Introduction

Space radiation consists of proton and helium from solar particle events (SPE) and high-energy heavy ions from galactic cosmic ray (GCR). This mixture of radiation with particles at different energy levels has different effects on biological systems. Currently, majority studies of radiation effects on human were based on single-source radiation due to the limitation of available method to model effects of space radiation on living organisms. While NASA Space Radiation Laboratory is working on advanced switches to make it possible to have a mixed field radiation with particles of different energies, the radiation source will be limited. Development of an easily available experimental model for studying effects of mixed field radiation could greatly speed up our progress in understanding the molecular mechanisms of damage and responses from exposure to space radiation, and facilitate the discovery of protection and countermeasures against space radiation, which is critical for the mission to Mars.

Bleomycin, a radiomimetic agent, has been widely used to study radiation induced DNA damage and cellular responses. Previously, bleomycin was often compared to low linear energy transfer (LET) gamma radiation without defined characteristics. Our recent work demonstrated that bleomycin could induce complex clustered DNA damage in human fibroblasts that is similar to DNA damage induced by high LET radiation. These type of DNA damage is difficult to repair and can be visualized by γ-H2AX staining weeks after the initial insult. The survival ratio between early and late plating of human fibroblasts after bleomycin treatment is between low LET and high LET radiation. Our results suggest that bleomycin induces DNA damage and other cellular stresses resembling those resulted from mixed field radiation with both low and high LET particles. We hypothesize that bleomycin could be used to mimic space radiation in biological systems. Potential advantages and limitations of using bleomycin to treat biological specimen as an easily available model to study effects of space radiation on biological systems and to develop countermeasures for space radiation associated risks will be discussed.

Evidences

Bleomycin can induce complex clustered DNA damage like high linear energy transfer (LET) radiation

Cell survival behavior of confluent normal human fibroblast AG1522 after bleomycin treatment is similar to the mixed field radiation exposure.

References:

4. AR Kennedy (2014) Biological effects of space radiation and development of effective countermeasures. Life Sciences in Space Research, 1, 1–10

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