

Challenges of Life Support/Medical Support for Human Missions (8)
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FMRI STUDIES FOR ASTRONAUT CO2 EXPOSURE TRAINING

Abstract

article

1 Introduction

CO2 exposure training is routinely conducted at NASA by astronauts as symptoms of hypercapnia can arise acutely both on ground and in spaceflight. Interestingly, literature shows a biphasic role in neuropeptides involved in respiratory rhythm during chronic CO2 exposure, where they are upregulated rather than downregulated. Respiratory rhythm is coordinated by the action of two centrally coupled brainstem oscillators: the preBötzinger (preBötC) complex localized in the ventrolateral medulla and the parafacial respiratory group/retrotrapezoidal nucleus (pFRG/RTN) clusters of interneurons rostral to preBötC. This neuroplasticity reiterates the importance of not only acute, but perhaps longer-term CO2 exposure training for astronauts.

2 Proposition

Here, we propose to conduct studies with longer exposure durations and examine the effects of hypercapnia in astronauts who must face hypercapnic loads in spaceflight. Adverse effects on cognitive processes and breathing in microgravity of CO2 have been documented and should be further examined.

3 Application

The use of fMRI studies to examine breathing has revealed essential insights about respiratory rhythms in the past. It would be interesting to subject astronauts or astronauts-in-training to an fMRI to compare the effects of hypercapnic loads. Preliminary reports have suggested that hyperventilatory responses become attenuated with longer-term CO2 exposures. This could indicate that there are significant differences in the respiratory rhythms post-chronic CO2 exposures such as after spaceflight.