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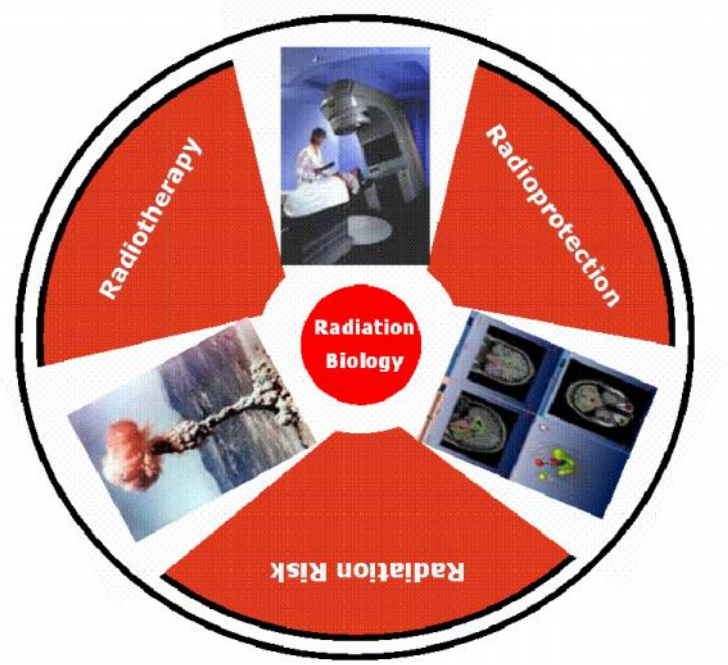

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Happy New Year 2013

Radiation Science Today

January-March **Issue:** 21 **Year:** 2013

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1. An Interview on 'Radiation Phobia after Fukushima Accident: Facts and Myths' with *Dr B. R. Scott*

An Interview

on

Radiation phobia after Fukushima Accident: Facts and Myths

with

Dr B. R. Scott

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Albuquerque, NM 87108, USA

by

Radiation Science Today (RST)

A severe Earthquake (of a magnitude of 8.9) followed by high intensity tsunami at North-East Coast of Japan on March 11, 2011 devastated the region. The news of floating ship, cars etc. appearing on TV screens of news channels has traumatized the public worldwide. The public perception after the incident resulted in severe public fear about radiation application for various industrial and medical applications.

RST: After Fukushima nuclear accident there was public fear about spread of radio-isotopes in environment, which may lead to adverse health effects to public. What is your opinion about the same?

BRS: The public fear associated with the radiological emergency was not limited to Japan and was promoted by the false claim that no level of radiation exposure is safe. No health consequences were found by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) to have been caused by the radiation exposures related to Fukushima. However, more than 1,000 premature deaths have been reported related to the population that was evacuated because of the radiological emergency. These deaths are called disaster-related deaths and relate to evacuation-associated severe stress to fragile individuals including severely ill elderly that were evacuated from hospitals.

RST: After Fukushima nuclear accident, do you think there will be any long term adverse health effects, if so what kinds of and how much we should be concerned with?

BRS: Long-term health effects may result from prolonged psychological stress especially for evacuees. Based on reported radiation doses to the public, no radiation-induced health effects are expected for this group. Some recovery workers are reported to have effective radiation doses exceeding the 250 mSv limit. Depending on the radiation doses received by the indicated workers, there may be an increase or decrease in their cancer risk. A decrease in the cancer risk can occur when radiation adaptive responses arise. The radiation adaptive response can involve removal of existing pre-cancer cells (e.g., smoking-related neoplastically transformed cells) via apoptosis and activated anticancer immunity which can destroy cancer cells caused by cigarette smoke carcinogens and other agents. Cigarette smoke carcinogens and other agents can cause cancer-promoting inflammation, while low-dose radiation suppresses the inflammation. Our research group recently published data [V. Bruce et al. Dose-Response 10(4): 516-526, 2012] showing that repeated small gamma-ray doses given 1 month after injecting a high-level of cigarette smoke carcinogen (Benzo[a]pyrene; abbreviated BaP) into mice that causes multiple lung tumors (adenomas) per animal prevented 3 or more BaP-related lung tumors per animal from occurring.

"…A decrease in the cancer risk can occur when radiation adaptive responses arise. The radiation adaptive response can involve removal of existing pre-cancer cells (e.g., smoking-related neoplastically transformed cells).."

RST: There is comparison in media that Fukushima accident may cause more severe health effects than Chernobyl accident. What is your opinion and how these two accidents are different in terms of short and long term health effects, if any?

BRS: The Fukushima accident is far less severe than the Chernobyl accident. Some emergency workers at Chernobyl received lethal (acute-radiation-sickness-related) radiation doses which is not the case for Fukushima as the radiation exposure limit set for recovery workers was far below the threshold for lethal damage and prodromal symptoms and even the few workers that had doses exceeding the limit did not exceed the threshold for acute effects. Despite having been assigned the same accident severity level (International Nuclear and Radiological Event Scale Level 7) as Chernobyl, the majority of the radioisotopes released

from Fukushima were blown out to sea. Also, the Japanese government quickly stopped consumption of contaminated foods and milk, thereby reducing the potential for thyroid problems as were suffered by children related to radioiodine released from Chernobyl. In addition, following the Chernobyl accident, there were more than 100,000 radiation-phobia-related, ill-advised abortions by pregnant females that may have received small radiation doses.

"...for Fukushima the radiation exposure limit set for recovery workers was far below the threshold for lethal damage and prodromal symptoms..."

RST: How the Linear No Threshold (LNT) model of risk assessment is responsible for such public fear against radiation?

BRS: Indeed, the invalid LNT hypothesis is largely responsible for public fear about ionizing radiation, 'no matter how small the radiation dose'. Based on the LNT hypothesis some scientist calculated a very small average radiation dose to a large down-wind population from Fukushima and multiplied the average dose times the population size to get the collective dose, which was then used to calculate hypothetical cases of cancer death occurring even outside of Japan. Reporting such hypothetical deaths in the news media as though they were real, frightened many worldwide. UNSCEAR submitted a report in 2012 stating that uncertainties in low-dose-radiation effects are such that the committee does not recommend multiplying low average doses by a large number of individuals to estimate numbers of radiation-induced health effects within a population exposed to incremental doses at levels equivalent to or less than natural background radiation. The LNT hypothesis is also responsible for the confusing dose unit sievert (or related units such as millisievert) which unfortunately has two different meanings. One relates to a weighted dose to an organ (e.g., equivalent dose to the thyroid) derived using radiation weighting factors. The other (effective dose) relates to using both radiation and tissue weighting factors. The hypothetical effective dose relates to the total body so that if only the thyroid is exposed and thyroid cancer is the only risk then with effective dose some of the risk for thyroid cancer is effectively attributed to lung, skin, gastrointestinal, and other cancers (same combined detriment as when the total body is uniformly irradiated with gamma rays). Regarding this issue, the International Commission on Radiological Protection (ICRP) Task Group 84 Report (November 22, 2012)

related to lessons learned from Fukushima states that the confusion created by not specifying the dose quantity (equivalent of effective dose) when giving numerical values in terms of sieverts merit a careful analysis of possibilities to improve the situation. The report also points out that a strict and consequent application of a simplified dose reporting could help to improve the situation in cases of radiological emergencies.

"...International Commission on Radiological Protection (ICRP) related to lessons learned from Fukushima states that the confusion created by not specifying the dose quantity (equivalent of effective dose)..."

RST: How radiation biologists can contribute to overcome against fear against radiation and bring about facts in public?

BRS: Radiation biologists as well as health physicists can help to educate the general public and members of the news media about ionizing radiation sources, especially the natural radiation environment. It is important that the public realize that everyone is radioactive throughout life and the radiation doses normally received from natural radiation sources are harmless. In fact there is growing evidence that low doses of radiation (especially low-LET forms) activate the body's natural defenses against cancer and thereby protect from cancer being caused by other agents. The low-dose-radiation-activated natural protection appears to be regulated epigenetically. Interestingly, protective epigenetic changes after low radiation doses appear to be in orders or magnitude more likely than cancer-related gene mutations.

RST: Do you feel that we have sufficient evidence to conclude about health effects of low dose of radiation. If not, what types of research evidences need to bring about the facts about health effects of low dose of radiation?

BRS: My view is that we do not have sufficient evidence to conclude about the health effects (deleterious and beneficial) of low-dose radiation. Important ongoing areas of research include adaptive response, bystander effects (protective and deleterious), genomic instability, genetic susceptibility and resistance, and multigenerational effects. Research findings from our research group point to epigenetically-regulated, low-dose-radiation protective effects (e.g., cancer suppression) being much more likely than deleterious effects on health, especially for low-LET radiation and combined low- and high-LET radiation. Given this, there is

a need for understanding the biological mechanisms responsible for the protective effects and also for quantifying low-dose radiation benefits, especially since benefits may be orders of magnitude more likely than for cancer induction and genetic effects. A colleague, Charles (Chuck) Sanders, has proposed the use of low-dose-radiation for curing inflammatory diseases including cancer (Dose-Response 10(4):610-625, 2012) since low-dose radiation suppresses inflammation. This is also an area where new low-dose-radiation research could be quite fruitful (e.g., combined low-dose-radiation plus gene therapy for cancer).

"...there is a need for understanding the biological mechanisms responsible for the protective effects and also for quantifying low-dose radiation benefits..."

RST: What approach you feel should be adopted to convey to the public the facts and myths about health effects of low dose of radiation?

BRS: A number of approaches involving leading experts could be used including journal (popular) publications directed at the general public with easy to follow language and figures, web-based information (e.g., videos) specifically prepared for the public, educational materials (e.g., pamphlets) provided to schools, colleges, universities, members of the news media, and local and national governments, and educational workshops for teachers, members of the press, and others.

Brief biographical note of Dr B. R. Scott: Dr. Scott's career has largely focused on developing models for predicting health risks and benefits from exposure of humans to ionizing radiation and conducting supportive experimental and epidemiological studies. He has worked on risk assessment problems that relate to local, national, and international issues. His acute lethality risk model was recently used to assess the possibility of life-threatening harm to recovery workers at Fukushima. He is a member of the Editorial Board for the *Dose Response* Journal and a member of the Editorial and Scientific Committee for the *International Journal of Low Radiation*. He was the recipient of the *Outstanding Leadership in the Field of Dose-Response Award* from the International Dose-Response Society, 2008.

2. MR Raju Award Lecture (ICRB-2012) Article

Modulation of radiation injury by pro-oxidant and antioxidant

by
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Ionizing radiation is known to alter the various biomolecules of cells and lead to cellular damage. Reactive oxygen species (ROS) generated by exposure of ionizing radiation play a major role in initiating the radiation injury. Of the total injury caused by radiation exposure to the cells, about 75% damage is mediated through ROS production. The major ROS produced by photolysis of water during radiation exposure includes hydroxyl radical (•OH), superoxide radical (O2•−) and hydrogen peroxide (H2O2) [1]. Among these, •OH is most potent inducer of radiation toxicity [2]. Since ROS are major denominator of radiation injury, antioxidant molecules having ROS scavenging ability are expected to protect against radiation injury while pro-oxidants worsened the radiation effects. This is the conventional wisdom of modulation of radiation injury which accentuates that antioxidants would behave as radiation protector, while pro-oxidants act as radiation sensitizer [1-3]. Although this conventional wisdom for the modulation of radiation injury stands true in some instances, but this may not be the unified concept.

"…UCB induced immunotoxicity by depleting cellular GSH and p38MAPK activation in lymphocytes…"

Our results showed that unconjugated bilirubin (UCB), an endogenous antioxidant potentiated the radiation injury by augmenting radiation induced apoptosis, immunosuppression and infection susceptibility in the experimental mice [4]. UCB is produced by enzymatic degradation of heme and is considered as one of best known antioxidant of body, possessing 10,000 time better antioxidant property than that of GSH [5]. In spite of having such strong antioxidant property, bilirubin at clinically relevant concentration showed strong immunotoxic effects in murine model [6]. Our result showed that treatment of murine splenic lymphocyte with UCB (1-100μM) induced apoptosis in a concentration dependent manner. It was also toxic to splenic T cells, B cells, macrophages, LPS-stimulated CD19+B cells, human peripheral blood mononuclear cells and red blood cells and immunotoxicity is mediated through induction of both apoptosis and necrosis [5]. Further inhibitor studies

revealed that UCB activated both the extrinsic and intrinsic pathways of apoptosis. Activation of CD95 (Fas), caspase-8, Bax, MMP, cytoplasmic Ca+2 in UCB treated lymphocytes further supported the result. UCB depleted GSH and activated p38MAPK in treated lymphocytes. N-acetyl cysteine (NAC), a known GSH donor when used in combination with UCB, it attenuated the UCB-induced p38MAPK activation and apoptosis. These results suggest that UCB induced immunotoxicity by depleting cellular GSH and p38MAPK activation in lymphocytes. Figure1 summarizes the molecular pathways involved in immunotoxic effects of UCB.

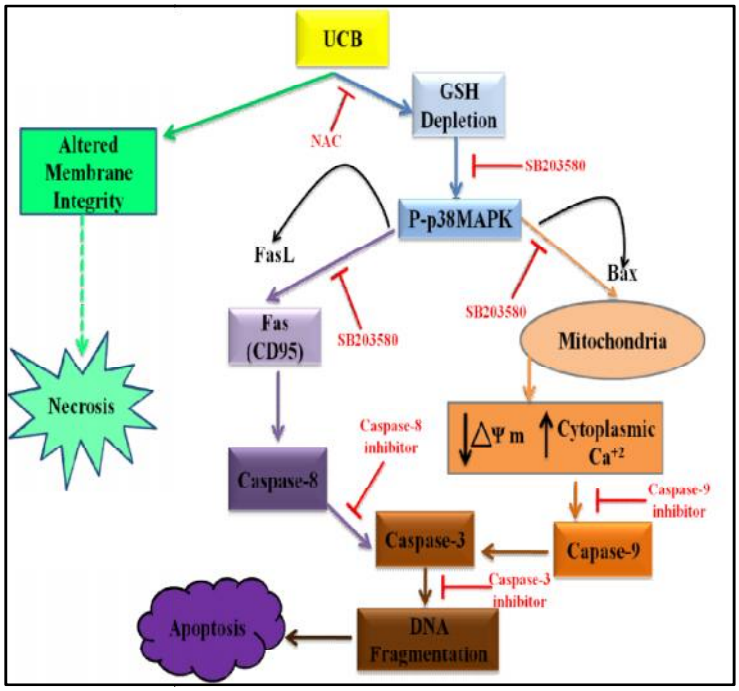

Fig.1: Molecular pathways involved in immunotoxic effects of UCB

In combination with radiation, it was found that UCB further augmented radiation induced apoptosis in lymphocytes in a concentration dependent manner. In vivo administration of UCB to mice prior to radiation exposure showed that it potentiated the radiation induced splenic atrophy, bone marrow aplasia, lymphopenia, thrombocytopenia and neutropenia [4]. In an acute bacterial peritonitis model, UCB pretreatment of mice significantly increased radiation induced pro-inflammatory cytokines (TNF-α, IL-6 and IL-1β), nitric oxide and peritoneal bacterial load resulting in increased infection and death [4]. Studies using pharmacological inhibitor of p38MAPK, demonstrated the involvement of p38MAPK activation in the inflammatory cascade of peritonitis.

Further, our results demonstrated that 1, 4 naphthoquinone (NQ) well known pro-oxidants protected against radiation injury in murine splenic lymphocytes. Depending upon

the concentrations and pulse duration, ROS act as mediator of signaling molecules. Low levels of ROS behave as second-messenger and known to induce pro-survival pathways by activating redox-sensitive transcription factors like NF-E2–related factor 2 (Nrf2) [7]. Our result showed that treatment of lymphocyte with NQ activated Nrf2. Further use of Nrf2 inhibitor confirmed the role of Nrf2 activation in NQ mediated radioprotection. Nrf2 control the fate of cells through transcriptional up-regulation of antioxidant response element-bearing genes, including those encoding for endogenous antioxidants, phase II detoxifying enzymes, and transporters [8].

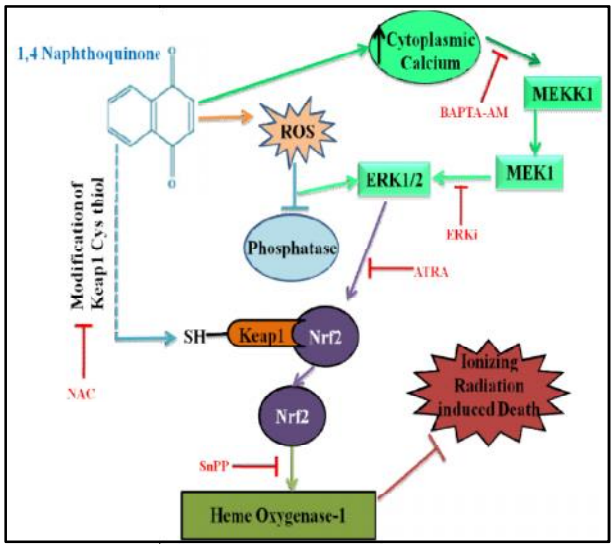

Fig. 2: NQ induced activation of prosurvival pathways for radioprotection

Expression of the Nrf2-dependent proteins is critical to maintain cellular redox homeostasis through elimination of toxicants/carcinogens [9]. Treatment of lymphocyte with NQ resulted in upregulation of Nrf2 dependent cytoprotective genes like HO-1, MnSOD, and catalase which is shown to protect against radiation induced death. Our results demonstrated that a prooxidant like NQ has multiple targets in cells and can protect against radiation-induced apoptosis by activation of multiple prosurvival mechanisms including upregulation of calcium-ERK1/2-Nrf2/HO-1 pathway (Fig. 2)

Our results showed that treatment of mice with NQ prior to radiation exposure protected against the radiation induced splenic atrophy, bone marrow aplasia, and hematopoenia. It was found that NQ administration 0.5h prior to 7Gy WBI was able to significantly prevent radiation induced mortality and weight loss. Further NQ was shown to have a dose modifying factor (DMF) value of 1.18.

Therefore, our results opened a new arena for the discovery of novel radiomodifiers. Even an antioxidant may worsened the radiation injury whereas pro-oxidant can protect radiation insult via activation of redox sensitive survival signaling pathways [6,10]. The protection against radiation injury by ROS scavenging, antioxidants need to be evenly present in all the cells, and among the cells the entire compartment needs to encompass the antioxidant molecules in sufficient high concentration to scavenge the ROS production. Since maintaining such enough concentration of antioxidants in the entire cellular compartment during radiation exposure is difficult to achieve throughout the body, antioxidant potential alone might not suffice to prevent the radiation injury. Therefore activation of multiple pro-survival factors might be one of the possible alternatives to prevent radiation injury. In the view of these published reports, the conventional wisdom of modulation of radiation injury needs to be changed, even pro-oxidant can protect radiation insult while antioxidant may worsened the radiation injury [4, 10].

"...an antioxidant may worsened the radiation injury whereas pro-oxidant can protect radiation insult via activation of redox sensitive survival signaling pathways..."

Acknowledgments

The author thanks his research guide Dr. T.B. Poduval for his expert guidance through the work. Further author sincerely acknowledge Dr. K.B. Sainis, Dr. Santosh K. Sandur, Dr. Deepak Sharma, Dr. Hari N. Bhilwade, Mr. Rahul Checker, Ms. Shweta Suryavanshi and Mr. Chandan Wilankar for their invaluable helps and suggestions in the design and execution of experiments throughout the study.

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A brief biography of author: Dr. Nazir M. Khan is currently working as a scientist at Genomics and Molecular Medicine Unit, CSIR-IGIB (Institute of Genomics and Integrative Biology), New Delhi. He has recently been awarded with PhD degree in Life Science from Bhabha Atomic Research Centre (BARC) under aegis of Homi Bhabha National Institute (HBNI), Mumbai. He joined BARC after graduating from 51st batch of training school and 2nd batch of HBNI. His research interest include role of cellular redox homeostasis in the modulation of radiation injury and immune responses. He is also involved in the investigation of anticancer, anti-inflammatory and immunomodulatory properties of various natural products.

Note: Dr Nazir M. Khan has been conferred Dr and Mrs MR Raju Award for excellence in radiation biology research by Indian Society for Radiation Biology during International Conference on Radiation Biology, 2012 (ICRB-2012) 'Cosmic Radiation to Radiation Therapeutics' along with the 11th Biennial Meeting of Indian Society for Radiation Biology (ISRB), November 22-24, 2012, Advanced Centre for treatment, Research and Education in Cancer (ACTREC), Navi Mumbai, India.

3. 'Best Idea Award' Lecture (ICRB-2012) Article

Magneto-liposomes for combinatorial hyperthermia, chemo and radiation therapy of cancer

by
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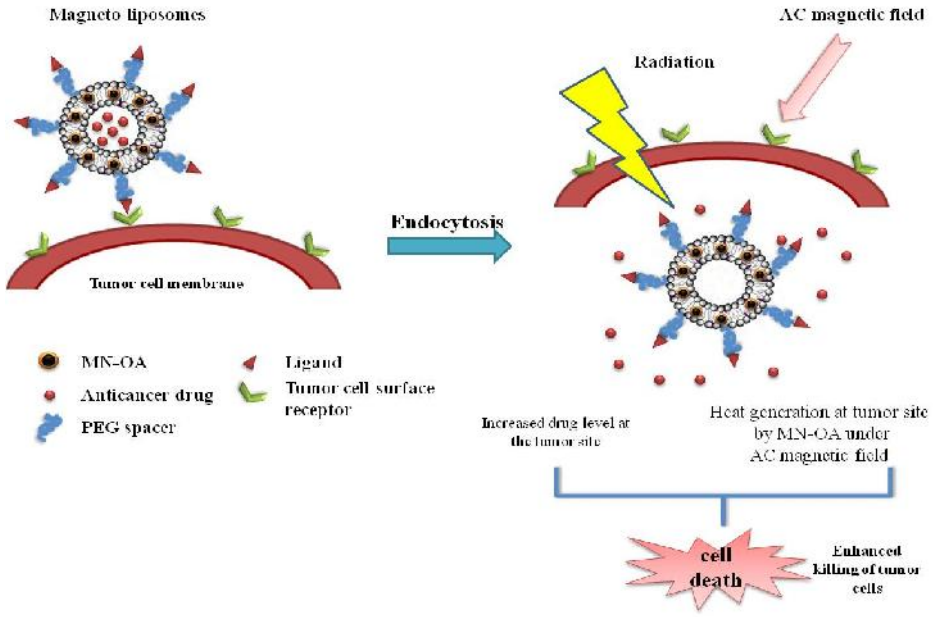
Cancer remains one of the leading cause of death all over the world with more than 10 million new cases every year [1]. The current cancer management options primarily include: surgery, chemotherapy and radiation therapy. However, these approaches suffer from limitations like resistance of tumor cells to chemotherapeutic agents/radiation, adverse side effects of chemo or radiotherapy, etc [2]. Hence, a combinatorial approach for treatment of cancer is necessary. One such approach involves active targeting of the chemotherapeutic drugs/radiosensitizers to the tumor site with the help of targeted nanoparticles, which can then be combined with hyperthermia or radiation therapy for better cancer management.

In the present work, we have synthesized oleic acid (OA) functionalized iron oxide magnetic nanoparticles (MN-OA) for hyperthermia therapy of cancer cells. Their average size of ~10 nm, combined with reduced agglomeration and increased dispersibility in physiological medium, demonstrate their suitability for *in vitro* and *in vivo* hyperthermia applications. The *in vitro* hyperthermic tumor cell killing efficacy of MN-OA was evaluated in Wehi 164 (mouse fibrosarcoma) tumor cells by trypan blue dye exclusion method. As compared to control, tumor cells treated with MN-OA and hyperthermia showed significant decrease in cell viability. This was supported by altered cellular morphology (cell detachment and circularization) after MN-OA and hyperthermia treatment. In addition, as compared to control, relative apoptotic death was found to be significantly enhanced in tumor cells treated with MN-OA and hyperthermia.

"...active targeting of the chemotherapeutic drugs/radiosensitizers to the tumor site with the help of targeted nanoparticles, which can then be combined with hyperthermia or radiation therapy for better cancer management..."

Future Perspectives

Synthesis of Magneto-liposomes involves encapsulating MN-OA in the liposomes, which can be further fabricated to load anti-cancer drugs and to be used in combination with radiotherapy. Capping the surface of these magneto-liposomes will help to improve their blood circulation time. Moreover, these magneto-liposomes could also be targeted to tumor site using specific tumor cell surface receptors. Once in circulation the magneto-liposomes can extravagate to the target tumor site with the help of enhanced permeability and retention effect. This is possible due to the leaky vasculature of the tumor tissue as compared to normal tissue. Also, since the lymphatic drainage in tumor tissue is little or negligible, the magneto-liposomes (and the heat generated by them under *AC* magnetic field conditions) will be retained at the tumor site for longer duration [4]. At the tumor site, the magneto-liposomes will be internalized by the tumor cells by receptor mediated endocytosis. When an *AC* magnetic field is applied, the heat generated by MN-OA (42 °C) will enable efficient delivery of the anti-cancer drug inside the tumor cells. In combination with radiation, the (i) increased drug level at the tumor site, (ii) heat generated by MN-OA and (iii) OA will act as radiosensitizers and enable efficient killing of the tumor cells.



Scheme: Magneto-liposomes for combinatorial hyperthermia, chemo and radiotherapy of cancer

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A brief biography of author: Neena Vilas Jadhav is currently working as scientific officer 'C' at Radiation Biology and Health Sciences Division of BARC, Trombay. She received her post-graduate diploma in life sciences and Radiation Biology from Training School of BARC in the year 2011. She completed her post-graduation in Biotechnology from Ramnarain Ruia College, University of Mumbai, Mumbai, in the year 2010. Her research interests include development of novel magnetic nanoparticles (MN) formulations for hyperthermia applications in cancer therapy and studying the mechanism underlying magnetic nanoparticles mediated hyperthermic killing of tumor cells. Development of novel nanoparticles based drug delivery systems for effective killing of cancer cells.

Ms. Neena Jadhav has been conferred 'Best Idea Award' during International Conference on Radiation Biology, 2012 (ICRB-2012) 'Cosmic Radiation to Radiation Therapeutics' along with the 11th Biennial Meeting of Indian Society for Radiation Biology (ISRB), November 22-24, 2012, Advanced Centre for treatment, Research and Education in Cancer (ACTREC), Navi Mumbai, India.

4. FROM ARCHIVES OF RADIATION SCIENCES

Paper: Proliferation Kinetics of Density-inhibited Cultures of Human Cells, A Complex in Vitro Cell System
Source: CANCER RESEARCH (1973) 33, 2343-2348

(http://cancerres.aacrjournals.org/content/33/10/2343.long)

Authors: George F. Zinninger and John B. Little
Laboratory: Department of Physiology, Harvard University School of Public Health, Boston, Massachusetts, USA

Highlights of the paper

In present paper, proliferation kinetics and cell cycle parameters have been measured in exponentially growing and density-inhibited stable-plateau phase cultures of Chang human liver (LICH) cells. The results showed that the mean duration of phases of the cell cycle was ~doubled in density-inhibited cultures. Moreover, density inhibited cultures of LICH cells possess kinetic characteristics of tumors in vivo. Such culture system may provide a useful in vitro system to study of the effects of chemotherapeutic agents and protracted schedule of radiation, and interaction between the two modalities of cancer therapy.

Significance and comments about the paper

This paper is one of the seminal papers investigating cell kinetics in density inhibited cells with their possible application to be used as an in vitro cell culture model to study effects of cancer therapeutic agents.

by
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Note: *Interested readers may submit similar articles. This column is aimed to highlight the salient points and significance of seminal research articles/events in radiation biology and allied sciences, which further substantially changed the understanding in that particular research field.*

5. ARTICLES OF THE ISSUE

- **Frequency of Transferrin Receptor Positive Reticulocytes (TF-Ret) in Blood as an Indicator of Total-Body Radiation Exposure: A Pilot Study in Nuclear Medicine Patients**

  http://www.bioone.org/doi/abs/10.1667/RR2818.1

- **Telomere length and telomerase activity impact the UV sensitivity syndrome xeroderma pigmentosum**

  http://cancerres.aacrjournals.org/content/early/2013/01/01/0008-5472.CAN-12-3125.abstract.html?papetoc

6. LITERATURE UPDATE

Radiation Biology

- **Processing of DNA double strand breaks by alternative non-homologous end-joining in hyperacetylated chromatin**
  http://www.genomeintegrity.com/content/3/1/4/abstract
- **Differential gene expression in human fibroblasts after alpha-particle emitter 211At compared with 60Co irradiation**
  http://informahealthcare.com/doi/abs/10.3109/09553002.2013.746751
- **Executive Function in Rats is Impaired by Low (20 cGy) Doses of 1 GeV/u 56Fe Particles**
  http://www.bioone.org/doi/abs/10.1667/RR2862.1

- **Molecular characterisation of murine acute myeloid leukaemia induced by 56Fe ion and 137Cs gamma ray irradiation**
  http://mutage.oxfordjournals.org/content/28/1/71.abstract.html?etoc
- **Differential gene expression in human fibroblasts after alpha-particle emitter 211At compared with 60Co irradiation**
  http://informahealthcare.com/doi/abs/10.3109/09553002.2013.746751
- **Topoisomerase IIα levels and G2 radiosensitivity in T-lymphocytes of women presenting with breast cancer**
  http://mutage.oxfordjournals.org/content/27/6/737.abstract?etoc
- **mFISH Analysis of Chromosome Aberrations Induced In Vitro by α-Particle Radiation: Examination of Dose-Response Relationships**
  http://www.bioone.org/doi/abs/10.1667/RR3020.1.2
- **Modeling Cell Survival after Photon Irradiation Based on Double-Strand Break Clustering in Megabase Pair Chromatin Loops**
  http://www.bioone.org/doi/abs/10.1667/RR2964.1
- **Permeability Changes of Cationic Liposomes Loaded with Carbonic Anhydrase Induced by Millimeter Waves Radiation**
  http://www.bioone.org/doi/abs/10.1667/RR2949.1
- **DNA damage and eIF4G1 in breast cancer cells reprogram translation for survival and DNA repair mRNAs**
  http://www.pnas.org/content/109/46/18767.abstract.html?etoc
- **Mitigation of radiation injury by selective stimulation of the LPA(2) receptor**
  http://www.ncbi.nlm.nih.gov/pubmed/23127512
- **Acute and fractionated irradiation differentially modulate glioma stem cell division kinetics**
  http://cancerres.aacrjournals.org/content/early/2013/01/01/0008-5472.CAN-12-3429.abstract.html?papetoc
- **Chromosome Damage in Human Cells by γ Rays, α Particles and Heavy Ions: Track Interactions in Basic Dose-Response Relationships**
  http://www.bioone.org/doi/abs/10.1667/RR3089.1
- **Variations in the RBE for Cell Killing Along the Depth-Dose Profile of a Modulated Proton Therapy Beam**
  http://www.bioone.org/doi/abs/10.1667/RR2737.1

- **Hedgehog Signaling Regulates the Repair Response in Mouse Liver Damaged by Irradiation**
  http://www.bioone.org/doi/abs/10.1667/RR3091.1

- **X-Ray Microbeam Irradiation of the Contusion-Injured Rat Spinal Cord Temporarily Improves Hind-Limb Function**
  http://www.bioone.org/doi/abs/10.1667/RR2921.1

Low dose Radiation Biology

- **Effects of Low-Dose Ionizing Radiation and Menadione, an Inducer of Oxidative Stress, Alone and in Combination in a Vertebrate Embryo Model**
  http://www.bioone.org/doi/abs/10.1667/RR3042.2
- **Increased susceptibility to delayed genetic effects of low dose X-irradiation in DNA repair deficient cells**
  http://informahealthcare.com/doi/abs/10.3109/09553002.2013.752596
- **Radioadaptive Response Following In Utero Low-Dose Irradiation**
  http://www.bioone.org/doi/abs/10.1667/RR3029.1

Radiation carcinogenesis

- **Genetically mediated Nf1 loss in mice promotes diverse radiation-induced tumors modeling second malignant neoplasms**
  http://cancerres.aacrjournals.org/content/early/2012/10/13/0008-5472.CAN-12-1728.abstract?papetoc
- **H-ferritin overexpression promotes radiation-induced leukemia/lymphoma in mice**
  http://carcin.oxfordjournals.org/content/33/11/2269.abstract.html?etoc
- **Mouse Models for Efficacy Testing of Agents against Radiation Carcinogenesis:A Literature Review.**
  http://www.ncbi.nlm.nih.gov/pubmed/23271302

Radiation induced Bystander effect

- **The effect of growth architecture on the induction and decay of bleomycin and X-ray-induced bystander response and genomic instability in lung adenocarcinoma cells and blood lymphocytes.**
  http://www.ncbi.nlm.nih.gov/pubmed/22947118
- **Differential regulation of microRNA expression in irradiated and bystander cells**
  http://www.ncbi.nlm.nih.gov/pubmed/23113353
- **Effects of Radiation on Levels of DNA Damage in Normal Non-adjacent Mucosa from Colorectal Cancer Cases**
  http://www.ncbi.nlm.nih.gov/pubmed/23065707
- **Suppression of Endogenous Hydrogen Sulfide Contributes to the Radiation-Induced Bystander Effects on Hypoxic HepG2 Cells**
  http://www.bioone.org/doi/abs/10.1667/RR2967.1
- **Bystander Effect Induced by UV Radiation; why should we be interested?**
  http://www.ncbi.nlm.nih.gov/pubmed/23175338
- **A simulation study of the radiation-induced bystander effect: modeling with stochastically defined signal reemission.**
  http://www.ncbi.nlm.nih.gov/pubmed/23197991
- **The effect of genetic background and dose on non-targeted effects of radiation**
  http://www.ncbi.nlm.nih.gov/pubmed/22853854
- **Inhibition of GSH synthesis potentiates temozolomide-induced bystander effect in glioblastoma**
  http://www.sciencedirect.com/science/article/pii/S0304383512007227
- **The induction of a radiation-induced bystander effect in fish transcends taxonomic group and trophic level.**
  http://www.ncbi.nlm.nih.gov/pubmed/23206292
- **Mechanisms involved in the induction of radiation-induced non-targeted effects. Introduction**
  http://www.ncbi.nlm.nih.gov/pubmed/23016738

- **Interactions of Apoptotic Cells with Macrophages in Radiation-Induced Bystander Signaling.**
  http://www.ncbi.nlm.nih.gov/pubmed/23237586
- **Non-targeted effects of ionising radiation-Implications for low dose risk.**
  http://www.ncbi.nlm.nih.gov/pubmed/23262375

Radiation Protection

- **Radioprotective effects produced by the condensation of plasmid DNA with avidin and biotinylated gold nanoparticles**
  http://link.springer.com/article/10.1007%2Fs00411-012-0429-6
- **Filgrastim Improves Survival in Lethally Irradiated Nonhuman Primates**
  http://www.bioone.org/doi/abs/10.1667/RR3049.1

Cancer Biology and Therapy

- **Prevention of tobacco carcinogen-induced lung cancer in female mice using antiestrogens**
  http://carcin.oxfordjournals.org/content/33/11/2181.abstract.html?etoc
- **Superior penetration and retention behavior of 50 nm gold nanoparticles in tumors**
  http://cancerres.aacrjournals.org/content/early/2012/10/16/0008-5472.CAN-12-2071.abstract?papetoc
- **Androgen receptor splice variants mediate enzalutamide resistance in castration-resistant prostate cancer cell lines**
  http://cancerres.aacrjournals.org/content/early/2012/11/01/0008-5472.CAN-12-3630.abstract?papetoc
- **Roles of Estrogen Receptor and p21Waf1 in Bortezomib-Induced Growth Inhibition in Human Breast Cancer Cells**
  http://mcr.aacrjournals.org/content/early/2012/11/01/1541-7786.MCR-12-0133.abstract?papetoc
- **Cancer-Associated Fibroblasts Drive the Progression of Metastasis through both Paracrine and Mechanical Pressure on Cancer Tissue**

http://mcr.aacrjournals.org/content/early/2012/11/01/1541-7786.MCR-12-0307.abstract?papetoc

- **EGFR/JIP-4/JNK2 Signaling Attenuates Cetuximab-Mediated Radiosensitization of Squamous Cell Carcinoma Cells**
  http://cancerres.aacrjournals.org/content/73/1/297.abstract.html?etoc
- **Macrophage Delivery of an Oncolytic Virus Abolishes Tumor Regrowth and Metastasis After Chemotherapy or Irradiation**
  http://cancerres.aacrjournals.org/content/early/2012/11/21/0008-5472.CAN-12-3056.abstract?papetoc
- **Curcumin inhibits prostate cancer metastasis in vivo by targeting the inflammatory cytokines CXCL1 and -2**
  http://carcin.oxfordjournals.org/content/33/12/2507.abstract.html?etoc
- **CCR2 deficiency prevents neuronal dysfunction and cognitive impairments induced by cranial irradiation**
  http://cancerres.aacrjournals.org/content/early/2012/12/13/0008-5472.CAN-12-2989.abstract?papetoc

Cancer Radiotherapy

- **Genome-Wide Transcription Responses to Synchrotron Microbeam Radiotherapy**
  http://www.bioone.org/doi/abs/10.1667/RR2885.1
- **A Pooled Analysis of Thyroid Cancer Incidence Following Radiotherapy for Childhood Cancer**
  http://www.bioone.org/doi/abs/10.1667/RR2889.1
- **In Situ Vaccination with CD204 Gene-Silenced Dendritic Cell, not Unmodified Dendritic Cell, Enhances Radiation Therapy of Prostate Cancer**
  http://mct.aacrjournals.org/content/11/11/2331.abstract?etoc
- **Macrophage Delivery of an Oncolytic Virus Abolishes Tumor Regrowth and Metastasis After Chemotherapy or Irradiation**
  http://cancerres.aacrjournals.org/content/early/2012/11/20/0008-5472.CAN-12-3056.abstract?papetoc

- **Dual targeting of EGFR and HER3 with MEHD7945A overcomes acquired resistance to EGFR inhibitors and radiation**
  http://cancerres.aacrjournals.org/content/early/2012/11/20/0008-5472.CAN-12-1611.abstract?papetoc

Technological advancement/note

- **Detection of Partial-Body Exposure to Ionizing Radiation by the Automatic Detection of Dicentrics**
  http://www.bioone.org/doi/abs/10.1667/RR2728.1
- **A critique of methods to measure cytotoxicity in mammalian cell genotoxicity assays**
  http://mutage.oxfordjournals.org/content/27/6/615.abstract?etoc
- **A co-culture system of human intestinal Caco-2 cells and lymphoblastoid TK6 cells for investigating the genotoxicity of oral compounds**
  http://mutage.oxfordjournals.org/content/27/6/631.abstract?etoc
- **Performance of in vitro γH2AX assay in HepG2 cells to predict in vivo genotoxicity**
  http://mutage.oxfordjournals.org/content/27/6/645.abstract?etoc
- **Insensitivity of the in vitro cytokinesis-block micronucleus assay with human lymphocytes for the detection of DNA damage present at the start of the cell culture**
  http://mutage.oxfordjournals.org/content/27/6/743.abstract?etoc

Radiation safety

- **Long-term epidemiological studies of atomic bomb survivors in Hiroshima and Nagasaki: study populations, dosimetry and summary of health effects**
  http://rpd.oxfordjournals.org/content/151/4/671.abstract?etoc
- **Radiation effects on cancer risks in the life span study cohort**
  http://rpd.oxfordjournals.org/content/151/4/674.abstract?etoc
- **RERF databases and implications for future studies**
  http://rpd.oxfordjournals.org/content/151/4/677.abstract?etoc
- **Detection of Partial-Body Exposure to Ionizing Radiation by the Automatic Detection of Dicentrics**

http://www.bioone.org/doi/abs/10.1667/RR2728.1

- **A Pooled Analysis of Thyroid Cancer Incidence Following Radiotherapy for Childhood Cancer**

  http://www.bioone.org/doi/abs/10.1667/RR2889.1

- **Naturally occurring radionuclides in food and drinking water from a thorium-rich area**

  http://link.springer.com/article/10.1007%2Fs00411-012-0428-7

- **Doses from radon progeny as a source of external beta and gamma radiation**

  http://link.springer.com/article/10.1007%2Fs00411-012-0413-1

- **Lung dosimetry of inhaled radon progeny in mice**

  http://link.springer.com/article/10.1007%2Fs00411-012-0431-z

- **Studies on mass attenuation coefficient, effective atomic number and electron density of some vitamins**

  http://link.springer.com/article/10.1007%2Fs00411-012-0427-8

- **Microdistribution and Long-term Retention of 239Pu (NO3)4 in the Respiratory Tracts of an Acutely Exposed Plutonium Worker and Experimental Beagle Dog**

  http://cancerres.aacrjournals.org/content/early/2012/10/22/0008-5472.CAN-12-1824.abstract?papetoc

- **Leukemia Risk Associated with Chronic External Exposure to Ionizing Radiation in a French Cohort of Nuclear Workers**

  http://www.bioone.org/doi/abs/10.1667/RR2822.1

- **Frequency of Transferrin Receptor Positive Reticulocytes (TF-Ret) in Blood as an Indicator of Total-Body Radiation Exposure: A Pilot Study in Nuclear Medicine Patients**

  http://www.bioone.org/doi/abs/10.1667/RR2818.1

- **Biological Effects of Inhaled 239PuO2 in Beagles**

  http://www.bioone.org/doi/abs/10.1667/RR2504.1

- **Risk of Thyroid Cancer among Chernobyl Liquidators**

  http://www.bioone.org/doi/abs/10.1667/RR2975.1

- **Pegfilgrastim Administered in an Abbreviated Schedule, Significantly Improved Neutrophil Recovery after High-Dose Radiation-Induced Myelosuppression in Rhesus Macaques**

  http://www.bioone.org/doi/abs/10.1667/RR2900.1

- **Inhalation and external doses in coastal villages of high background radiation area in Kollam, India**
  http://rpd.oxfordjournals.org/content/152/1-3/154.abstract.html?etoc

Non-ionizing radiation

- **UVB irradiation changes genotoxic potential of nonylphenolpolyethoxylates— remarkable generation of γ-H2AX with degradation of chemical structure**
  http://mutage.oxfordjournals.org/content/28/1/7.abstract.html?etoc
- **Telomere length and telomerase activity impact the UV sensitivity syndrome xeroderma pigmentosum**
  http://cancerres.aacrjournals.org/content/early/2013/01/01/0008-5472.CAN-12-3125.abstract.html?papetoc
- **Terahertz Radiation at 0.380 THz and 2.520 THz Does Not Lead to DNA Damage in Skin Cells In Vitro**
  http://www.bioone.org/doi/abs/10.1667/RR3077.1

7. NEWS

Nuclear Technology & Safety

Fukushima Accident and Radiation Safety

- **Environmental radiation at Izu-Oshima after the Fukushima Daiichi nuclear power plant accident**
  http://rpd.oxfordjournals.org/content/152/1-3/234.abstract.html?etoc

Science and Society

Science in General

- **Neem oil limonoids induces p53-independent apoptosis and autophagy** **http://carcin.oxfordjournals.org/content/33/11/2199.abstract.html?etoc**
- **Oxidative damage to DNA by diesel exhaust particle exposure in co-cultures of human lung epithelial cells and macrophages** **http://mutage.oxfordjournals.org/content/27/6/693.abstract?etoc**
- **Early childhood poverty, immune-mediated disease processes, and adult productivity** **http://www.pnas.org/content/109/suppl.2/17289.abstract.html?etoc**

8. VIEWS

- **Controversies and challenges regarding the impact of radiation therapy on survival** **http://annonc.oxfordjournals.org/content/24/1/38.abstract.html?etoc**
- **Whole-body 18FDG–PET/CT or whole-body gadolinium-enhanced MRI for distant staging?** **http://annonc.oxfordjournals.org/content/24/1/9.extract.html?etoc**

9. ARTICLE SERIES/REVIEWS

- **Patient-derived tumour xenografts as models for oncology drug development** **http://www.nature.com/nrclinonc/journal/v9/n6/abs/nrclinonc.2012.61.html?lang=en?WT.ec_id=NRCLINONC-201206**
- **Basic principles of molecular effects of irradiation.** **http://www.ncbi.nlm.nih.gov/pubmed/22476592**
- **Changing paradigms in radiobiology** **http://www.ncbi.nlm.nih.gov/pubmed/22273762**
- **Stem cell therapy: from bench to bedside**

http://rpd.oxfordjournals.org/content/151/4/633.abstract?etoc

- **Regulatory mechanisms and clinical perspectives of miRNA in tumor radiosensitivity**
  http://carcin.oxfordjournals.org/content/33/11/2220.abstract.html?etoc
- **Differential regulation of microRNA expression in irradiated and bystander cells**
  http://www.ncbi.nlm.nih.gov/pubmed/23113353
- **Cytokines in radiobiological responses: a review**
  http://www.ncbi.nlm.nih.gov/pubmed/23106210
- **How DNA-repair proteins find their targets**
  http://www.pnas.org/content/109/45/18243.extract.html?etoc

- **Mouse Models for Efficacy Testing of Agents against Radiation Carcinogenesis:A Literature Review.**
  http://www.ncbi.nlm.nih.gov/pubmed/23271302

10. RECENT BOOKS

- **ICRU report 85: fundamental quantities and units for ionizing radiation**
  http://rpd.oxfordjournals.org/content/150/4/550.extract?etoc
- **Actions for Survival** Saving Lives in the Immediate Hours After Release of Radioactive or Other Toxic Agents
  http://www.brodskybooks.com/uploads/Brodsky-ActionsForSurvivalOrderForm3-17-2011_Fillable.pdf

11. LETTER(S) FROM THE READERS

- Came across ISRB eNewsletter very recently. The eNewsletter was indeed a revelation. 'Excellent' is the word to describe it. The information content, breadth and quality of coverage achieved across all relevant areas is remarkable. The passion, commitment and professionalism of the Editorial team, especially the Editor in publishing a top-notch quality eNewsletter is truly commendable and highly appreciated.
  -Dr A. P. Krishnaja, *Ex-Senior Scientist, Radiation Biology and Health Sciences Division, Bhabha Atomic Research, Mumbai*

12. UPCOMING CONFERENCE & WORKSHOP OF ISRB

International Conference on Radiation Biology: (ICRB-2014) and 12th Biennial Meeting of Indian Society for Radiation Biology New Delhi, 2014

For updated information visit web page:

http://www.isrbindia.com/upcoming-events-of-the-society/

13. UPCOMING MEETINGS / WORKSHOPS

- **XXXVIII ANNUAL CONFERENCE OF ENVIRONMENTAL MUTAGEN SOCIETY OF INDIA (EMSI)AND NATIONAL CONFERENCE ON "CURRENT PERSPECTIVES ON ENVIRONMENTAL MUTAGENESIS AND HUMAN HEALTH", January 28 to 30, 2013 at Venue: Multipurpose Hall, Training School Hostel, Anushaktinagar, Mumbai- 400 094 India**

  Contact person: Dr. Birajalaxmi Das, Convener, 38th EMSI-2013, Radiation Biology and Health Sciences Division, Bhabha atomic research Centre, Trombay, Mumbai 400085,India **Email:** **emsimumbai2013@gmail.com**

- **Conference on Heavy Ion Therapy and Space Radiation Symposium, May 15-18, 2013, Chiba, Japan**

  Deadline for abstract submission: January 31, 2013

  Web page: http://hitsrs2013.org/

- **13th International Wolfsberg Meeting on Molecular Radiation Biology/Oncology 2013, June 22-24, 2013.**

  Contact person: Prof. Dr. H. Peter Rodemann, Head, Division of Radiobiology & Molecular Environmental Research, Dept. of Radiation Oncology, Univ. of Tuebingen, Roentgenweg 11, D-72076 Tuebingen, Germany, **Tel:** +49 (0)7071 298 5962; **Fax:** +49 (0)7071 29 5900; **E-Mail**: **hans-peter.rodemann@uni-tuebingen.de**

  www.wolfsberg-meeting.com

- **11th Workshop on Microbeam Probes of Cellular Radiation Response, October 3-4, 2013, Bordeaux, France**

  Deadline for abstract submission: July 31, 2013

  Web page: http://www.cenbg.in2p3.fr/microbeam2013/

  Important Notice: Are you organizing any Workshop/Meeting related to Radiation Research or in related research areas? You can add the announcement of event to this eNewsletter **free of cost**!! The announcement would reach to ISRB Community as well many more in India and abroad. The details of announcement may be communicated to: **isrb_enewsletter@yahoo.co.in.** Moreover, the information would be included to web page as and when it would be available.

14. AWARDS/HONORS TO ISRB MEMBERS

Name of the ISRB Member	Affiliation	Award/Honors	Year/ Period
Dr Amit Kumar	Radiation Biology and Health Sciences Division, Bhabha Atomic Research Centre, Mumbai	**Post Doctoral Fellowship,** MD Anderson Cancer Centre, Texas, USA	2012

Congratulations *to the Life Member of Indian Society for Radiation Biology for prestigious Awards and Honors!!*

We wish many more in future!!

15. RECENT PUBLICATIONS/PATENTS OF ISRB MEMBERS

Author/Affiliation	Title	Citation	Key words
S. Desai[1], **A. Kumar**[2], S. Laskar[2] and **BN Pandey**[3,*] [1]Radiation Biology and Health Sciences Division, Bhabha Atomic Research Centre, Mumbai 400 085, India; [2]Department of Radiation Oncology, Tata Memorial Hospital, Mumbai; *Email: badrinarain@yahoo.co.in	Cytokine profile of conditioned medium from human tumor cell lines after acute and fractionated doses of gamma radiation and its effect on survival of bystander tumor cells	Cytokine (2013) 61(1):54-62. **http://www.ncbi.nlm.nih.gov/pubmed/23022376**	Bystander effect; conditioned medium; cytokines

Note: Underlined and **bold** author(s) are Life Members of ISRB

16. CAREER FORUM

Grants and Awards

http://www.isrbindia.com/eNewsletter/career-forum/

Article related to career issues

http://www.isrbindia.com/eNewsletter/career-forum/

Important Web Sites

http://www.isrbindia.com/eNewsletter/career-forum/

Important Notice: If you have any vacancy in your laboratory/Institute, you can advertise the post through this eNewsletter. In addition, any award in these fields may be also announced. **It is absolutely free!!** The advertisement would reach to Members of ISRB and many more, who may be interested about the vacancy. The details of vacancy may be communicated to: **isrb_enewsletter@yahoo.co.in**

17. USEFUL LINKS

http://www.isrbindia.com/eNewsletter/useful-links/

18. IMPORTANT JOURNALS

http://www.isrbindia.com/eNewsletter/journals-links/

19. NEW LIFE MEMBERS OF ISRB

Warm welcome to New Life Members of ISRB!!!

S. N.	Name	Affiliation
1.	Mr. Baban Sukadeo Thawkar (ISRB/T-09/302)	Konkan Gyanpeeth Rahul Dharkar College of Pharmacy and Research Institute, Karjat, Vengaon Road, Dahivali, Taluka: Karjat, Raigad 410 201, INDIA
2.	DR V. Sarojini (ISRB/S-62/304)	Assistant Professor in Physics, Department of Physics, Lakshmi Puram College of Arts and Science, Neyyoor 629 802, Taminadu, INDIA
3.	Dr Christopher J.Z. Lawlor (ISRB/L-04/305)	Department of Zoology, Government Kolasib College, Kolasib 796 081, INDIA
4.	Dr Archana Mukherjee (ISRB/M-26/306)	Radiopharmaceuticals Division, Bhabha Atomic Research Centre, Mumbai 400 085, INDIA
5.	Dr Pankaj Taneja (ISRB/T-10/307)	Department of Radiation Biosciences, Institute of Nuclear Medicine and Allied Sciences, Lucknow Road, Delhi 110 054, INDIA
6.	Dr Paban K. Agrawala (ISRB/A-09/308)	Department of Radiation Biosciences, Institute of Nuclear Medicine and Allied Sciences, Lucknow Road, Delhi 110 054, INDIA

20. NOTICE BOARD

- ## Update your email and contact address

Dear Members of ISRB,

The eNewsletter would be send to ISRB Members by email only. If your email address is getting changed or you have any other preferred email, please communicate to us as soon as possible on **isrb_enewsletter@yahoo.co.in**. In case, any other ISRB Member, who is not receiving eNewsletter, please intimate us his/her email address.

In addition, if any other friend or colleague is interested to receive the eNewsletter, please let us know his/her email address to be included in our mailing list. The

eNewsletter is free to ISRB Members as well as non-Members too. **The subscription of eNewsletter is absolutely free!!!**

In addition, it is frequent problem to communicate with ISRB members due to change in address. If your contact address has been changed please intimate to Secretary, ISRB. This would help us to reach you and communicate, when ever needed.

- ## Join ISRB

Are you/your colleague/friend working in Radiation Research or related field and still not a Member of Indian Society for Radiation Biology? Join ISRB.

As Member of ISRB, (a) you would join with scientific community working in Radiation Research and related research areas. (b) You are entitled to participate in Meeting/Workshops of ISRB at reduced Registration Fee (c) Your interaction with Scientists and experts from India and abroad would help in your career.

To be a Member of ISRB, fill the attached application form (in last of eNewsletter) along with along with Membership fee to Secretary, ISRB. For details, contact Secretary or any of the Office Bearers of ISRB as given below.

The application form can be downloaded from the web page: **www.isrbindia.com** or click on following link:

http://www.isrbindia.com/assets/Uplaods/ISRB-Membership-Application-Form.doc (MS Word Version)

http://www.isrbindia.com/assets/Uplaods/ISRB-Membership-Application-Form.pdf (PDF Version)

- ## Awards/Honors to ISRB Members

Editorial Board '**Radiation Science Today'** is pleased to launch a column "**AWARDS/HONORS to ISRB Members**" in the eNewsletter. We hope the column would make us more aware with each other about our awards/ scientific achievements.

This column is only for Members of Indian Society for Radiation Biology. If you are Member of ISRB and received any award or scientific honour, you are requested to send details of same in following format on email address: **isrb_enewsletter@yahoo.co.in**, with **subject line**: Awards/Honors.

To avoid the verification of Membership and any ambiguity from non-ISRB Members, a line of statement is requested that 'I am a Member / Life Member of Indian Society for Radiation Biology'.

Details of award or scientific recognition can be submitted in prescribed format

provided below as when received, which would be included in next upcoming issue of the eNewsletter.

Please circulate the announcement to your colleagues and friends, who are Members of ISRB. Please provide complete information to avoid unnecessary delay in publication in eNewsletter.

Name and Present Address of ISRB Member	Affiliation (if any)	Name of Award/Honor	Year/Period

Statement: I am Member/Life Member of Indian Society for Radiation Biology.

Name of the ISRB Member:

• Recent publications/patents of ISRB Members

Dear Members of ISRB,

It is our pleasure to mention that in last two years, '**Radiation Science Today**' the eNewsletter published by Indian Society for Radiation Biology, has made a significant contribution to link the Members of Society working in various research fields of radiation biology and allied sciences. To further strengthen the interaction amongst Members of ISRB, we have initiated a new Column **'Recent Publications of ISRB Members' beginning** from issue of eNewsletter i.e. **Jan-March , 2010 Issue 9.**

The publication/patents meeting following criteria would be included in the eNewsletter:

1. At least one author of citation should be Life Member of ISRB.

2. Citations only with final page number should be provided i.e. 'In Press' citations would not be considered.

3. It should be published in National/International Journals or Book/Book Chapters. No abstract or Conference Proceedings would be considered.

4. Names of ISRB Members names should be bold and underlined. The authors may provide maximum five key words. The email address of corresponding authors should be provided so that interested may contact to seek some clarification or to receive reprints.

5. Members should provide full citation(s) as and when it would be made available in the required format.

All ISRB Members are requested and encouraged to submit their recent publication(s) in format provided with **Subject Head line: Publication.** A copy of the format is provided below for your reference.

You may communicate the message to other ISRB members, if they could not receive this communication.

Authors/Affiliation/Email	Title	Citation	Key Words
Kumar A, Ali M, Mishra P, **Pandey BN**, Sharma P, **Mishra KP**. Email: mishra_kaushala@rediffmail.com Radiation Biology and Health Sciences Division, Bhabha Atomic Research Centre, Mumbai - 400085, India	Thorium-induced neurobehavioural and neurochemical alterations in Swiss mice.	International Journal of Radiation Biology, 2009, 85(4):338-347.	Thorium Toxicity; Neurobehavioral, neurochmeical alterations; oxidative injury
Hazra B[1], **Pandey BN**, Kumar A, Ghosh S[1], Kumar B[1], **Mishra KP** Email: banasrihazra@yahoo.co.in Radiation Biology and Health Sciences Division, Bhabha Atomic Research Centre, Mumbai - 400085, India [1]Department of Pharmaceutical Technology, Jadavpur University, Kolkata , India	Plant Products in modification of cellular damage by radiation: Implications in cancer radiotherapy	In "Herbal Drugs: A Cancer Chemopreventive and Therapeutic Perspective" (Ed.: R. Arora, INMAS, New Delhi), Publisher: Jaypee Brothers Medical Publishers, New Delhi , 2009	Cancer radiotherapy; Natural Plant Products; Apoptosis

- ## You can contribute in this eNewsletter

You can send your contribution, which may be included in this eNewsletter under **'Reader's Column'**

Brief scientific article (maximum 1000 words, if reference needed, in 'International Journal of Radiation Biology' style) may be submitted for publication in eNewsletter. Your article may fall under following subject category: (i) radiation sciences or related research areas; (ii) your opinion on any scientific issue, technique or some general topics; (iii) any major finding or research concept from the archives of radiation sciences. The article should be original. It would be published in eNewsletter after general screening/reviewing of the article by the Editorial Board.

For any further clarification or submission of any article write to Editor on email address: isrb_enewsletter@yahoo.co

In addition, if you come across any recent journal / books published in radiation and related research areas, please send us the details of the book/journal on our email: isrb_enewsletter@yahoo.co. The details of books/journal would be included in the eNewsletter **free of cost**!!!

INDIAN SOCIETY FOR RADIATION BIOLOGY
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Dr. Vijay K. Singh (Foreign Member)	Armed Forces Radiobiology Research Institute, Bethesda, MD, USA
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We hope you will find this Newsletter as a useful resource of information. However, we look forward for your active contribution and valuable comments/ suggestions for improvement of the eNewsletter on **isrb_enewsletter@yahoo.co.in** or any of the Member of Editorial Board.

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Editorial Board

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Application for Membership

Affix your passport size photo here

To:

Secretary
Indian Society for Radiation Biology (ISRB)

Dear Sir,

I wish to apply for **Life Membership** for the Indian Society for Radiation Biology. My particulars are given below:

1. Full Name (Block Letters)
   .....
2. Present Position/Title
   .....
3. Date of Birth ...
   .....
4. Academic qualifications: Degree University Year

   ....
   .....

   ....
   .....

   ....
   .....
5. Field of Specialization
   .....
6. Research Interest
   .....

.....

7. Address: Official:
..……..……..…..…..…....

……..……..
……..

Tel… ……..Fax: …… E-mail
.....……..……..……....

Permanent
……..…..…...

8. Life Membership fee : Rs 2000.00 Foreign members: US$ 200
Bank transfer/Draft/Cheque No. ……Date: ……Drawn on Bank. ……

……in favour of 'Indian Society for Radiation Biology' is enclosed.

(Note: Outstation cheques would not be accepted. DD should be payable at Mumbai or Delhi.)

Place: ……..…….. Date:…….. Signature: ……..……....

Proposed by ……Membership No. and Signature ……..……...…..……...……...

Seconded by ……..… Membership No. and Signature ……...……..…

For Use of ISRB Secretariat Only

Membership No. .....Type of Membership .....….....……...……...….....
Membership approved/not approved by Executive Council in its meeting held on…….
Payment received vide …… on
……...

Secretary/Treasurer: ……..

President, Indian Society for Radiation Biology

Please mail the Application for Membership along with recent passport size photographs to:
Dr B. N. Pandey, Secretary, ISRB, Radiation Biology and Health Sciences Division, Bhabha Atomic Research Centre, Mumbai 400 085, India. E-mail: isrbindia@yahoo.in; badrinarain@yahoo.co.in