Abstract:

A major focus of the Microbiology Laboratory is to investigate the effect of spaceflight on the human immune response. Some of our major interests are in the area of innate immunity, including neutrophils, monocytes, basophils, and NK-cells. The phagocytic and oxidative functions of neutrophils are significantly reduced by stress and other factors associated with spaceflight. Most functional studies are studied using flow cytometry technology. A health related indicator of the immune response is the reactivation of latent viruses. Herpes viruses including Epstein-Barr virus, cytomegalovirus, herpes simplex 1, and varicella-zoster have been the viruses studied in this context. Viral reactivation studies have been conducted on astronauts, cosmonauts, and used in ground-based analogs (e.g., Antarctic and an undersea habitat). Viral reactivation has been shown to increase in all of these studies. Stress and perhaps other factors associated with spaceflight appear to be the initiators that mediate their effects through the hypothalamus-pituitary-adrenal axis reducing cell-mediated immunity. Under conditions of reduced immunity, the latent viruses are reactivated and shed in saliva or urine. Viruses are detected by PCR technology that provides viral copy number. Viral specific immune responses are being investigated using tetramer technology.

A second major area of interest involves the behavior of microorganisms in the space environment. Investigations of the effects of the spacecraft environment on microbial growth and physiology, antibiotic susceptibility, virulence, genetic changes, biofilm formation, and changes in microbial ecology are ongoing. Since flight opportunities are limited, ground-based models are employed to simulate microgravity. A NASA-developed rotating bioreactor is used to model some aspects of the low-shear, microgravity environment of spaceflight. Analyses commonly employed include PCR, DGGE, SEM, genotyping, as well as classical culture based technology.