

Acute Effects
Ann R. Kennedy, D. Sc.
University of Pennsylvania School of Medicine
Department of Radiation Oncology

This lecture topic is about the acute biologic effects associated with exposure to the types of radiation encountered by astronauts during space travel. The radiation environment encountered during space travel will expose astronauts to higher doses of radiation, and more varied types of radiation, than those encountered on earth. Two of the types of radiation which are encountered by astronauts during space travel, protons and highly energetic, heavy charged particles known as HZE particles, are not encountered by people on earth and are of particular concern for the health of astronauts. Very little is known about the biological effects of these types of radiation. Of particular concern for the health of astronauts is the potential exposure to relatively high doses of solar particle event (SPE) radiation. At times of extravehicular activity, it is conceivable that astronauts will be exposed to sufficiently high doses of SPE radiation, particularly protons, that the acute radiation syndrome (ARS) will occur. This lecture will cover the acute effects of radiation which could occur in astronauts following exposure to high doses of SPE radiations.

A major question in space radiation research concerns the ways in which the expected biological effects of space radiations can be minimized. The effects of SPE radiation can be minimized through shielding approaches. There are numerous agents which can minimize the effects of conventional radiation(s) and which may affect the acute effects brought about by exposure to SPE radiation(s) as well. The Armed Forces Radiobiology Research Institute (AFRRI) has medical guidelines for the ARS

(<http://www.afrri.usuhs.mil/outreach/guidance.htm#policies>), as does the US Dept. of Health and Human Services (the REMM (Radiation Event Medical Management) site (<http://www.remm.nlm.gov>)). Supportive care when ARS symptoms develop include the administration of antimicrobial agents (which can include systemic antibiotics [especially those directed at gram-negative bacteria]), antiemetic agents, antidiarrheal agents, fluids, electrolytes, analgesic agents and topical burn creams (Waselenko, J.K. et al. Ann. Intern. Med. 140: 1037, 2004). For nausea and vomiting, serotonin receptor antagonists (5HT₃ receptor antagonists) are very effective prophylaxis. There are two drugs that have been approved by the FDA (Zofran and Kytril) for radiation induced nausea and vomiting. Kytril (granisetron) is preferred by the US Army and is currently maintained in the National Stockpile. Both of these drugs are known to stop retching and vomiting when given either before or after irradiation, even when vomiting and retching is occurring. Immune suppression can occur due to declines in lymphohematopoietic elements and infection is a possibility. Of particular importance is the radiation induced decline in neutrophil counts. Methods for controlling infection with antibiotics during the critical neutropenic phase can be used.

References are given on the slides as appropriate, with the first author's name, and journal reference. A major reference for the general concepts described on the characteristics of the acute effects of radiation is the following textbook:

Hall, E.J. Chapter 8 – Acute Effects. In: Radiobiology for the Radiologist. Lippincott Williams & Wilkins, pp. 117-128, Philadelphia, 2006.