Paper ID: 86302
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student

IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Medical Care for Humans in Space (3)

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THE PURSUIT FOR A "GOLD STANDARD" CARDIOPULMONARY RESUSCITATION (CPR) METHOD FOR HUMAN SPACEFLIGHT: A NOVEL CPR TESTING PLATFORM

Abstract

With the emergence of long-duration space travel, providing effective healthcare to astronauts is crucial for their survival. Leading interests in the space medicine field center on risk mitigation and contingency planning, with a particular focus on addressing life-threatening emergencies such as cardiac arrest. To date, several cardiopulmonary resuscitation (CPR) methods such as the Handstand, Reverse Bear Hug, and the Evetts-Russomano have been described to overcome the absence of gravity, however each method has its inherent limitations that could potentially compromise survival. To identify the optimal CPR method as the 'gold standard', each method should be evaluated through objective metrics under salient microgravity environments to assess CPR efficacy and outcomes.

The Laboratory of Cardiovascular Fluid Dynamics at Concordia University took on the challenge by developing the first high-fidelity CPR manikin as a testing platform to provide real-time feedback on cardiovascular performance during cardiac reanimation. Utilizing 3D-printed technologies, the design of the cardiovascular fluidic system within the CPR manikin simulates blood circulation dynamics. This testing platform is the first to accurately gauge simulated cardiovascular responses, including blood pressure and cerebral blood flow through a fiber optic pressure transducer. By focusing on these metrics, this approach provides a precise internal assessment of CPR effectiveness under microgravity environments when compared to traditional metrics such as chest compression depth. This research study aspires to enhance our current understanding of CPR dynamics by offering direct insights into the compression-decompression waveforms during cardiac reanimation in microgravity.

Delivering promising results, the first-generation "Cardiopulmonary Resuscitation Identification System in Space" (CRISiS) payload was tested successfully under microgravity environments during a parabolic research flight in 2023—which used an electric linear actuator to perform automated mechanical CPR compressions onto our CPR manikin. The successful validation and verification of the CRISiS payload will pave the way for future studies to assess the efficacy of CPR methods in the spaceflight environment. Thus, these initial findings will be instrumental in defining the "gold standard" of CPR methods for human spaceflight missions and support the advancement of novel CPR devices, further addressing complex health challenges surrounding deep-space exploration.