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Guest Editorial

RADIATION BIOLOGY AND RADIATION COUNTERMEASURES

There is a growing concern of radiation injuries to the public and various professionals due to nuclear proliferation and enhanced terrorist activity as well as the risk of exposure in medical practice during radiation therapy and radio-diagnostics. Therefore, development of effective medical countermeasures against radiological and nuclear scenarios is of immense importance to the defence of all nations and for ensuring the safety of professionals and patients susceptible to radiation exposure.

Ionizing radiation causes damage at various hierarchical levels of organisation of biological systems, and based on the levels of exposure, the hazards vary from acute mortality to delayed manifestations in the form of potentially fatal diseases including cancer. Damage to biological systems by ionising radiation is caused primarily by the macromolecular lesions (particularly the genetic material, DNA). At moderate doses, damage to hematopoietic and gastro-intestinal systems mainly contributes to the acute effects due to mitotic and interphase deaths of constituent cells, largely related to the residual DNA damage following the action of repair systems. Therefore, radiobiological research related to various aspects of damage manifestation at the molecular, cellular, and systemic levels, including assessment of the absorbed dose, forms an important aspect of efforts related to the development of radiation countermeasures.

Fundamental research in radiation sciences covering physical, chemical, biological, and medical aspects has been successful in understanding the effects of radiation at various levels of biological organisation leading to discovery of potential targets at the molecular, cellular, and systemic levels for developing countermeasure agents and strategies. On the other hand, translational research, employing a wide range of novel biological models relevant to human subjects, has not only validated several radiobiological concepts, but has also facilitated the development of countermeasure agents and diagnostics for managing the victims of radiation exposure.

This issue of *Defence Science Journal* comprises contributions from leading researchers in the field of radiation biosciences covering different aspects of radiation countermeasures. Moulder and Medhora provide an overview of the three principal components involved in the management of emergencies arising out of mass exposure to radiological and nuclear accidents, *viz*., technology for rapid absorbed doses assessment, alleviation of acute hematological injuries, and approved drugs for mitigation of chronic effects. Very appropriately they point out that migrating from the vast existing laboratory studies to a deployable programme is quite challenging and long-drawn, requiring efforts to overcome regulatory barriers and also is cost prohibitive.

Uma Devi and Paban Agrawala have given an overall account of the current status on the development of radioprotectors, highlighting the limitations of some of the existing radioprotective agents and have thrown light on the properties of some medicinal plants with potential radioprotective capabilities. They have also identified the research needs relevant to developing countries for developing radiation countermeasure agents.

While reviewing the current status on the nuclear disaster management, Ravishankar provides an insight into various components involved in the medical management encompassing decontamination, first-aid, prevention, and treatment of infections as well as burn injuries. He also emphasises the need to have suitable hospital care with bone marrow, stem cell transfusion and restitution of the immune system.

Damage to hematopoietic system is one of the major contributing factors to acute radiation syndrome, where leucopenia and thrombocytopenia is caused by injury to stem cells and progenitors in the bone marrow. Vijay Singh and co-workers have discussed various approaches to the mobilisation of progenitors and their utility as a bridging therapy for radiation casualties.

Assessment of absorbed radiation dose is critical for the management of acute as well as late effects of ionising radiation. Among various biological indicators of radiation exposure, cytogenetic damage is considered practical and reliable for dose estimation. The contribution by Venkatachalam and co-workers highlights the importance and establishment of biodosimetry facility using well established genetic markers like dicentric chromosomes, micronucleus formation and stable translocations for retrospective dose estimation, besides discussing the development of γH2Ax assay, as a potential marker of triage dosimeter.

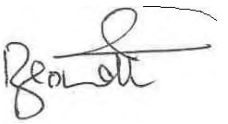
Hande and co-authors provide an overview of some of the current radiation genomics landscapes as well as potential future systems to illustrate radiation genomics as an effective tool in biological dosimetry, which offers an efficient, and high-throughput means to delineate mechanisms of action, risk assessment, and identify processes critical to disease progression, besides predicting levels of radiation exposure.

The review by Patel and co-workers discusses the mechanisms underlying the action of promising radiation countermeasure agents that encompass modulation of various signalling pathways involved in radiation-induced damage, *viz.*, oxidative stress, cell cycle, as well as cell death. They point out some of the limitations with the existing and the potential countermeasure agents and stress that the search for ideal agents should still continue.

Prem Kumar and co-workers have given a brief overview of how *in vitro* models, ranging from bacteria to various mammalian cells cultivated in 2-D and 3-D (like spheroids) cultures with specific genetic alterations, have provided insight into the complex relationships between damage induction and various

signal transduction pathways, allowing identification of molecular and sub-cellular targets for developing countermeasure agents. They also provide an exhaustive account of *in vivo* models, ranging from simple worms to non-human primates, which have been gainfully employed to evaluate efficacy as well as toxicity of potential countermeasure agents.

I am thankful to the Editorial Team of *Defence Science Journal* for devoting the issue of the journal to the contemporarily important area of biomedical sciences covering important aspects of "*Radiation Biology and Radiation Countermeasures*". This coincidently is one of the main research focuses of the Institute of Nuclear Medicine and Allied Sciences, a constituent laboratory of DRDO, Government of India that is celebrating Golden Jubilee Year of its purposeful existence and contributions to the Armed Forces as well as to the society. I am also thankful to all the authors for their valued contributions and to the reviewers for their timely and critical evaluation of the manuscripts.



Dr B.S. Dwarakanath
Scientist "G" and Additional Director
Institute of Nuclear Medicine and Allied Sciences
Delhi–110 054, India