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PULMONARY VOLUME AND CAPACITY OUTCOMES UPON RETURNING TO EARTH FOLLOWING MICROGRAVITY EXPOSURE: A SYSTEMATIC REVIEW AND META-ANALYSIS

Abstract

Purpose: The advent of consumer spaceflight and space tourism raises the issue of individuals who are not in peak physical health being exposed to periods of microgravity. It is likely lung function will be altered by gravity, so it is important to understand the key anatomical and functional changes currently understood to occur with a change in gravitational load, and implications of such changes upon return to Earth. Our knowledge of the long-term effects of space on human health is still in its infancy. The impact of microgravity on lung anatomy like volume and capacity after return have not been systematically reviewed in recent times. There is however microgravity lung data dispersed in multiple publications and by amalgamating the current research on anatomy, we can extrapolate and simulate the effects spaceflight might have on those with pulmonary impairments. Therefore, the aim of this work was to review all available evidence and provide a comprehensive analysis of the effects of microgravity on pulmonary anatomy post-flight. Methodology: A systematic review was conducted with eleven studies including parabolic flight (10-25 s), short-duration (30 d) and long-duration (¿30 d) spaceflight analyzed. Lung volumes and capacities reported before flight (pre-flight) and afterwards (post-flight) were extracted. A meta-analysis was performed to directly compare differences between the two timepoints across multiple studies where possible. Results: Although no change was seen in lung volume and capacity between pre-flight and post-flight across all flight types, the data available is insufficient to deduce a finding. While pulmonary anatomy is not improved after microgravity exposure, there is no evidence to suggest it is impaired. Conclusions: The review highlights the stability of the lung anatomically in microgravity and exposure for short or long periods is, overall, not a serious health concern for lung anatomy. The physiological basis of lung volumes and capacity measures are clinically significant and microgravity exposure during spaceflight may impact those with pulmonary health problems like obstructive or restrictive lung diseases. This work provides an evidence-based reference for experts in medicine, healthcare, and human spaceflight programs to understand the human lungs in space, in preparation for spaceflight tourist activities and long-duration exploration missions beyond the Earth's gravity including a Lunar habitat and advancing to Mars, and future direction for research to address current gaps.