ORBITAL FITNESS: AN OVERVIEW OF SPACE SHUTTLE CARDIOPULMONARY EXERCISE PHYSIOLOGY FINDINGS

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Limited observations regarding the cardiopulmonary responses to aerobic exercise had been conducted during short-duration spaceflight before the Space Shuttle program. This presentation focuses on the findings regarding changes observed in the cardiopulmonary exercise responses during and following Shuttle flights. During flight, maximum oxygen uptake (VO_2max) remained unchanged as did the maximum work rate achievable during cycle exercise testing conducted during the last full flight day. Immediately following flight, the ubiquitous finding, confirmed by investigations conducted during the Spacelab Life Sciences missions 1 and 2 and by NASA Detailed Supplemental Objective studies, indicated that VO_2max was reduced; however, the reduction in VO_2max was transient and returned to preflight levels within 7 days following return. Studies regarding the influence of aerobic exercise countermeasures performed during flight on postflight performance were mostly limited to the examination of the heart rate (HR) response to submaximal exercise testing on landing day. These studies revealed that exercise HR was elevated in individuals who performed little to no exercise during their missions as compared to individuals who performed regular exercise. In addition, astronauts who performed little to no aerobic exercise during flight demonstrated an increased HR and lowered pulse pressure response to the standard stand test on landing day, indicating a decrease in orthostatic function in these individuals. With regard to exercise modality, four devices were examined during the Shuttle era: two treadmills, a cycle ergometer, and a rowing device. Although there were limited investigations regarding the use of these devices for exercise training aboard the Shuttle, there was no clear consensus reached regarding which proved to be a "superior" device. Each device had a unique operational or physiologic limitation associated with its use. In conclusion, exercise research conducted during the Shuttle Program demonstrated that attenuation of postflight deconditioning was possible through use of exercise countermeasures and the Shuttle served as a test bed for equipment destined for use on the International Space Station.

Learning Objective: Overview of the Space Shuttle Program research results related to aerobic capacity and performance, including what was learned from research and effectiveness of exercise countermeasures.

Abstract for: Panel on The Legacy of Biomedical Research during Space Shuttle: Lessons Learned, 83rd Annual Scientific Meeting of the Aerospace Medical Association, Atlanta, GA, May 13–17, 2012.