Medical Support For A Manned Stratospheric Balloon and Freefall Parachute Flight Test Program

[1, 2]J. B. Clark, A. A. Pilmanis, [2,3] D.H. Murray, [4]M. Turney, [5] C. G. Bayne, [6] J. P. Bagian

[1] NSBRI/ Center for Space Medicine BCM Houston TX, [2] UTMB Galveston TX, [3] USAFSAM San Antonio TX, [4] Tillamook Emergency Services Tillamook OR, [5] Janus Health, San Diego CA, [6] Dept of Veteran Affairs Washington DC. jclark1@bcm.edu, apilmanis@aol.com, MURRAY@medicine.tamhsc.edu, mturney@pacifier.com, James.Bagian@med.va.gov

Introduction

The United States and Russia conducted high-altitude manned balloon research during the 1950s and early 1960s in support of their impending manned space programs. The US Navy Strato-Lab program demonstrated the operational capability of the Navy Mark IV full pressure suit, which was the basis for the Project Mercury space suits, to an altitude of 113,000 feet. The US Air Force Project Excelsior was a series of high-altitude balloon parachute jumps testing the Beaupre multi-stage parachute system and the standard Air Force MC3 partial pressure suit. The first Excelsior jump resulted in a spin over 100 rpm during freefall. Ultimately this program demonstrated a safe freefall parachute jump from an altitude of 102,800 feet. The Russian high altitude balloon parachute program was conducted from the "Volga" pressurized gondola modeled after the Vostok spacecraft. Exiting at an altitude of 86,156 feet, an experienced test jumper damaged his faceplate upon exiting and died during descent. Project Strato Jump was a US civilian freefall record attempt from a high altitude balloon and open gondola. On the second attempt an altitude of 123,500 feet was reached but the jumper was unable to disconnect and on the 3rd attempt the jumper was mortally injured during inadvertent suit depressurization during balloon ascent. Based on the success of Project Excelsior, a procedure for personal parachute usage during Mercury-Redstone missions was developed. Although never used, the personal parachute system flew on Mercury-Redstone 3 (MR-3) manned by Alan Shepard.

Discussion

In 2009 a privately funded group formed to initiate a manned stratospheric balloon and freefall parachute jump flight test program. Lessons learned were applied from the early manned stratospheric balloon programs. Multiple development paths included space suit, parachute descent and life support system, pressurized capsule, and balloon system. The test program included unmanned balloon and capsule tests, vertical wind tunnel and high troposphere tests of the drogue and main parachute and space suit, low pressure chamber tests of the space suit and integrated thermal/ vacuum chamber tests of the capsule, space suit and parachute/ life support systems, which will ultimately lead to incremental stratosphere freefall parachute jumps. A team was formed to develop and implement medical and physiologic support for this program. Issues addressed included protocol development for oxygen prebreathe for Decompression Sickness risk reduction, medical/ physiologic threat briefing, medical/physiologic monitoring for the thermal vacuum test phase and stratospheric flights, launch and recovery medical planning, and contingency planning. Contingency planning included the development of protocols against two serious known threats during a stratospheric bailout. In response to the threat of exposure to vacuum from a suit depressurization, an ebullism treatment protocol was developed. A protocol was developed to address another serious threat, flat spin with negative Gz acceleration. The selection and testing of the medical/ physiologic monitoring system for use in a pressure suit is a significant challenge. Other activities included safety review, Flight Rule development, Mission Control Center operation, human systems interface and capsule occupant protection evaluations.

Summary

Human stratospheric balloons flights entail many of the same operational risks and medical concerns as human suborbital space flights. The opportunities and mutual benefits for shared lessons learned between human stratospheric balloon and human suborbital space flights will be discussed. The results of this flight test program may have application for crew escape from suborbital spacecraft.