurate blind surface measurement of the wounds by transparency tracing was used for assessment of the wound healing at 1st, 3rd, 7th, 10th and 15th days after making wounds.

Results: Surface area measurement of the wounds showed a progressive surface reduction in both groups. However, for thorium treated group, the rate of recovery was significantly enhanced compared to that of the control group. Although the wound area in the thorium group was not significantly different from that of the control group at the 3rd and 5th days after wounding, a statistically significant difference was observed between the thorium and the control groups at the day7, day10 and day 15. The mean wound surface in thorium and

control groups were 150.20±15.87 and 186.37±12.68 mm^2 at day7 ($P<0.001$), 92.90±15.97 and 134.12±14.19 mm^2 at day 10 ($P<0.001$), 1.4±0.41 and 8.56±2.04 mm^2 at day15 after wounding, respectively ($P<0.01$)

Conclusions: These findings suggest that low-level radioactive burned mantle accelerates wound healing in rats. However, as thorium oxide is a known human carcinogen, more research is needed to clarify if low levels of radioactive burned mantle can be utilized for accelerating the healing of human wounds.

Key words: *Lantern mantle, wound healing, thorium, radioactivity*

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-150

CELLULAR PHONE ELECTROMAGNETIC RADIATION EFFECTS ON HUMAN BRAIN USING FUZZY LOGIC

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Different types of the appliances use electromagnetic beams with different power and frequency. High power microwave beams can influence the biologic environments and human. Up to now, there is no related document showing the effect of the low power electromagnetic radiation on humans. According to various documents and reports gathered since 20 years ago, there are no effects on human body from low frequency electromagnetic waves. An electromagnetic wave is generated by variable charge of electrical current in an antenna by an electrical power source. We propound the effect of non ionic Radio Frequency (RF) / microwaves (200- 24000 MHz) on the cells division in the growth phase, specially the brain cells. In the telecommunication systems, industry and medical equipment, Microwave is vastly used. So there is so much concern about using these appliances. Beams absorption by a biological system has two types of effects on the cells: 1) thermal effects, 2) non thermal effects. Non thermal effects of the RF beams are not investigated by scientists clearly. RF beams causes temperature increment in the cells because of dissipating the electromagnetic induction energy as the electrical current which is circulated in the cell. The electrical current creates the undesired heat. As far as we know RF power of the cellular phones is 0.5 to 5 watt. Approximately half of this power is absorbed with the phone talker. Also the RF power of the mobile communication central stations installed in residential and industrial areas reaches to 5 to 10 kilowatts that can cause unwanted effects on biologic environments and human. In the full paper we propose an idea of analyzing the thermal effects of the RF beams on the brain cells using fuzzy logic. In this method some parameters such as power of RF beam, time long of the radiation, distance of the radiation source, etc, are imported to the fuzzy analyzer developed in MATLAB software environment. The fuzzy analyzer is based on some IF-THEN rules which are obtained from the previous studies, experimental data and available RF appliances. There is no clear formula about the thermal effects of the cellular phones on the body cells; therefore, fuzzy logic helps us to determine the intensity of the effects in an area. The fuzzy analyzer gives us the danger rate of the RF radiation in a specific area specially brain. The temperature increment pattern in the brain can be predicted by using the fuzzy analysis results.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-151

STUDY OF WATER INVENTORIES OF NATURAL AND ANTHROPOGENIC RADIONUCLIDES IN SOUTHWEST CASPIAN REGION

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Abstract

Inventory measurement of natural radionuclides Radium-226 (^{226}Ra) and Potassium -40 (^{40}K) as well as anthropogenic ones, Cesium-137 (^{137}Cs) and Strontium-90 (^{90}Sr), besides total alpha and beta counting has been carried out on drinking water, spring water, surface water and sea water samples in southwest Caspian region. This study is considered as part of a comprehensive measurement program of environmental radioactivity in North-Alborz ecosystem. Measurements of ^{226}Ra, ^{40}K and ^{137}Cs inventories in water samples have been performed using HPGe gamma spectrometry system. Measurement results indicated a range of 11.0 to 93.0 Bq l^{-1} for ^{40}K specific activity, whereas the levels for ^{226}Ra and ^{137}Cs were lower than the detection limits of the system (LLDs) of 0.1 Bq l^{-1} and 0.3 Bq l^{-1}, respectively. The follow up measurement of ^{226}Ra by more sensitive radon emanation method indicated a range of 2.0 -38.2 mBq l^{-1} for this radionuclide. Attempts were made also to measure ^{137}Cs inventory levels using radiochemical (AMP) and physical (Anfezh) methods, which led to a range of 2.4 to 7.4 mBq l^{-1} for southwest coastal water of Caspian Sea and lower than LLD of 1.5 mBq l^{-1} for water samples from Aras River. Total alpha and beta measurements, which were performed by applying precipitation method and using gas proportional counters, indicated a range of 38.3-92.6 mBq l^{-1} and 41.8-263.6 mBq l^{-1}, respectively. In the case of ^{90}Sr inventory measurement, radiochemical separation followed by beta analysis resulted in a range of 8.2-10.3 mBq l^{-1} for southwest coastal water of Caspian Sea and lower than LLD of 3.0 mBq l^{-1} for water samples from Aras River.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-152

STUDY OF ^{222}RN CONCENTRATION LEVELS IN GUILAN DWELLINGS

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Abstract

Radon-222 (^{222}Rn) is a naturally occurring colorless, odorless, and tasteless radioactive gas with a half-life of 3.8 days, which is produced in the uranium decay chain. It is a product of the radioactive decay of Radium-226 (^{226}Ra). All rocks contain some uranium-most of them in the region of 1 to 3 parts per million (ppm) of uranium. Granite rocks, as volcanic rocks, dark shale and certain sedimentary rocks, have higher than average uranium content, as much as 100 ppm. The higher the uranium content in rocks and soil in an area, the greater the chances of higher radon levels indoors.^{222}Rn along with its short-lived daughter products deliver the largest component of radiation dose to the general public. Therefore, measurement of its concentration in dwellings is of crucial importance in the assessment of population exposures. To perform such a measurement, passive radon diffusion dosimeters (etched track detectors installed in the AEOI diffusion chamber) were employed in this survey. The detector consists of a film, namely CR-39 (polyallyl diglycol carbonate), which is housed in a tight-fitting container with a filter that permits radon gas to enter, but not its progeny. After few months' exposure in the field, these films are processed in EC-chambers before being counted for tracks under a microscope to give a measure of exposure. More than 80 measurement stations were selected, mostly at rural health centers, throughout Guilan Province including Astara, Talesh, Rezvanshahr, Anzali, Rasht, Fouman, Somesara, Shaft, Masal and Roudbar. Measurements were carried out in three periods over a year. The range of radon-concentration levels in the region of interest is 18-340 Bq m^{-3}. On the basis of collected data, concentration levels of 30 to 50 Bq m^{-3} are the most frequent levels recorded in all measuring stations.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-153

STUDY OF NATURAL BACKGROUND RADIATION IN GUILAN

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Abstract

Determination of natural background radiation, which consists of terrestrial radiation and secondary cosmic rays, is of considerable importance in the assessment of exposure to the population as well as the early step in radioecological studies. This study, as part of a comprehensive project on measurement of environmental radioactivity in the North Alborz ecosystem, has been devoted to environmental gamma measurements at 1 m above the ground, which is usually taken as a standard measurement height, using thermoluminescent detectors (TLDs). The outcome of such studies provides a data base upon which we can assess the relative magnitude of the effects of accidental releases of radioactivity from anthropogenic sources should they occur. LiF: Mg, Cu, P chips, $CaSO_4$: Dy powder and CaF_2 bulbs were chosen as environmental dosimeters due to their relatively high sensitivities and promising field performances. More than 80 measurement stations were selected, mostly at rural health centers, throughout Guilan Province including Astara, Talesh, Rezvanshahr, Anzali, Rasht, Fouman, Somesara, Shaft, Masal and Roudbar. The mean outdoor gamma dose-rates for three evaluation periods from January to November are (117±15), (115±۲۰) and (120±17) nGy h^{-1} with an annual average of (117±18) nGy h^{-1}. Mean gamma dose-rates for indoor locations in the same evaluation periods are (131±20), (13317±) and (138±19) nGy h^{-1} with an annual average of (134±19) nGy h^{-1}.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-154

STUDY OF WAVELET TRANSFORMATION IN MEDICAL IMAGING

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Wavelet transforms and other multi-scale analysis functions have been used for compact signal and image representations in denoising, compression and feature detection processing problems for about twenty years. Numerous research works have proven that this family of analysis functions provided a very efficient framework for signal or image data. This tool has very extended applications in medicines and biophysics. A multiresolution analysis gives a zoomed vision of a signal at different scales in such a way that disposal of different signal versions each of them characterized by a different detail level, is possible. One of the very important applications of this tool is denoising of signal and image that can be useful in medical imaging and denoising of them. On the other hand this tool is dependent on many variables such as Wavelet function, steps of image decomposition, Threshold and shrinkage function. Therefore they have different effects on image denoising. In this paper, at first introduction of this new tool and principal of denoising are explained, and then different stats of it are studied. It is shown that how this tool can be used in medical image denoising. Finally, using of this tool, the noisy image has been reconstructed with computing of different Thresholds and shrinkage functions. Optimal Threshold value and shrinkage function are recognized.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-155

REALITY OF LOW-DOSE EFFECT OF IONIZING RADIATION, REGARDING HEALTH CONSEQUENCE 20YEARS AFTER THE CHERNOBYL ACCIDENT

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Common people have imprinted knowledge that radiation is carcinogenic even at a very small dose. Because the low dose effect of radiation was explained by " the linear no threshold (LNT) hypothesis", that is often confused with the reality. Due to the Chernobyl accident in 1986 Apr. about 14 x 10^{18} Bq of radioactive materials were released from the atomic reactor and it resulted 10 – 50 mSv of individual accumulated radiation exposure respectively, to inhabitants of contaminated area during 1986 – 2006. While clear evidences obtained 20 years after the Chernobyl accident are:

1. Nearly 4000 cases of thyroid cancer have been diagnosed among children who were 0 – 18 years at the time of the accident in Belarus, Russia and Ukraine during 1992-2000. More than nine children (less than 1%) died and the rest were treated and survive.
2. There was no excess leukaemia among inhabitants of contaminated area.
3. In Belarus a slight increase of mammary cancer of women less than 45 was found.
4. The mental health impact of Chernobyl is the largest public health problem.
5. It is difficult to manifest a radiation-specific excess risk or increase of cancer statistically because the value is so small that it must be buried in the range of natural cancer background variation. The above results tell us the fact of the effects of low dose of radiation through the bitter experiences with our human bodies in those countries.

Since 1980s the author has obtained lots of data which manifests the animal has a protective power against radiation, i.e. increase of hepatic metallothionein (anti-oxidative function), increase of thymic apoptosis, and increase of spleen colony formation (immune function) after mice were exposed to radiation. It means that the animal possesses host-defense mechanisms against radiation. LNT hypothesis is only true if the animal has no protective power against radiation. Therefore the author deems that LNT hypothesis is not consistent with biological reality.

It is not easy to establish a threshold dose for cancer in human population because of the presence of a few sensitive people to radiation or other toxic substances based on genetic heterogeneity and variation of lifestyles in the population. Important thing is that we must consider the biological reality, not superficial curve linearity.

1st Human, Life and Radiation Conference
29-31 October 2006
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DILS FOR FOODSTUFFS CONSUMED IN IRAN

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Measures to protect the public following an accidental release of radionuclides to the environment will depend on the circumstances including the extent which extent: territorial, size of population, or rate of irradiation – be more specific of the potential hazards. The projected levels of risk are an important precondition in emergency planning. The levels can be expressed in terms of concentration levels in the environment or in foodstuffs. Dils are not for projection of anything, but for recommended action these derived intervention levels (dils) can be determined for a range of important radionuclides that could be released to the environment in the event of a nuclear accident. Derived intervention levels for ^{90}sr, ^{131}i, ^{134}cs + ^{137}cs, and ^{238}pu + ^{239}pu + ^{241}am radionuclide groups were calculated for mostly consumed foodstuffs in iran. These nine here are only 7 presented radionuclides are expected to deliver the major portion of the radiation dose during the first year following an accidental episode of radiological food contaminations as we learned from the chernobyl accident sr-90, plutonium and americium were not major contributors to the total dose in this nuclear accident. Calculation for DILs was based on recommendations from international organization and average food consumption rate data by national nutrition and food technology research institute. From our research it was found that dils for foodstuffs consumed in iran for mentioned radionuclide groups are equal to 387, 250, 1023 and 2.8 bq kg^{-1}.
DILs differ by a factor of up to about 20 depending on the group of population (children – adults etc.) And type of food. Authors should define the population group and type of food for these values, which seem to me too restrictive for iodine-131 and alpha emiters.

After the Chernobyl accident the currently used dils became in various countries too restrictive, in comparison with pre-accident values, established in an emotionally not disturbing situation. For example dils presented in the british nrpb energency data handbook, report nrpb-r182, of March 1986 (edited few days before the chernobyl accident, and based on a wide range of british studies starting with the experience of windscale accident in 1957) are for sr-90 4100 bq / kg for drinking water, 1200 for milk, 110,000 for fresh vegetables amd 160,000 for fruits. For iodine-131 dinking water 2400, milk 2000, fresh vegetables 110,000, and fruits 160,000.. For cesium-17 corresponding values are 7300, 3600, 190,000, and 280,000. For plutonium-239 dils for vegetables and fruit are similar as for cesium-137, and for americium-241 in vegetables 5800 bq/kg and in fruit 7800 bq/kg.

1st Human, Life and Radiation Conference
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PUBLIC DOSE ASSESSMENT OF ELEVATED NATURAL RADIATION AREAS OF MAHALLAT (IRAN)

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Abstract

There are five hot springs called "Abegarm-e-Mahallat", located in central part of Iran, used by visitors as spas. This is an elevated natural radiation area (ENRA) due to the presence of Radium-226 (^{226}Ra) and its decay products, in particular Radon-222 (^{222}Rn). ^{222}Rn was measured both indoors and outdoors at the of hot spring locations, closed pools, and dwellings, using PRASSI portable radon meter system. The mean concentration of ^{226}Ra in these hot springs, measured by the emanation method, ranged from 0.48±0.05 kBq m^{-3} to 1.35±0.13 kBq m^{-3}. ^{222}Rn concentrations measured in the hot springs using a liquid scintillation counter ranged from 145±37 kBq m^{-3} to 2,731±98 kBq m^{-3}. Indoor and outdoor radon concentrations were in the range of 15 to 900 Bq m^{-3} and 7 to 300 Bq m^{-3}, respectively. Radiation levels above that of normal background (around 100 nGy h^{-1}) were mainly limited to the Quaternary Travertine formations in the vicinity of the hot springs. Effective dose of habitants and tourists is calculated by considering occupancy factor, radon and gamma exposure rates. The results of environmental radiological studies in this region are presented and discussed.

1st Human, Life and Radiation Conference
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COMPARISON BETWEEN RADIOACTIVITY CONTENT OF SHIRAZ WATER SUPPLIES AND SPRING WATERS OF FARS PROVINCE

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Abstract

Drinking water can come from either ground water sources (e.g./ Wells, springs,…) or surface water sources (rivers , lakes. Streams, etc.). Water can pick up radioactive material as it flows through the rocks soil or cracked cement surrounding a water source, therefore contaminating that water source. A less publicized but also important health hazard is the presence of naturally occurring radioactive substances in ground water. Large concentration of dissolved radium and uranium radiounuclides can be detected in many ground-water supplies.

In this work, 104 samples were gathered from different water supplies of Shiraz city and water springs of Fars province. Gross alpha and beta, total uranium and Ra-226 activity in each sample were determined in each sample. The activity of Ra-226 was measured by Radon Emanation method and total uranium was determined by using laser fluorimetry.

In Shiraz water supplies, Ra-226 concentration was between 4.0-61.5 mBq/L in summer and 2-217 mBq/L in winter. The mean concentration of Ra-226 was 15.72 mBq/L in winter and 29.46 mBq/L in summer. The U concentration of Shiraz water ranged between 2.6-16.7 ppb in summer and 4.36-39.88 ppb in winter, while the mean concentration of U in Shiraz water was 9.44 and 7.37 ppb in winter and summer respective .The concentrations of total α & ß was measured at the level of minimum Detectable Activity (MDA) of the instrument.

In spring waters of Fars province, Ra-226 concentration varied between from 2 to 35.9 mBq/L. The U concentration was between 1.6-36.2 ppb and the mean concentration of U was 5.94 ppb. The concentration of total α and ß of spring waters was measured in the minimum Detectable Activity (MDA) of instrument.

These values show that the radioactivity content of Shiraz water is more than that of spring waters of Fars province. In other words the quality of Fars province spring waters is better than the Shiraz water supplies.

1st Human, Life and Radiation Conference
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AN INVESTIGATION OF NATURALLY OCCURRING RADIOACTIVE MATERIALS(NORM) IN OIL AND GAS WELLS IN NAR& KANGAN AND GACHSARAN

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Abstract

It is known that in mining, treatment and transport of oil 232Th and U-238 , their daugther and 40K which are initially contained in geological structures and waters, etc., are released to the environment in one or another species. They are considerably redistributed in the process of mining and treatment; contaminate equipment working area surfaces, etc., concentrating in a number of cases up to considerably high levels with the possibility of rising of exposure of staff and population and dispersion to inhabited environment.

Sediments of mined waters containing radionuclides condensed on the inner surfaces of oil and gas equipment, and escape and forced released of oil and mined waters on the soil surface are the main source of pollution of technological equipment and environment with natural radionuclides in oil and gas production. In this study, the activity concentration of Ra-226, Th-232 and K-40 of Nar&Kangan and Gachsaran in oil and gas fields were measured. These values were determined using an HPGe detector and a gamma spectrometry system. This study shows that in Nar& Kangan gas field, the concentration of Ra-226 is between14 to 200 Bq.Kg-1 . The concentration of Th-232 ranges from 4.0 to 37 Bq.Kg-1 .The concentration of K-40 varies between39 to 600 Bq.Kg-1. In Gachsaran oil field, the concentration of Ra-226, Th-232 and K-40 ranged from 5 – 29, 4.0-17 and 40.0 - 342 Bq.Kg-1 respectively. These values are lower than the permissible level concentration in oil and gas residues.

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DEVELOPMENT A POINT SOURCE MODEL FOR ELEKTA SL 25 LINEAR ACCELERATOR USING MCNP4C MONTE CARLO CODE

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Abstract

Monte Carlo modeling of a linear accelerator is a prerequisite for Monte Carlo dose calculations in external beam radiotherapy. In this study, a simple and efficient model was developed for Elekta SL 25 linear accelerator using MCNP4C Monte Carlo code.

The head of Elekta SL 25 linac was simulated. Energy and fluence distribution of photons crossing the phase space plane were calculated. A simple point source model was developed based on calculated photon spectra. Using this model, percent depth doses (PDDs) and beam profiles were calculated for different field sizes. The results of MC calculations were compared with measurements. There was a good agreement between MC calculations and measurement for descending part of PDD curves. But, comparing calculated PDDs with measurement showed up to 10% differences for build up region of PDD curves for both energies. For beam profiles, there was 2% difference in flat region and up to 15% difference was seen for out of field region. These results were acceptable according to recommended criteria. Although, using our model the run time was decreased 24 times in comparison to original full Monte Carlo method.Our study showed that our model is accurate and effective for MC calculations in radiotherapy treatment planning. Also, it substantially lowers MC runtime for radiotherapy purposes.

Key words: Monte Carlo modeling, Medical linear accelerator, MCNP4C, Radiotherapy dose calculations.

1st Human, Life and Radiation Conference
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HLR-P-161

DISADVANTAGES OF RADON IN HOME

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Abstract

Human being are exposured to naturally cosmic&ancient radiation. Radon is the largest source of exposure persone to naturally occurring radiation. Radon and his daughters(progeny)while decay,cause alpha particles and consequently increases the risk of morbidity of lung cancer. To interfere it and find a way to treat it and save our life to have a better life we are force to realize its properties. In this paper we are trying to realize different ways of radon entrance to home, the way it can bother mans, and the way to intervene of its entrance.

Key word: Radon, Home safe, Lung Cancer, Air pollution, health

1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-162

TERAHERTZ IMAGING

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Abstract
The terahertz region of the electromagnetic spectrum spans the frequency range between the mid-infrared and the millimeter / microwave .For some imaging cases ,using of viability terahertz signals is preferred to nuclear and x-ray imaging .Free electron lasers ,lamps ,gas lasers and recently semiconductor electronic mixers and femtosecond laser are techniques to produce terahertz signals. Basic THz mixer elements are produced by standard semiconductor science and technology .Recent demonstrations, using pulsed near-infrared femtosecond laser systems, of the viability of THz medical imaging and spectroscopy have sparked international Interest ; yet much research still needs to be undertaken to optimize both the power and bandwidth in such THz systems . In this article, it is described imaging techniques, and commercial applications of T-ray imaging. T-ray computed tomography, T-ray diffraction tomography, and tomographic imaging with a Fresnel binary lens are three T-ray (terahertz wave) tomographic imaging modalities that are compared in this paper.

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AFFECTS OF RADIOACTIVE AEROSOLS IN INHALATION SYSTEM OF THE HUMAN BODY

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The goal of this research is investigation about the behavior and affects of radioactive aerosols in respiring system. By studying and researching in this field by using different references, the below results obtained:
1. Aerosol motion is produced by gravitational or electrical fields, fluid motion, and molecular (Brownian) forces [1]. 2. Deposited insoluble radioactive particles in the tubes of conducting airways which are ciliated and have a continuously movement are rapidly swept up through the trachea and swallowed [2]. 3. Some of the insoluble radioactive particles deposited in the pulmonary compartment, remain for a long period [2]. 4. If we consider the lung conducting airways as tubes with different diameters, by considering only particles that are too insoluble to exhibit any hygroscopic action in the humid atmosphere of the lung, four processes may be effective in bringing about deposition:
a. Radioactive particles may be stopped as they pass from one tube into a smaller one, because the streamline along which they move enters the second tube at a distance from its wall that is less than the radius of the particle [2]. b. Radioactive particles with sufficient inertia may deviate far enough from the air streamline to impact near the place which the tube is divided into two branches [2]. c. Radioactive particles which move through tubes not perfectly in a straight line have a component of their sedimentation velocity that is normal to the tube surface and some of them fall onto the surface [2]. Very small particles are struck about sufficiently by the random thermal motion of the air molecules, so that they are deposited on the tube walls by the process of diffusion [2].
5. Theoretical and experimental evidences show that electric charge is ineffective after a particle has entered the respiratory tract. But there is an interesting fact that according to minimum deposition, spherical particles, produced by methods that invariably yield charged particles, consistently show greater overall deposition than do particles produced by condensation method, which yield particles that are seldom charged [2].
6. Although the depth of penetration increases with decreasing particle size, but the percentage of pulmonary retention increases with increasing size. So, the smaller particle size, the smaller will be the percentage of the material retained in lungs [3].

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STUDY OF THE CAUSES OF HEIGH RATE MORTALITY OF YANGAJEH VILLAGE AT CHAKANEH –SARVELAAYAT OF NEISHABOOR,IRAN

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The Yangacheh village is located at 250 km far from Mashad city, midway Ghoochan road and Chakaneh of Sarvelayat of Neyshaboor city, after Abdollahgive .(ref ,to corresponding map) with a population about(?).
Its geographical altitude and longitude is 58.3 & 36.30 respectively,. Its height is about 1941 meters from sea level.
The main reasons for this research was the high mortality rate of about 65% due to cardiac infarction(CI) and gastrointestinal(GI)cancers, among the residents in this region.(According to mortality office of local hygienic service).
At first ,it was thought that these cancers are due to environmental nuclear radiations, but our primary studies and analyzing of some kind of local plants(Anoukh , Gamy, and Yonjeh), in Atomic Energy Organization of Iran(Tehran, Van- de Graff Accelerator of Nuclear physics department),by XRF&PIXE detection methods , showed ,in ppm scale , a non significant radiations above permitted doses.(See Spectrum plots) .
But , in investigation of consumed **meat** of the villagers, we found a high rate of nitrate and nitrite in comparison to normal permitted value. Analyzing the samples of plants showed a high rate of Iron (Fe)ion, about 600 + 10 mgr/ gram of samples .The source of consumed water of villagers also showed a permitted rate of radiation .
So we thought that there must be some relation between cardiac infarction (CI) and the high consumption amount of Iron- ion in regional meat. This factor, in our opinion,at that time, was the cause of the infarct.
Some samples of stones (Turkois , Kaolite, and regional soils of Sarvelayat_Neyshaboor, also, have been analyzed in L'aab Research Center of Mashad (see corresponding plots) and found no radiation too.
At that time we supposed that this high rate of cardiac infarct may be due to its high rate consumption of Iron (Fe)ions in the blood. When we asked about our opinion from some of the cardiologists in Mashad city ,they couldn't confirm our assumption.

Even we asked from professor Sadeghi , the outstanding cardio surgeon in Switzerland , at that time, but he ignored it. He was born in Sarvelayat region.
Some years later we have found a foreign article which confirmed our assumption .we will discuss about it in full paper.

Key words :Yangajeh Vilage of Sarvelaayat of Neyshaboor, regional foods ,water and plants, Iron ions, XRF&PIXE detectors, cardiac infarction (CI), Gastrointestinal (GI) Cancers, Nuclear radiations, Meat consumption, Atomic Energy Organization of Tehran, High rate Mortality

1st Human, Life and Radiation Conference
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MONTE CARLO SIMULATION OF 9-MEV PHOTON INTERACTIONS FROM ELECTRON ACCELERATOR OF IMAM REZA ع HOSPITAL, ON BODY TISSUE COMPARISON WITH MCNP CODE AND EXPERIMENTAL DATA.

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The energy distribution of photons from a medical linear accelerator is an important characteristic of a radiotherapy photon beam. The knowledge of clinical beams is essential for dosimetry, treatment planning, and design of a medical accelerator. Knowledge of the energy spectrum is important, since the response of dosimetry devices is generally energy dependent, thus varies with depth in the irradiated material. Generally the photon energy spectrum is unknown, and the therapeutic beam is only characterized by the maximal energy in MeV or by a quality index. A direct measurement of the spectrum is difficult because of the high fluence and energy. We have simulated the photon beam of a 9 MV clinical Electron accelerator by a Monte Carlo method written in Fortran and justified our results by comparing it with MCNP code. Measured and calculated depth-dose distributions are in fairly good agreement, within 2-3% for the positions in the range 2-30 cm in the water phantom.

Today a Monte Carlo simulation of photon transport is generally used in the treatment planning of cancer patients irradiated with photons.

Key words: MonteCarlo simulation , Photons beam transport , body tissue, 9 MeV electron accelerator ,Imam Reza ع Hospital

1st Human, Life and Radiation Conference
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HLR-P-167

STUDY OF EXPOSURE TO PATIENTS IN ROUTINE TEST CHEST X-RAY EXAMINATION BY TL DOSIMETERS

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Abstract

Entrance Surface Dose (ESD) is one of the main quantities to be measured in other to assess the patient dose in radiographical exposures. It is essential to be evaluated in quantity control measures at radiological centers, as well as in the process of Dose Reference Level (DRL) determination.

To evaluate ESD levels in chest X-ray examination, which is the most frequent practice in medical radiography, surface dose measurements were carried out for 164 patients in Iran Medical University hospitals at Guilan.

Dosimetry was performed using thermoluminescent dosimeters (TLDs). Tissue-equivalent LIF: Mg, Cu, P chips were used inside air-equivalent badges positioned at the center of exposure filed. Dosimeters were then put through the specific reading cycle of a Harshaw TL reader and ESDs were calculated applying ECC and RCF calibration factors previously determined with the cooperation of Iranian SSDL.

On the basis of performed measurements, the range of surface dose received by patients in this study, in the PA position, is within 0.04 to 0.77 mGy, with an average ESD of 0.21 ± 0.09 mGy.

Key words: X-ray exposures, Patient dose, ESD due to chest X-ray, Thermoluminescent Dosimeters (TLDs)

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-168

DESTRUCTIVE EFFECTS RADIOFREQUENCY WAVES ON THE USER'S CELL PHONE HEALTH .

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Introduction & Goal: During two last decades, the use of cell phone has increase rapidly. Now, more than 1 billion persons use cell phone world wide. However, according to some studies its long time use and exposure to waves of amplifier anthens probably cause disadvantages on health. cell phone s waves can affect on sensitive population (children, patients on old) and cause migraine, confusion, vomiting, insomnia, exhaustion, caser, tumor, meningitis, infertility, In fact, for identifying effects of this wave on human and animals, numerous studies have performed.

Review Literature: Holland institute in 2003 in an experimental study on mice showed that exposing to wave of 0.7v/m for 45, caused disadvantages .Studies showed that exposure to cell phone for 7.5 hours causes leucopenia. Other studies have shown the relation between use of cell phone and decreasing of memory.

Kejers Honson performed a study on 11000 user in sudan and results showed that long use causes symptoms such as, exhaustion, head ache and burning feeling in hand. the last date from England, Donmark, Finland, Nonway and sewden showed that 678 user affected to Nero Acoustics .

Lancet magazine in 1998 published that cell phones waves can cause hypertension.

Result : Actually concerning the symptoms of cell phone it should be complete substitution. this findings don't imply on not using of cell phone but by applying guidelines such as more use of fixed phone keeping away from body , keeping at least 2cm far from ear during talking un necessary use like sending jokes,…. Can it safely.

1st Human, Life and Radiation Conference
29-31 October 2006
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NECESSITY OF SKIN PROTECTION AGAINST ULTRAVIOLET RADIATION

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Introduction and Aims: Ultraviolet (UV) radiation is essential for survival of man on planet earth, in the other hand; UV radiation is one of the most ubiquitous environmental hazards that impacts every living creature under the sun. Skin is the largest human organ, and is the only organ directly exposed to UV radiation that nowadays, as a result of cultural changes, complex psychological reactions to natural skin color are seen; Such that pale-skinned individuals regard some degree of tan as cosmetically highly desirable, while dark-skinned individuals use destructive and expensive bleaching techniques to lighten their skin. Even the use of artificial sources of UV for tanning purposes is seen recently. In spite of UV's established benefits, chronic exposure to UV irradiation causes premature skin aging (photoaging), local and systemic immunosuppression, and ultimately photocarcinogenesis. The aims of this investigation are to more recognition of UVR hazards and their mechanisms and moreover, help to upgrade of public awareness level of these hazards and to recommend emphatically for necessity of skin protection against these radiations.

Methods: This paper is a review article and is including the latest and newest results of more recently investigations.

Results: There is no doubt that solar UV exposure is the most important environmental risk factor for the development of skin cancers, such as: Basal Cell Carcinoma (BCC), Squamous Cell Carcinoma (SCC), and Malignant Melanoma. Premature skin aging and immunosuppression are additional effects of UV radiation on the skin that followed by more incidence of tumors, also infectious and autoimmune diseases. We can say that the trigger of almost of these events following the UV irradiation is Reactive Oxygen Species (ROS) free radicals in the skin. Also it is important to know, all human skin sensitivity to UV radiation isn't same and divided into various types (UV-sensitive skin types and less UV-sensitive skin types).

Key word: UV Radiation, Photoaging, Photocarcinogenesis, SCC, BCC, Malignant Melanoma, Reactive Oxygen Species (ROS).

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29-31 October 2006
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HLR-P-170

INVESTIGATION OF INCINERATION AS A TREATMENT SOLUTION IN AEOI WASTE MANAGEMENT STRATEGY

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Abstract

As nuclear technology develops and is used in electric power production industry and nuclear medicine, the production of radioactive wastes in our country will be a major problem in near future. A substantial portion of the low and intermediate level radioactive wastes generated in the various parts of the nuclear fuel cycle, in nuclear laboratories and other places where radionuclides are used for research, and in industrial, medical and other activities, is combustible.

There are various waste treatment solutions as follows:

- Encapsulation,
- Incineration,
- Acid leaching and digestion,
- Compaction,
- Melting,

Incineration of radioactive wastes provides a very high volume reduction and converts the wastes into radioactive ashes and residues that are non-flammable, chemically inert and much more homogeneous than the initial wastes. Considering stringent safety requirements and the cost of final disposal, the incineration of radioactive waste has thus become a very important part of the waste management strategy. In particular, as a rather complex high temperature process, the incineration procedure has to meet certain specific safety requirements.

The AEOI purchased the ENI (Esfahan Nuclear Incinerator) plant from French CEC Co. in 1976 for incineration of wastes of TNRC (Tehran Nuclear Research Center). The manufacturer committed to install, start-up, and instruct the system which never happened. In 1977, the plant packages were delivered to AEOI and, later on, the packages were transferred to EFPRC (Esfahan Fuel Production and Research Center). At present, the ENI has been installed, preliminarily started up and can come into operation soon but it has been strongly requested to study and justify incineration solution for AEOI waste management strategy.

The incineration plants shall be operated in compliance with the authorization for plant discharges to the environment. Radiation exposure to the public and the operating personnel

shall be ensured in the operation to be ALARA, social and economic factors being taken into account. These objectives shall be studied deeply in the current situation of ENI (The incinerator has been transported to Esfahan and should incinerate certain combustible wastes, while it was primarily supposed to be installed in Tehran and incinerate the TNRC wastes) and justify its operation from nuclear safety, economic and social points of views.

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BIOLUMINESCENCE IMAGING OF TUMOR TISSUES: SITE-DIRECTED MUTAGENESIS OF FIREFLY LUCIFERASE TO PRODUCE RED-LIGHT IN MOLECULAR IMAGING

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Abstract :

Molecular imaging offers many unique opportunities to study and investigate biological process in intact live organisms. Bioluminescence refers the process of visible light emission in living organisms. Bioluminescence imaging (BLI) is based on the sensitive detection of visible light produced during enzyme oxidation of a molecular substrate when the enzyme (luciferase) is expressed in vivo as a molecular reporter. Bioluminescence at the emission wavelength (for example 560 nm for firefly luciferase) can be imaged as deep as several centimeters within tissue, which at least will be able to image at organ-level resolution. Using higher wavelength in red area (around 620 nm) deeper area of tissues has been imaged. This technology has been applied in studies to monitor transgenic expression, metastasis of malignant cell and tissues, transplantation, toxicology, viral infective disease and gene therapy. The bioluminescence color of firefly luciferases is determined by the luciferase structure and assay conditions. It is well known that the in vitro bioluminescence color of firefly luciferases can be shifted toward red (higher) wavelengths by lowering of pH and also modification of assay conditions. The cDNA encoding Iranian luciferase from *Lampyris turkestanicus* has been cloned and functionally expressed in E. coli in our laboratory [BBRC, 2004]. By insertion of an additional residue and substitution of some critical residues, using site-specific mutagenesis in this green-emitter luciferase the color of emitted light was changed to red. This luciferase with red-emission ability can be used to monitor of migration of malignant cells.

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AIR RADIOACTIVITY MONITORING SYSTEM DESIGN OF ESFAHAN NUCLEAR INCINERATOR TO PROVIDE A RADIATION PROTECTED SYSTEM

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Abstract

The goal of this research is designing of air radioactivity monitoring system of Esfahan nuclear incinerator in order to measuring the captured dose of the workers, and their radiation protection, according to the standards of International Atomic Energy Agency.

The importance of radioactive aerosols is their entrance to the human body through inhaling and in special cases through skin absorption. The radioactive substances mainly enter the human body through the respiring system. Assessing of the damages of radioactive substances which enter the body through this way is a complicate task and depends on physical and physiological aspects. It is proved that it is impossible to eliminate inhaling of the radioactive aerosols completely in radioactive working places. Also, the goal of the radiation protection programs is to minimize the absorbed dose by the workers in such working places as low as possible, below the maximum allowed value.

The most important and the final goal of air radioactivity monitoring in Esfahan nuclear incinerator is protecting the health of the people who work in this place and be ensuring that these people obtain the minimum inhaling dose and radioactive radiation.

In this research according to standards the below ones are considered as notable radioactive aerosols and rays that workers should be protected against them in Esfahan nuclear incinerator:

1. α, β Particles and γ rays according to all radioactive materials
2. Iodine and its composites
3. Tritium and its oxides
4. Radon and Thoron
5. Inert gases
6. ^{14}C

The negative pressure which exists inside of this system causes that the radioactive particles do not enter the working area, but because of the storage of radiated materials which should be incinerated, the working area contains radioactive particles. Besides mask which should be used by the workers all the time in working area, the tools which are considered for measuring the absorbed dose by the workers in this system are:

1. Personal samplers: film badge and real time dosimeters with pen shape

2. Breathing zoon sampler
3. Air specific source sampler
4. Grab sampler
5. Total particulates sampler (α, β, γ)
6. Impactors (to specify particle size)
7. Radioactive gases sampler

1st Human, Life and Radiation Conference
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HLR-P-175

ENVIRONMENTAL CONTROL AND MONITORING OF RADIOACTIVE WASTE DISPOSAL FACILITY

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Burial of low and intermediate Radioactive Waste in the ground has been practiced in different countries for many years. The method is cheap, safe and simple for disposing of certain radioactive waste, provided some reasonable provisions are made.
The objective of Waste Management is to protect human and his environment now and in the future without imposing undue burden to the future generations. The Waste Management Department which is responsible for management of radioactive waste in Iran is trying to develop the required infrastructure for safe management of present waste and what will be produced in near future, from operation of NPPs and nuclear fuel production programme.
Low and Intermediate level solid radioactive waste can be buried in shallow ground which is located near to rector and in region with arid climate, where the precipitation is low, but evaporation is high. There is a risk of radioactivity to man if radioactive waste is buried in area in high water table and high population density. There are further precautions like seimicity which must be taken to prevent release of activity to the environment. In this article, all operations that have to be done under careful control and surveillance to ensure that operators and the public don't receive radiation doses greater than ICRP limits have been presented.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-176

COMPARATIVE EVALUATION OF ^{40}K CONCENTRATION IN MILK SAMPLES OF WESTERN AZARBAYJAN, TEHRAN, KERMANSHAH AND MAZANDARAN PROVINCES IN ORDER TO STUDY OF RADIO ECOLOGICAL DIFFERENCES BETWEEN THESE FOUR AREAS OF IRAN

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Abstract

Potassium-40 is a naturally occurring radioactive isotope of potassium. The half-life of ^{40}K is 1.3 billion years and it decays to calcium-40 by emitting a beta particle with no attendant gamma radiation (89% of the times) and to the gas argon-40 by electron capture with emission of energetic gamma ray (11% of the times). ^{40}K is an important radionuclide from the health physics point of view in terms of the dose associated with naturally occurring radio nuclides by virtue of the wide spread distribution of potassium in the environment and animals including man. Potassium-40 can present both an external and an internal health hazard. The strong gamma radiation makes external exposure to this isotope a concern. While in the body, potassium-40 poses a health hazard from the beta particles and gamma rays. Potassium-40 behaves the same as ordinary potassium, both in the environment and within the human body – it is an essential element for both. Hence, what is taken in is readily absorbed into the bloodstream and distributed throughout the body; with homeostatic controls regulating how much is retained or cleared. The health hazard of potassium-40 is associated with cell damage caused by the ionizing radiation that results from radioactive decay, with the general potential for subsequent cancer induction. In this research we have collected 32 milk samples of four geographical areas of Iran (i.e. western Azarbayjan, Tehran, Kermanshah and Mazandaran provinces). Samples were poured in Marinelli beakers and were counted via gamma spectroscopy of ^{40}K. The system we used was a high pure Germanium (H. P. Ge) γ-

spectrophotometer and the samples were counted for 30,000 second. ^{40}K concentrations in milk have ranged between 12-38 μci/kg. Data were collected and in order to compare the radio ecological differences between these four areas the statistical T-test (α=0.05) have been done. Our results show no significant differences in ^{40}K distribution between these four areas.

1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-178

PEPT AND IT`S APPLICATION

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Abstract

Positron emission tomography (PET) is a radioactive tracer imaging technique, which relies on detecting the pairs of back to back gamma rays produced when a positron annihilates with an electron. Detecting both gamma rays in coincidence defines a line passing close to the source. By detecting all gamma rays emerging from different parts of the system and using standard tomographic image reconstruction, cross sectional images of the distribution of radioactive fluid can be seen. In nuclear medicine, PET is used to assess the concentration of metabolic fluid molecules (which are labelled with a radionuclide that decays by emitting a positron) in different parts of the body.

Verifying the position of a single emitting particle in an object instead of determing the distribution of a positron emitting fluid is the basis of another technique invented at Birmingham University called PEPT. One weakness of PET is that it is a slow technique unsuitable for observing fast flows whereas PEPT has not this limitation. With using of this technique the location of radioactive labeled particle can be accurately determined. Analysis of the particle

This technique is basis on detecting a number of gamma rays which is produced by annihilation of positron with electron, then by using triangulation the positron (tracer) location can be determined.

This technique is tested on ADAC Forte scanner which consists of two detector head, each containing a scintillation crystal of sodium iodide 50×40 cm^2 and 16mm thickness. Also this technique is tested on ECAT 931 scanner which consists of 4096 BGO crystal.

This technique has several advantages with respect to PET such as low radioactive dose, less measuring and capability to produce radioactive labelled red blood cell.

Tracking red blood cell Labeled with enough active ^{15}O or ^{11}Co that emits positron can be used to observe the activity of red blood cell in the blood circulation. Initial trial laboratory result shows successfully labeling one single red blood cell with enough ^{11} CO or ^{15}O those emitting positron and tracking of them shows distributions of red blood cell.

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MODELING TRANSLATION PHOTON WITH TISSUE IN PULSE OXYMETRY OF FETAL WITH USE FROM NEAR INFERARED

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Abstract

Reflectance pulse oximetry permits the use of alternative monitoring sites, and is the approach commonly employed in fetal pulse oximetry systems. The purpose of this study is to translation photon with tissue for to earn of optimize in fetal pulse oximetry trans-abdominal in ante partume the best distance between detector and source .**Methods.** Monte Carlo simulations of reflectance pulse oximetry were run on a nine-layer tissue model, varying depth and arterial pulse (systole and diastole) and there are two vesals for mum and fetal itch include a random combination of oxy and deoxy hemoglobin and met hemoglobin and carboxy hemoglobin existence of each percent can operate it . then after calculating the percent of oxygen saturation can be calculated according to fluence with measured in 4 period of simulation **Conclusions.** according to the detector witch of supposed to be in the surface of each tissue the best place for detector is aplace witch the number of photon that comes to the detector from the fetuse head .

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HLR-P-180

SIGNIFICANT ENHANCEMENT OF TRANSDERMAL TRANSPORT OF INSULIN IN RATS BY THERAPEUTIC ULTRASOUND II- NPH INSULIN

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Objective: Therapeutic ultrasound has long been used for enhancing transdermal drug delivery in sport medicine. This technique is based on using ultrasound to increase percutaneous absorption of a drug. It has been shown that enhancement of transdermal drug transport varies significantly from drug to drug and no enhancement has been found for several drugs. The aim of this study was to assess the possible enhancement of therapeutic ultrasound on transdermal delivery of regular insulin in rats.
Materials and Methods: Thirteen rats (average weight: 200g) were divided randomly into two groups of ultrasound exposure (8 animals) and sham exposure (6 animals). All exposures were performed using Sonoplus-490 (Enraf-Nonius) therapeutic ultrasound equipment. After inducing general anesthesia, animals were exposed or sham exposed to therapeutic ultrasound (3 MHz frequency, 1W/cm^2 intensity, pulsed, 5 min duration). In exposure and sham-exposure treatments, 5 ml of Enraf-Nonius gel was used as the acoustic coupling medium. An area with a surface of about 25 cm^2 on the animals' abdominal skin was shaved for a better acoustic coupling. In both groups 5 units of human NPH insulin was blended into 5 ml of acoustic gel. Blood sampling from animals orbits was performed 3 hours after exposure.
Results: Ultrasound significantly increased transdermal transport of insulin in rats. The glucose level in irradiated rats was 79.75±9.05 mg/dL (mean ± SD), compared to 133.83 ±17.22 mg/dL in sham exposed rats.
Conclusions: Data obtained in this study clearly suggest that transdermal transport of insulin can be enhanced effectively by therapeutic ultrasound. Further researches should be directed to finding an optimum frequency and intensity of ultrasound that cause the most significant enhancement of transdermal transport of insulin. This will be an effort to make using ultrasound instead of needles to inject insulin, possible.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-181

ISOTOPIC DETERMINATION OF URANIUM AND THORIUM CONCENTRATIONS IN FOODSTUFFS BY CALCIUM PHOSPHATE PRECIPITATION METHOD AND ALPHA SPECTROMETRY.

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Abstract

At present a wide selection of instruments and methods capable of high precision results and low detection limits is available for the assessment of concentrations of elements, species or radionuclides. Natural radionuclides in particular those emitting alpha particles, make the largest contribution to the world population exposure. These radionuclides enter the human body through two main pathways, inhalation and ingestion and food is considered to be the main pathway of these isotopes. Therefore investigation to find proper methods with available materials is very important.

Food monitoring project has been started in environmental radiological protection section of NRPD and determination of some radionuclides has been reported.

The present work is in direction of this project in order to determine some of the alpha emitters. The method has been applied for chicken, beef and fish flesh which are the main protein sources in people diet and will be applied for other foodstuff such as vegetables in future. In order to quality control of the method, one of the reference materials of International Atomic Energy Agency (IAEA-315) was used as standard sample.

An appropriate method has been introduced for isotopic determination of uranium and thorium. The method is based on co precipitation of these radionuclides with calcium phosphate and then separation each of them using ionic exchange Dowex 1×8 resin and at last alpha spectrometry of the obtained sources. Chemical yield was different from 20 to 65%.

The method consists of 6 main following steps:

1- Sample preparation, 2- Leaching, 3- Calcium Phosphate Precipitation**,** 4- Thorium purification, 5-Uranium Separation and at last 6- Source preparation and alpha spectrometry.

Also the method can be applied for measuring the public effective dose due to food consumption.

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HLR-P-182

EVALUATION OF ANNUAL EFFECTIVE DOSE TO THE INDIVIDUALS LIVING IN SHIRAZ FROM URANIUM CONTENT OF SOIL USING A DOSE CALCULATOR

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Abstract

Naturally occurring radionuclides (mainly Ra-226, Th-232, their decay products and K-40) are sources of external and internal radiation exposure to man. Soil and building materials, contain these radionuclides and cause indoor and outdoor exposure to gamma radiations and inhalation of the short-lived daughter product of radon-222. Radionuclide content in building materials used in Iran, and the indoor and outdoor concentration of Rn-222has been studied previously by Mehdizadeh.In the present study ,using these data and "uranium in soil individual dose calculator " the radiation risk for an individual living in Shiraz was estimated. The result of this study indicates that annual effective dose of external exposure and annual effective dose from inhalation of radon to individuals were 73.6 μsv and 421.2 μsv respectively.

key words: radionuclide, dose, external exposure, dose calculator

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29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-183

EFFECTS OF LOW RADIOACTIVE AEROSOLS ON INHALATION SYSTEM OF THE HUMAN BODY

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Abstract

The goal of this research is investigation about the behavior and affects of low radioactive aerosols such as $^{125}I, ^{128}I, ^{131}I, Tl, Ga$ [1] in respiratory system related to the radioactive wastes which are going to be incinerated in Esfahan Research and Fuel Production Center. By studying and researching in this field by using different references, the below results obtained:

1. Aerosol motion is produced by gravitational or electrical fields, fluid motion, and molecular (Brownian) forces [2].

2. Deposited insoluble radioactive particles in the tubes of conducting airways which are ciliated and have a continuously movement are rapidly swept up through the trachea and swallowed [3].

3. Some of the insoluble radioactive particles deposited in the pulmonary compartment, remain for a long period [3].

4. If we consider the lung conducting airways as tubes with different diameters, by considering only particles that are too insoluble to exhibit any hygroscopic action in the humid atmosphere of the lung, four processes may be effective in bringing about deposition:

a. Radioactive particles may be stopped as they pass from one tube into a smaller one, because the streamline along which they move enters the second tube at a distance from its wall that is less than the radius of the particle [3].

b. Radioactive particles with sufficient inertia may deviate far enough from the air streamline to impact near the place which the tube is divided into two branches [3].

c. Radioactive particles which move through tubes not perfectly in a straight line have a component of their sedimentation velocity that is normal to the tube surface and some of them fall onto the surface [3].

d. Very small particles are struck about sufficiently by the random thermal motion of the air molecules, so that they are deposited on the tube walls by the process of diffusion [3].

5. Theoretical and experimental evidences show that electric charge is ineffective after a particle has entered the respiratory tract. But there is an interesting fact that according to minimum deposition, spherical particles, produced by methods that invariably yield charged

particles, consistently show greater overall deposition than do particles produced by condensation method, which yield particles that are seldom charged [3].

6. Although the depth of penetration increases with decreasing particle size, but the percentage of pulmonary retention increases with increasing size. So, the smaller particle size, the smaller will be the percentage of the material retained in lungs [4].

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29-31 October 2006
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HLR-P-185

SIGNIFICANT ENHANCEMENT OF TRANSDERMAL TRANSPORT OF INSULIN IN RATS BY THERAPEUTIC ULTRASOUND I- REGULAR INSULIN

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Therapeutic ultrasound has long been used for enhancing transdermal drug delivery in sport medicine. This technique is based on using ultrasound to increase percutaneous absorption of a drug. It has been shown that enhancement of transdermal drug transport varies significantly from drug to drug and no enhancement has been found for several drugs. The aim of this study was to assess the possible enhancement of therapeutic ultrasound on transdermal delivery of regular insulin in rats. Thirteen rats (average weight: 200g) were divided randomly into two groups of ultrasound exposure (7 animals) and sham exposure (6 animals). All exposures were performed using Sonoplus-490 (Enraf-Nonius) therapeutic ultrasound equipment. After inducing general anesthesia, animals were exposed or sham exposed to therapeutic ultrasound (3 MHz frequency, 1W/cm^2 intensity, pulsed, 5 min duration). In exposure and sham-exposure treatments, 5 ml of Enraf-Nonius gel was used as the acoustic coupling medium. An area with a surface of about 25 cm^2 on the animals' abdominal skin was shaved for a better acoustic coupling. In both groups 5 units of human regular insulin was blended into 5 ml of acoustic gel. Blood sampling from animals orbits was performed 3 hours after ultrasound exposure. Ultrasound significantly increased transdermal transport of insulin in rats. The glucose level in irradiated rats was 108.43±13.04 mg/dL (mean ± SD), compared to 183.33±53.67 mg/dL in sham exposed rats. Data obtained in this study clearly suggest that transdermal transport of insulin can be enhanced effectively by therapeutic ultrasound. Further researches should be directed to finding an optimum frequency and intensity of ultrasound that cause the most significant enhancement of transdermal transport of insulin. This will be an effort to make using ultrasound instead of needles to inject insulin, possible.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-186

THE EFFECTS OF HEAVY WATER ON BIOLOGICAL SYSTEMS

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Abstract

Heavy water is a term that refers to deuterium oxide. The physical and chemical properties of deuterium oxide are quite similar to those of ordinary water. The main difference is that ordinary hydrogen nucleus (protium) contains only one proton, but deuterium also contains a single neutron along with the single proton, thus making it a heavier atom compared with ordinary hydrogen. Another famous hydrogen isotope, tritium, also exist which is radioactive and has a half life of 12.5 years.

The isotopic substitution in deuterium alters the bond energy of the oxygen-hydrogen bond; this change usually goes unnoticed when considering the physical and chemical properties of heavy water, but dramatically changes the biological properties of the substance when considered with other isotopic chemicals.

Isotopes of other chemicals have very slight different behaviors; these differences are so small that they are unusable or even undetectable, but this is not true for ordinary water. Neutrons and protons have almost the same weight, thus the weight of deuterium is two times more than protium. The larger chemical isotope-effects seen with deuterium and tritium manifest because bond energies in chemistry are determined in quantum mechanics by equations in which the quantity of the reduced mass of the nucleus and electrons appears. This quantity is altered far more greatly than other heavy isotope substitution in other chemical elements. And we also must note that biological systems are very sensitive to small changes in solvent properties of water.

To perform their tasks, enzymes rely on their finely tuned networks of hydrogen bonds, both in the active center with their substrates, and outside the active center, to stabilize their tertiary structures. Because the hydrogen bond containing deuterium is stronger than normal hydrogen bonds, some reactions that accrue inside the cell are disrupted.

The main victim of highly deuterated environments are the delicate assemblies of mitotic spindle formation necessary for cell division in eukaryotes which stop in heavy water, therefore seeds do not germinate in heavy water and plants stop growing if given only heavy water.

اولین کنفرانس
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Rafsanjan University of Medical Sciences & Health Services
1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-187

Experiments show that heavy water with a degree of 25% deuteration causes sterility in small animals which is sometimes irreversible. This is expectable because neither gametes nor zygotes can develop. A concentration of 90% heavy water rapidly kills fish, flatworms and tadpoles. When deuteration reaches an amount of 50%, mammals such as rats die. The mode of death is similar in that of cytotoxic poisoning (such as chemotherapy) or in acute radiation syndrome (though of course deuterium is not radioactive), this is due to deuterium's action in generally inhibiting cell division. As in chemotherapy, deuterium-poisoned mammals die of a failure of bone marrow (bleeding and infection) and intestinal-barrier functions (diarrhea and fluid loss). Mouse studies have shown that drinking only heavy water with a normal feed leads to degeneration of tissues that need to replenish themselves frequently, and leads to cumulative damage from injuries that don't heal quickly. Deuterium oxide has even been tested as a chemotherapeutic agent, but with no noticeable results.

To cause death in human beings with heavy water, a very large amount must be consumed, meaning that accidental or intentional poisoning is unlikely. Large amounts of heavy water must be ingested without any ordinary water intakes for many days to produce any noticeable toxic effects. Volunteers drinking large amounts of pure heavy water have reported dizziness which is natural, due to the effects of the fluid density changes in the inner ear. For example, a 70 kg man that drinks nothing but pure heavy water must continue this act for about a week to reach 25% deuteration, after that the victim will show symptom of illness, after two weeks of consuming pure heavy water and reaching 50% deuteration, the victim will show symptoms of sever poisoning.

A famous incident of accidental ingestion was reported in the year 1990. A disgruntled employee of the Point Lepreau Nuclear generating Station took a sample of heavy water and loaded it in to a water cooler. Eight employees drank from that water. The incident was revealed when these employees began leaving bioassay urine samples with elevated tritium levels. Had pure heavy water been used in the water cooler, the incident would have probably never been detected.

1st Human, Life and Radiation Conference
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HLR-P-188

ADSORPTION OF CS-137 FROM LIQUID RADIOACTIVE WASTE USING SYNTHETIC SORBENTS

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Abstract

Adsorption of cesium from low active liquid waste on synthetic mordenite (zeolon 900 Na) as a sorbent has been investigated by Ion exchange process. The static distribution coefficient (Kd, $cm^3.g^{-1}$) values were determined for mordenite-cesium solution system as a function of sorbent grain sizes, pH,contact time, static factor (SF) and different Na^+ and K^+ concentrations. The sorption efficiency was measured by decontamination factor (D.F) in dynamic condition. The Kinetic of the adsorption studied show that the rate of cesium ion on sorbent is high. The X-ray powder diffraction Pattern of the sample confirm that the synthetic mordenite used in this research is pure, crystalline and sodium form. The presence of the complementry Na^+ and K^+ decreases the sorption of cesium on sorbent the order $K^+ > Na^+$. Based on the results obtained in dynamic and static equilibrium experiments in the laboratory the synthetic mordenite (zeolon 900Na) is effective as sorbents for sorption of cesium from this liquid Radioactive waste.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-189

BETAVOLTAIC BATTERIES IN HUMAN LIFE FOR BETTER LIFE

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Abstract:
Nuclear technology and atomic rays have a lot of use for life and some of them improve in these years and will use in everyday life in future.
One of the most important uses of nuclear material is using them in nuclear batteries.
These batteries have excellent specials that other kinds of batteries do not have this properties for example nuclear batteries can use for long time without refueling and can use in very remote places while have a good current density and sufficient safety.
Betavoltaic batteries are one form of nuclear batteries that used a thin layer of beta emitter radioisotope as a fuel and a semiconductor.
Beta rays bombard the semiconductor crystal and produce electron- hole pairs so these pairs produce a current and we can use this current for long time may be till radioisotopes half life.
Using these batteries may be cause a good energy sources in cell phones or laptop computers or pacemakers and …for long time and this means using one battery without refueling or battery replacement and saving a lot of costs.

Key words: Nuclear technology, Human life, Betavoltaic batteries, Beta ray.

اولین کنفرانس انسان پرتو و زندگی
۹ - ۷ آبان ۱۳۸۵
Rafsanjan University of Medical Sciences & Health Services
1st Human, Life and Radiation Conference
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HLR-P-190

THE 1ST QUALITY CONTROL PROGRAM FOR ASSESSMENT OF THE STATUS OF RADIATION PROTECTION IN RAFSANJAN INTRAORAL RADIOGRAPHIC FACILITIES

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Background: Intraoral radiographies are the most frequent X-ray examinations in humans. Due to the large number of intraoral radiographies, the collective does to the population is significant. According to International Commission on Radiation Protection (ICRP) recommendations, the selection of a diagnostic reference level (DRL) should be specific to a country or region. This quality control program was performed to assess the status of radiological protection in Rafsanjan intraoral radiographic facilities and also to contribute to the establishment of diagnostic reference levels for intraoral radiographies.

Materials and Methods: This study performed in 32 dental clinics in Rafsanjan, Iran in 2005. The quality control program consisted of recording the main characteristic data of dental radiographic machines (manufacturer, model, year of installation, and workload), irradiation parameters (kVp, mA, irradiation time, focus to skin distance, field size, collimation type, filtration, entrance surface dose)and overall compliance with radiation protection regulations (education , shielding , and personal monitoring). Entrance surface doses were measured using thermoluminescent dosimeters(TLD). Three TLD chips were placed on the skin of each patient. The doses were averaged for each for each radiography and mean ESD of all patients calculated.

Results: 12 out of 32 dentists (37.5%) had successfully passed radiation protection courses. In all 32 facilities, collimators had circular apertures. The radiographic machines examined covered a very wide range of brands, models and years of installation. Three facilities(8 %) were operating at 50 kVp, 3 at 60 kVp (8 %), 8 at 65 kVp(22%), and the remaining 18 units were operating at 70 kVp. Only 1 out of 32 clinics (4%) used personal monitoring devices for occupational dose measurements. Lead aprons for protecting the patients were available in only 8 clinics (25%). Thyroid and gonad shields were available in 8 (25%) and 6 clinics (18.8%) respectively. The mean ± SD entrance surface dose at the center of the beam on the

patient's skin in intraoral radiography was 0.73 ± 0.57 mGy (ranged from 0.12 to 2.18 mGy).

Conclusion: Considering compliance with the radiation protection legislations, most dental facilities showed poor performances. Diagnostic reference level values of 2.5 and 7 mGy are proposed for intraoral radiographies by UK and International Atomic Energy Agency(IAEA) respectively. In this study, entrance surface doses measured in all clinics were within the acceptable range. The calculated third quartile value for ESD in intraoral radiographies was 0.9 mGy that could be adopted as a local diagnostic reference level. This is much lower than the above mentioned suggested DRLs

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SELECTING AND PRODUCTION OF SUITABLE FUEL FOR EMPLOYING IN BETAVOLTAIC BATTERIES

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Abstract:
Nuclear batteries are one of the most important parts of nuclear technology that have peaceful applications. There a lot of kinds of nuclear batteries but most useful kind of them are batavoltaic batteries that can be used in pacemakers, cell phones, laptop computers and many other places.
The most important matter in these batteries is using sufficient radioisotope as a fuel.
The fuel should have half life between 1-100 years and have pure law energy Beta radiation without Gamma or X-rays because of safety.
In this article we choose ^{63}Ni with 100 year half life as fuel and we try to produce it in TRR finally we could understand important impurities in irradiation of natural Ni and best way for production.

Key words: Betavoltaic batteries, Fuel, ^{63}Ni, irradiation, Beta ray

1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-193

DISTRIBUTION OF LIGHT IN PHOTODYNAMIC THRAPY OF FIBROSARCOMA TUMORS BASED ON SIMULATION OF MONTE CARLO

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Abstract

:Photodynamic leads to tumoral necrosis by synergic effect of tissue oxygen, photosensitizer and proper wavelenght.choice of wavelength of light, depends on photosensitizer and defines quantity of tissue treatment. 5-ALA is one of important photosensitizer that will be active in 630nm. distribution of dosage light in tumor tissue and control of permeation temprature are two of parameters that are essential in these treatments and must be controlled and improved .in relation to it and for the purpose of dosimetry measurement of tissue,one of common technics is monte carlo that we can define quality of dosage light distribution in the part of body under treatments.in monte carlo, method different models of tissue have just been considered.in this research we have studied distribution of three layer model of tissue.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-194

MAMMOGRAPHY PHANTOM DESIGN AND ASSESSMENT OF THE BEARST GLANDULAR DOSE AND BEAM QUALITY.

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Abstract

The use of mammography in the screening of women for breast cancer has become very common in many parts of the world.The need to obtain quality images in order to maximize the sensitivity of cancer detection has to be balanced agains the radiation dose to the breast and the consequent risk of cancer induction . One of the main factors effecting image quality and radiation dose is the beam quality .The aims of this study were to investigate how the choice of tube potential affects mean glandular dose (MGD),exposure (mAs) and assess correlation between MGD ,contrast and breast thicknesses. The effects of varying KVp on mAs, breast radiation dose, contrast, resolution and image quality has been assessed using a accreditation phantom desined whit Giotto and General Electric mammography x-ray sets.Dose and image quality results were compared.A standard breast phantom with dosimetric plate and imaging insert is constracted.Dose measurements are made with dosimeter Thermo Luminesecence Dosimetry TLD (plate parallel). For each unit , phantom images were generated at tree x-ray tube potentials from 24KVp to 28KVp. For each x-ray tube potential , measurements of the mAs and MGD were obtained.Increasing the KVp from 24 to 28 ,reduces mAs and MGD.MGD reduces 12%, from 2.5 to 1.8.There is a correlation between the MGD and contrast (R_2 =0.5576) and a correlation between the contrast and image quality (R_2 =0.97).Increasing breast thickness MGD increases from 1.4mGy to 2.5mGy and contrast redused from 0.57to 0.42 A good correlation between the dose and tube potential was observed.MGD and exposure time are function of x-ray tube potential. Increasing the xray tube potential reduced the exposure time and MGD.All of the measurements dose are lower than the regulatory limit of 3mGy.

Key words: Mammography, Accreditation phantom,Conterast, Mean Glanduar Dose (mGy)

1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-195

MEASUREMENT OF SOIL INVENTORIES OF NATURAL AND ANTHROPOGENIC RADIONUCLIDES IN GUILAN PROVINCE

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Abstract

As part of a comprehensive study program of environmental radioactivity in the North Alborz ecosystem, inventories of natural radionuclides Radium-226 (^{226}Ra), Thorium-232 (^{232}Th) and Potassium-40 (^{40}K) as well as the anthropogenic radionuclide Cesium-137 (^{137}Cs), a product of nuclear fission reaction, which has entered into the atmosphere through nuclear weapon tests and nuclear accidents, have been measured for more than 800 soil and surface vegetation samples collected from 70 sites throughout Guilan Province. Split-level composite sampling method was employed in individual sites on 0-5, 5-10, 10-15 and 15-20 cm depth intervals. Samples were air dried, homogenized and sealed in special holders and left for over 20 days to reach the required equilibrium. They were then subjected to gamma spectrometry using HPGe detectors. Gamma spectrometry systems were calibrated against standard samples provided by analytical quality control services of the International Atomic Energy Agency (IAEA). Measured mean values of specific activity are (21.5±1.6), (24.7±1.7) and (517.8± 33.1) Bq kg^{-1} for ^{226}Ra, ^{232}Th and ^{40}K, respectively. The range in^{137}Cs deposition is 244-4083 Bq m^{-2} with a mean value of (1983.5±99.2) Bq m^{-2}. In addition to the intrinsic value of these measurements in determination of radioactivity levels in the environment, ^{137}Cs inventories in surface horizons of soil could be used to investigate the spatial variations in total aerosol deposition (dry plus wet and occult depositions) in limited areas. ^{137}Cs becomes attached to the same aerosols which contain the bulk of the main pollutants sulphur and nitrogen oxides. The radioisotope "tags" the aerosols and can therefore be used as an environmental tracer for atmospheric and deposition processes such as surface roughness, land-use and orographic effects, in general, and deposition of acidic pollutants, in particular. Considering the physical

half-life of ^{137}Cs (~ 30 years), the advantage of this method in quantifying the pattern of aerosol deposition over installation of network stations for air and rain-water analysis is in its inherent ability to determine the long-term average of thousands of precipitation events and various deposition processes.

1st Human, Life and Radiation Conference
29-31 October 2006
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MONITORING AND ENVIRONMENTAL DOSIMETRY OF CONTROLLED AND SUPERVISED AREAS OF HEALTH PHYSICS GROUP OF NUCLEAR RESEARCH CENTER BY USING RADOS DETECTORS

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Abstract: Regarding to radiation effect of synthetic and neutral sources on human health, monitoring and environmental Dosimetry is very important. A sensitive detector such as rados is generally used for detecting and recording the nuclear accidents near radiation resources, such as Tehran Research Reactor (TRR), Gamma Irradiation Center (GIC), Radioisotope Production Center, Van-de Graff accelerator, and other workplaces with radiations at working days and off days.
In this research, five Stationary RADOS detectors such as stationeries Tehran Research Reactor (TRR), Bank, Aftab building, Parking and Zamin Chaman had been utilized.
These RADOS detectors have high measurement accuracy of 0.01 μSv/h and are able to monitor and announce the release of radionuclide into the environment under normal, abnormal and emergency conditions.
In this study, the amount of dose recorded was investigated from the beginning of 1384 through the month of khordad of 1385 at controlled and supervised areas of Health Physics Group of Nuclear Research Center.

The results of this detailed study show that the amount of produced radiation per year inside of supervised areas of Health Physics Group of Nuclear Research Center is far less than the registered standards of IAEA and ICRP.

Key words: monitoring, environmental Dosimetry, RADOS, detectors, radionuclide.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-198

THE DISTRIBUTION OF LEAD IN HUMAN TEETH, USING CHARGED PARTICLE ACTIVATION ANALYSIS

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Abstract: Lead is known to be toxic to human at blood-lead concentration exceeding 0.3 ppm in children and 0.4 ppm in adults. There is a relationship between high environmental lead levels and absorption it in different tissues. Bone and teeth have a remarkable capacity for removing lead from solution or suspension and therefore should be better indicators of cumulative lead exposure. Examination of teeth, some of which are always available from children and adults in any area seems likely to give a more complete picture than blood and urine determinations. A technique has been developed to measure lead content in teeth using $^{3}He^{+2}$ activation analysis. The alpha activity produced in the teeth is recorded on plastic flim alpha- track detectors(LR-115) and compared to the activity produced by the lead contained in standard glass. The lead content is found to increase with age in dentine and pulpal dentine, but not in enamel.
This paper is work has been done by T AL-Naimi, M I Edmonds and J H Fremlin. (University of Birmingham)
In Iran there is not a cyclotron that emitting 30 Mev helium-3 ions, but by chemical methods this is possible to measure lead content in sample.

Key words : activation analysis, cyclotron, half life, etching, SSNT detectors

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-199

REDUCTION OF THE GAMMA DOSE EQUIVALENT DUE TO ^{252}CF AND ^{241}AM-BE NEUTRON SOURCES IN THE PATIENTS SOFT TISSUES WHEN USING BODY CHEMICAL COMPOSITION ANALYZER BED.

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Abstract

The ^{252}Cf radioisotope and ^{241}Am-Be are routinely compact and portable encapsulated neutron sources that have wide range of applications in laboratories, industries and medicine, because of their high flux and reliable neutron spectrum. They are cost-effective neutron sources for Prompt Gamma Neutron Activation Analysis (PGNAA). PGNAA method can be used in medicine for neutron radiography and body chemical composition analysis. Unfortunately ^{252}Cf and ^{241}Am-Be sources generate not only neutrons, but also emit high-energy and undesirable gamma-rays that are useless when using PGNAA method. Also since the sample in medical treatments is a human body, it will be under the harmful bombardments of undesirable gamma-rays. In addition the existence of high-rate gamma rays eventuate simultaneous pulses in the detector that can be piled up and causes a significant background and distorts spectra in the region of interest (ROI). All of these restrictions forced us to attenuate these gamma-rays in a practical way without being concerned about losing the neutron flux or significant alteration in the neutron spectrum. In order to solve these problems, a relatively safe Body Chemical Composition Analyzer was designed that uses an optimal spherical gamma-ray shield, enclosing neutron source. Gamma-ray shielding effects and optimum radius of spherical Pb shield have been investigated and compared with the unfiltered case, bare source, using MCNP4C code. At the end the gamma ray dose equivalent per source neutron rate (user defined parameter) in the soft tissue for several radius of spherical Pb shield, for both neutron sources are calculated. Results show how using an appropriate gamma-ray filter can reduce the risk of exposure to the ^{252}Cf and ^{241}Am-Be neutron sources when using them in a Body Chemical Composition Analyzer.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-200

HORMONAL ALTERATIONS ASSOCIATED WITH EXPOSURE TO RADIATIONS EMITTED FROM VISUAL DISPLAY TERMINALS

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Background: Visual Display Terminals (VDTs) are widely used as effective interfaces between operators and computers in modern life. Millions of VDTs are currently in use for receiving and processing information. The majority of VDTs are based on cathode ray tube technique (CRT). However, liquid crystal displays (LCDs), and more recently plasma and electro luminance displays (ELDs) have been introduced as much better alternatives because of their lower weight and lower electromagnetic emissions. Operators who work with VDTs usually experience some form of fatigue, discomfort or pain. Although X-ray emissions from normally functioning VDTs are not detectable, these devices emit low frequency, very low frequency, and extremely low frequency electric and magnetic fields. The purpose of this study was to investigate the association of VDT use and the level of three hormones; cortisole, estradiol and testostrone.
Materials and Methods: Thirteen rats (weight ranged 100-120g) were divided randomly into three groups of CRT, LCD and sham exposure (6 animals each). All exposures were performed using an identical symmetric geometry. Blood sampling from animals' orbits was performed 3 hours after real/sham exposures.
Results: CRTs increased the cortisole level in rats. The cortisole level in rats exposed to emissions from CRTs, LCDs or sham irradiated were 14.62±2.44 mg/dL (mean ± SD), 12.87 ±4.30 mg/dL, 12.33 ±3.77 mg/dL respectively. However, these differences were not statistically significant. For estradiol and testosterone the differences in rats exposed to emissions from CRTs, LCDs or sham irradiated were not statistically significant.
Conclusions: Data obtained in this study provides no reason to suppose that low frequency electromagnetic fields produced by VDTs can make alterations in the levels of cortisole, estradiol and testostrone. Further studies should be performed to clarify whether work at VDTs can affect human health by altering the hormone levels.

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1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-201

CALCULATION OF REACTIVITY FOR $[dt\mu^* - dee]^*$ META-STABLE COMPLEX

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Abstract

The complexes like $[dt\mu^* - dee]^*$ are annihilated via the fusion or radiation (X-ray type) processes in the $dt\mu^*$ pseudo nucleus. These molecules are formed in the special conditions of the media, and can be used as a source of X-ray or nuclear energy production. The radiation of X-ray type has been discovered at Paul Sherrer Institute recently. In this paper, the photo-decay width or reactivity for the mentioned pseudo nucleus is calculated, using a new and simple quantum mechanical method.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-202

AN ANALYSIS OF PRESENT STATUS OF REGULATORY SPECTS IN INDUSTRIAL GAMMA RADIOGRAPHY IN IRAN

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Abstract

Industrial radiography is one of the essential methods in the modern technology to guarantee the quality control of many types of devices, pieces and machines operation, and usually involves intense radiation sources, which can expose people at work to significant amounts of radiation.

The aim of this research is to assess the level of dose to the industrial radiographers and the level of radiation safety regulations and radiation protection program implemented in Iranian industries.

In Iran, there are 607 mobile Gamma Radiography Projectors (GRP) containing ^{192}Ir radioactive sources. These GRP belong to 184 Industrial Radiography Companies (IRC). Approximately 1889 radiographer's works in these IRC.

According to the latest data presented by United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR 2000), the average annual effective dose to the industrial radiographers is 3.37mSv/y. Based on this work, average effective dose and collective effective dose to the radiographers are 4.70mSv/y and 8.87 Man.Sv respectively due to 2005.

Key words: Industrial Exposure, Industrial Radiography, collective dose, gamma projector, radiation protection program.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-203

SUBJECTIVE ILL HEALTH SYMPTOMS ASSOCIATED WITH EXPOSURE TO RADIATIONS EMITTED FROM VISUAL DISPLAY TERMINALS

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Visual Display Terminals (VDTs) are widely used as effective interfaces between operators and computers in modern life. Millions of VDTs are currently in use for receiving and processing information. Operators who work with VDTs usually experience some form of fatigue, discomfort or pain. Although X-ray emissions from normally functioning VDTs are not detectable, these devices emit low frequency, very low frequency, and extremely low frequency electromagnetic fields. The purpose of this study was to investigate the association of VDT use and the prevalence of poor health symptoms among VDT operators. Basic demographic data and self-reported symptoms were sought using a questionnaire administered to all apparently healthy individuals. Questions about some major confounding factors such as age, gender, amount of video display terminal work were also included. Exact Fisher Test was used for data analysis. Among self-reported symptoms, stress (59.7%), headache (51.0%), vertigo/dizziness (29.8%), concentration disorders (46.3%), anxiety (40.8%), fatigue (44.5%) and memory disorders (38.0%) were the main self-reported symptoms in control group. The frequency of these symptoms among VDT operators (cases) were 65.3%, 50.4%, 43.8%, 50.8%, 55.4%, 76% and 42.1% for headache, vertigo/dizziness, concentration disorders, anxiety, fatigue and memory disorders, respectively. A significant association was found between VDT use and the frequency of symptoms such as vertigo ($P<0.05$), depression ($P<0.05$), fatigue ($P<0.001$), sleep disorders ($P<0.05$) and vision disorders ($P<0.001$). The frequency of the individuals who reported that the symptoms got worse with continuing the use of VDTs, were 45.6% and 61.2% in controls and cases, respectively. These data suggest that long-term use of VDTs can be considered as a health hazard.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-204

MAGNETIC RESONANCE SPECTROSCOPIC (MRS), NEW IMAGING TECHNOLOGY FOR BREAST CANCER

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Abstract

breast cancer after beast lungs is secondary mortality cause from cancers. Today breast cancer risk factor have increased .for example: women elderly, precocious Puberty and precocious menarche, life style in industrial society.

MRS is new imaging technique that with use of spectrum in magnetic resonance wave with measured key metabolites and their concentrations at short acquisition times.

Analyses thousands of chemical components of cancer cell have a different identifiable place on the spectrum, a sort of color coded chemical signature: tcho (choline) concentration to be significantly higher in breast cancer.

The MRS detected breast cancer with 94 % sensitivity and 95% specificity, may diagnose breast cancer without biopsy.

The most important prognosis is due to early diagnosis .MRS breast cancer earlier, more accurately, less invasively and is correct for young women, monitoring response to therapy.

We hope this technique will eventually be use to avoid unnecessary biopsy.

Key words: magnetic resonance spectroscopy, breast cancer

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-205

A SYSTEMATIC PATTERN FOR EMERGENCY HOSPITALS IN NUCLEAR DISASTERS

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Abstract

Nuclear emergency department is a safe zone that prevents the second contamination with its specific management. The establishment of emergency hospitals in nuclear disasters effectively decreases the secondary contamination and threatening effects. The necessity of training and the contraction of emergency hospitals in such disasters have an efficient aid in better protection of exposed individuals. The most important point in creation of a nuclear emergency center in threatening areas is the formation of a local committee, to build and manage such center, and a subcommittee for organizes the plans and interconnects its sections. In the engineering of such medical center special considerations and valuable affairs are: decontamination of clients and separation and recognition of the clean and contaminated areas. In order to bring various issues in nuclear emergency hospital these major points must be considered. Policy and plans, design of emergency department, equipment required, personnel required, education and training, surveillance system. In the countries with probability of nuclear threatening situations the establishment of such emergency centers is usually part of disaster programs and in these countries serious training and specific organizations has implemented.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-206

INDOOR RADON MEASUREMENT IN THE AIR OF SOME APARTMENTS IN MASHHAD AFTER 9 COLD DAYS, WINTER 2006

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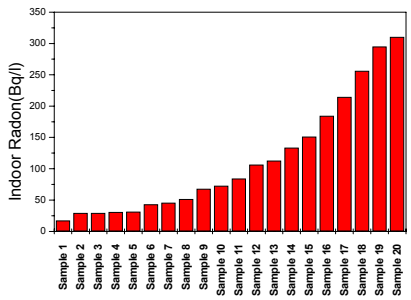
Abstract

Environmental monitoring and indoor radon measurement are important for health of life to give advises to the people in order to reduce the cancer risk of respiratory system. In the present paper, radon concentration in the air has been measured at indoor of some apartments in Mashhad after 9 cold days with PRASSI system. Most of people close the doors and windows during the cold days; so, the radon concentration level increases as we expect. Fig. 1 shows the histogram of radon concentration at 20 apartments. The result demonstrate about 40% of apartments have radon level low than the normal level (48 Bq/m^3), as shown in Fig. 2. Some of the apartments have radon level exceed the normal level up to 5-6 times! We must mention the outdoor radon was 14.3 Bq/m^3 in that time.



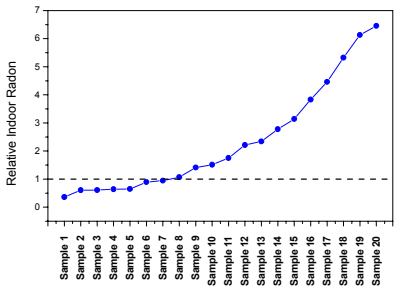


Fig. 1: The histogram of radon concentration in the air of 20 apartments.

Fig. 2: Relative radon concentration of the 20 apartments.

1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-207

A SURVEY INVESTIGATING THE AWARENESS OF RADIATION WORKERS FROM RADIATION PROTECTION AND SAFETY DOSES IN KERMAN TRAINING HOSPITALS

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Abstract

Background: Ionizing radiation specially x-rays and rays from radioactive materials are very important in diagnosis and treatment of diseases. Nowadays important and decisive medical decisions are based on physical examination and diagnosis from x-rays. Radiotherapy is one of the most important and effective manner in the palliative and curative treatment of human cancers. Nuclear medicine has developed in diagnosis, treatment and medicine investigation very quickly. Radiation protection sciense was created accorting to developing medicine science about the radiobiological effects and diseases from ionizing radiation.The Use of radiation rays is harmful and nonsafety without using the laws of radiation protection.

Methods: This study investigated awareness of radiation workers in Kerman hospitals, (54 staff) to safety doses in workers, non- workers, and fetus. It also investigated the damage effect of ionizing rays, the most important role in radiation protection, and the awarness of radiation workers of the kinds of ionizing rays along their life span by questionnaire.The analyses of the study was performed by spss 11.5.

Results: We missed ten subjects from 54 staff because they didn't answer the questionnaire. The employee's awarness about different effects of radiation and kinds of radiation rays were 45.5% and 59% (respectively).

The employee's awareness about safety doses and the use of film badge were29.5% and 16%.

The employee's awareness of the dose in urgent situation and the use of unit radiation protection were 29.5% and 54.5%. There was no relationship between the level of education

and their awareness of radiation protection (P>0.005). There was a meaningful relationship between the participation in education classes and awareness of employees (P<0.005). The mean of the scors was 7.6 (from 20) .This might be lower because ten subjects didn't participate in the survey.

Conclusion: Laws of radiation protection are used for preventing and decreasing harmful effects of ionizing rays. Radiation workers must know these laws.the use of ionizing rays is non- safety without knowing the laws of protection,and this lack of knowledge is harmful for staff. This study shows that staff needs constant and serious training classes about radiation protection. The teaching can be done by having seminars or classes so that staff can work with the least amount of harmful effects.

Key words: Radiation workers, Radiation Protection, Safety doses, Hospital

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-209

CHILDREN IN NUCLEAR ACCIDENTS

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Abstract

It is clear that in the recent years occurrence of nuclear accidents due to increasing nuclear technology is not avoidable. In these accidents, it is necessary to consider the incidence of physical and psychological injuries especially in vulnerable groups such as children, Because their health statues is really important for the community health. Children who are exposed to nuclear accident are more vulnerable physically and psychologically than the people in other age groups because of their unique characters. So, identifying the predisposing factors and protection strategies for them should be considered, in order to minimize nuclear accident–inducing problems.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-210

CARING FOR RADIOLOGICAL AND NUCLEAR ACCIDENT'S VICTIMS

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Abstract:

Countries who have found nuclear technology should have essential information about it. In spite of all attempts to prevent of nuclear accident, it is also necessary to have enough readiness for the management of these sorts of accidents to overcome the nuclear accident induced-problems. Exploding and leaking of any nuclear instruments would cause massive fatalities, injuries and major health problems from initial explosion (with blast, falling debris, and fires) and from the immediate and long-term effects of radiation exposure. One of the main health care team's duties is to provide care for these people. So, they must consider the manifestations of radiation sickness and syndromes when managing radiological injuries. Before offering any care to victims, must be sure about self-protection from contamination, disposing of contamination, controlling the spread of radioactivity. The following advices for the health care team in order to provide suitable care of these people are necessary. Knowing about others and self protection, primary care to victims in the first encounter in the accident place and hospital, isolation strategies, irrigation and bandage open and contaminated wounds, safe sampling for laboratory studies, early diagnosis of and distinguish between acquired radiation syndromes, and also considering the psychological aspects.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-211

DETERMINATION OF ACTIVITY FROM ^{40}K IN FOODSTUFF AND CALCULATION OF ABSORBED DOSE IN THE HUMAN BODY IN ARAK IRAN

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Abstract

Potassium 40 is a natural radionuclide with long half-life about 1.28 billion years and its abundance is 0.012 percent in natural potassium. Potassium is an important constituent of soil; it is widely distributed in nature and is present in all plant and animal tissues. Potassium-40 is a naturally occurring radioactive isotope of potassium. Determination of activity in foodstuff is very important, because potassium-40 after entrance in human body behave as an internal radioactive source that cause to destructive effect on the organism. in this experience we measured the activity of potassium-40 in different samples of foodstuff. Eating some foods that contain potassium can increase the mass of potassium-40 in human body for certain time. At least we calculated the amount of effective dose before and after eating food.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-212

NON IONIZING RADIATION PROTECTION

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Radiation Protection Act of Iran covers non ionizing radiation as well as ionizing radiation protection. In this paper, after introduction of non ionizing radiation (NIR), and its health effects, conducted activities by National Radiation Protection Department of Iranian Nuclear Regulatory Authority, to protect general public and radiation workers against health hazards of NIR are explained. These activities include:

- Necessitation of NIR protection in the country
- Assessment of the levels of electromagnetic fields in general public centers and also work places.
- Risk assessment of workers working with NIR sources.
- Publication of procedures and guides to work safely with NIR sources.
- Training of the NIR workers.
- Establishment of NIR lab to be able to measure different NIR and also to calibrate NIR measurement instruments.
- Type approval of imported NIR sources as well as quality control of NIR sources produced in the country.
- Development of "Non Ionizing Radiation Standard- Exposure Limits".
- Construction of some kinds of NIR measurement instruments.

1st Human, Life and Radiation Conference
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Rafsanjan University of Medical Sciences
HLR-P-213

RADIATION ACCIDENTS IN NEW MILLENNIUM

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A significant number of accidents, each with some unique aspect, have occurred worldwide during past 30 years.
The first article devoted to accidental exposure , entitled "A case Study of Accidental X-ray Burns Hitherto Recorded," was published in the accidents was established in 1902.
Although the health effects of ionizing radiation become increasingly recognized, an organized approach to the medical management of radiation accidents did not develop until the early 1940.
With the advent of peacetime uses of nuclear energy, particularly for electric power generation, a more organized approach for medical management of radiation accidents was established.
Between 1960 and 1979, eight conferences or symposia on radiation accidents had been conducted in Europe or United States.
53 serious radiation accidents have occurred since December 1, 1990. 26 of these accidents occurred in United State, and 27 occurred outside the United States. In all, 652 persons were involved, 259 of whom received a significant exposure, with 33 fatal outcomes.
One important question everyone at this conference should ask is" Will serious radiation accidents continue to occur in the future?"
Despite the diligent efforts of the radiation protection community, unfortunately, the answer is yes.
As the world population expands, more power will be needed, especially in less developed countries; there could be an expansion in Nuclear Power Plant industry within 25 years.
Oil exploration and petroleum refining also require nondestructive testing technology. Therefore the use of sealed sources, particularly of Ir-192 and Co-60, will continue o be needed for use in industrial radiography.
Human error will continue to contribute to accidents associated with the use of ionizing radiation and radioactive materials used of ionizing radiation and radioactive materials will diminish in industry, agriculture, medicine and research.
I will present the overview of some accidents and lesson to be learned from them for preventing such accidents in future.

1st Human, Life and Radiation Conference
29-31 October 2006
Rafsanjan University of Medical Sciences
HLR-P-214

DESIGN AND IMPLEMENTATION OF A CODE TO PRODUCE MCNP4C GEOMETRY INPUT FILE FROM TOMOGRAPHY IMAGES USING MATLAB SOFTWARE

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Nowadays, Monte Carlo simulations can be used as a powerful tool for evaluating internal and external body dosimetry. In this method, precision and accuracy of the simulated results depend entirely on the definition of target geometry. In regard to irregular samples (including organs), since there is a difference between simulated and real organ, defining geometry for simulating methods is a crucial issue. Such an issue can be led to the reduction of final result precision. Other studies have implemented this method and two codes of SCMS & OEPIDE are such examples.

In this study an interface program is written by MATLAB software, enabled to receive tomography images (CT-MRI-SPECT) as an input and then extract the geometry of target organs based on the MCNP requirements for input file. By Comparing characteristics and results of this program with similar programs, its advantages & disadvantages are examined. With regard to independency of the interface to the CT-number and the type of tomography images, working with various images is possible. The program prevents errors arising from CT-number variation in deferent sets.

1st Human, Life and Radiation Conference
29-31 October 2006
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HLR-P-215

THE ROLE OF NUCLEAR ENERGY IN IRAN'S SUSTAINABLE DEVELOPMENT

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According to the International Atomic Energy Agency, the consumption of electricity is practically synonymous with modern life in industrialized world. In this light, the optimization of production and consumption of energy is among the main strategies in either developed or developing countries. Sustainable development as it was initially defined by the Brundtland Report "*a development that meets the need of the present without compromising the ability of future generations to meet their own needs*" is looking for maintaining or increasing the overall assets available to future generations. Considering a report published by the World Bank in 2004, more than 96% of electricity production in Iran in 2001 came from fossil sources (74.9% from gas and 21.2% from oil) and the negligible remaining part (3.9%) was based on hydroelectric sources. Combustion of fossil fuels in Iran produces large amounts of CO_2 (the biggest contributor to global warming), noxious gases, and many toxic pollutants. These data clearly indicate that Iran needs emission free alternatives such as nuclear energy for its sustainable development. On the other hand, beyond electricity generation, the use of nuclear energy in medicine, industry, agriculture, food preservation and research significantly increases the quality of life and reduces the adverse effects on the environment without consumption of valuable fossil resources that should be saved for future generations. No doubt, fossil resources can be used in many industrial fields such as petrochemistry, while the only practical application of uranium is energy production.

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