

ACUTE EFFECTS OF SOLAR PARTICLE EVENT RADIATION

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A major solar particle event (SPE) may place astronauts at significant risk for the acute radiation syndrome (ARS), which may be exacerbated when combined with other space flight stressors, such that the mission or crew health may be compromised. The National Space Biomedical Research Institute (NSBRI) Center of Acute Radiation Research (CARR) is focused on the assessment of risks of adverse biological effects related to the ARS in animals exposed to space flight stressors combined with the types of radiation expected during an SPE. The CARR studies are focused on the adverse biological effects resulting from exposure to the types of radiation, at the appropriate energies, doses and dose-rates, present during an SPE (and standard reference radiations: gamma rays or electrons). Some conclusions from recent CARR investigations are as follows: 1. The relative biological effectiveness (RBE) values for SPE-like protons compared to standard reference radiations (gammas or electrons) for white blood cells (WBCs) vary greatly between mice, ferrets and pigs, with the RBE values being greater in ferrets than those in mice, and considerably greater in pigs compared to those in ferrets or mice (1-6). This trend for the data suggests that the RBE values for WBCs in humans could be considerably greater than those observed in small mammals, and SPE proton radiation may be far more hazardous to humans than previously estimated from small animal studies. 2. Very low doses of SPE proton radiation (25 cGy) increase blood clotting times in ferrets, and the low SPE-like dose-rate has more severe effects than high dose-rate radiation (7,8). 3. Results from pig and ferret studies suggest that disseminated intravascular coagulation (DIC) is a major cause of death at doses near the LD₅₀ level for SPE-like proton and gamma radiation (9, 10); from these data, it is hypothesized that DIC may contribute to radiation induced death at relatively low doses of radiation in all large mammals, including humans (9,10). 4. Exposure to SPE-like proton or gamma radiation, in combination with simulated microgravity (hindlimb suspension), leads to a very high level of morbidity/mortality in mice given a bacterial challenge with non-toxic levels of *Pseudomonas aeruginosa* or *Klebsiella pneumoniae*; the threshold for this effect was 1.5 Gy (Weissman et al., unpublished data). 5. The lack of T-cell activation was observed in mice exposed to SPE-like radiation with or without simulated hypogravity (either partial weight suspension or hindlimb suspension) (11, 12). 6. Radiation and simulated hypogravity had synergistic effects on immune system biological endpoints (e.g., 13). 7. Pigs exposed to simulated SPE radiation exhibited increases in intracranial pressure that remained elevated over the 90 day experimental period (14).

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