Abstract zum Seminarvortrag 15.07.2014

Facing antibiotic resistance in space - lessons learned from our model system Bacillus subtilis

Dr. Ralf Möller
German Aerospace Center (DLR e.V.), Institute of Aerospace Medicine, Radiation Biology Department, Research Group 'Astrobiology', Linder Höhe, D - 51147 Cologne, Germany

Maintaining astronaut health during long-term spaceflight is of prime importance to the success of exploration missions to destinations such as the Moon, near-Earth asteroids, or Mars. Health risks associated with the numerous long-term near-Earth orbital flights or stays on space stations as MIR or ISS resulted in a diminution of immune status and profound changes in the human bacterial microflora. Various spaceflight conditions such as microgravity and galactic cosmic radiation are known to induce in bacterial species increased virulence properties such as: adherence to mammalian cells, biofilm formation, resistance to disinfectants, macrophages, and antibiotics. As part of the normal population of microbial inhabitants on and within the human body, astronauts carry many microbes considered “opportunistic pathogens”, i.e. normally harmless microorganisms with the potential to cause disease in hosts with lowered immune function. Since the beginning of antibiotic use the emergence of antibiotic resistant bacterial pathogens is an inevitable consequence, which is now considered as one of the major threats to public health. On Earth, microorganisms shown to evolve resistance to single or multiple antibiotics, but evolution of antibiotic resistance under different gravity and radiation regimes relevant to human spaceflight is not at all well understood. In various surveys of air, water, and surfaces on the ISS, Staphylococcus sp. were found to dominate the total bacterial isolates. In addition, a large number of Bacillus species (B. cereus, B. licheniformis, B. megaterium, B. simplex, and B. subtilis) have been recovered from ISS samples. Bacillus subtilis is the most completely understood Gram-positive species in terms of its physiology, biochemistry, and molecular genetics. B. subtilis has served for decades as a workhorse model organism in numerous Astrobiology and Planetary Protection studies. There exists a wealth of molecular biology and genetic tools for studying antibiotic resistance in B. subtilis exposed to different spaceflight relevant conditions. This issue is particularly important due to the limited number of antibiotics to which astronauts will have access during long-term space exploration missions but also for public health concerns due to an increase of reported cases on the occurrence and propagation of antibiotic resistant microorganisms in hospitals. In my seminar talk, I will present data and results obtained during my research sabbatical (DLR Forschungssemester) at the Kennedy Space Center’s Space Life Sciences Laboratory