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An ex vivo model of the human airways to study the effects of long-term exposure to Space conditions

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An innovative 3D model of the human bronchial mucosa, a result of a long-term collaboration with Prof. Davies from the University of Southampton, UK, will be used to study, on board the International Space Station (ISS), the changes occurring in lungs exposed to the adverse environmental conditions found in Space. Our research group has developed a tissue engineered human airway model, providing a viable alternative to the use of animal models. The bronchial outgrowth offers numerous advantages compared to traditional approaches that use human tissue, including: the morphological analogy with the bronchial mucosa; the possibility to study long-term exposure (several months) to environmental factors (cigarette smoke, respiratory viruses, etc.) being able to analyze eventual changes in the long term; the possibility to add cellular and humoral components of the immune system in order to evaluate their effects. Recently, our application to the ILSRA 2014 solicitation by NASA/ESA, in which we propose to study the effects of prolonged stay on board the ISS on the development and function of human airway cells in our model, was successful and our project was selected. This project will involve several international partners, including, in addition to the University of Palermo and Southampton, the Euro-Mediterranean Institute of Science and Technology (IEMEST, Palermo), the University of Leiden (NL), the University of Galveston (Texas, USA), the Wyle Laboratories (Texas, USA) and NASA itself. The results obtained will be particularly useful in view of exploratory missions of our solar system planned in the near future.

To verify the resilience of the model to the extreme environmental conditions on board the vectors that transport the samples to the ISS, and therefore collect essential data prior to the flight experiments, differentiated outgrowths obtained from healthy patients were exposed for up to 1 week to the following stress conditions: withdrawal of growth medium, reduced culture temperature (10 and 20°C), absence of CO_2, intense rolling and shaking motions. TER values were measured 1 week prior to 1 week after the exposures to evaluate the effects of these stimuli. The data obtained show that even though the stimuli determined a slight degree of tissue alteration (reduction of TER) during exposure, the outgrowths promptly recovered their original structure and function.

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