
Methods to enhance man's survivability in the sustained high or low G environments continue to be at the forefront of aeromedical research. Several acceleration protection research efforts are being actively pursued in programs with high visibility. A new reentry G-suit for NASA which features uniform differential clothing and the lower extremities promises to increase G-protection during shuttle reentry without the discomfort of an abdominal bladder (AB). This suit concept should also be adaptable for the National Aerospace Plane's (NASP) reentry G-protection requirements. It is hypothesized that the lower G levels encountered in these environments do not significantly increase hemodynamic stress and thus the requirement for an AB is negated but the need to prevent blood pooling in hypovolemic crewmembers is critical. The same G-protection principle used in these suits, i.e., lower body uniform pressure, is also the basis for a new advanced technology anti-G suit (ATAGS) soon to be flight-tested by the USAF. The AB is an absolute necessity in ATAGS since it is to be worn in fighter-type aircraft with high G rates which cause a rapid increase in heart-to-eye distance, decreased eye-ball blood pressure and subsequent G-induced loss of consciousness (GLOC). The ATAGS is now in the process of fielding COMBAT EDGE, an ensemble which uses positive pressure for G-protection (PBG) in combination with the current anti-G suit. PBG offers relief to tactical aircrews from the fatiguing effects of acceleration in air-to-air combat. Preliminary studies have demonstrated that PBG is even more effective when used with ATAGS.

AEROSPACE MEDICINE RESEARCH IN THE 21ST CENTURY – AIRCRAFT PROTECTIVE EQUIPMENT. B. R. Harding. RAF Institute of Aviation Medicine, Farnborough, Hampshire, United Kingdom.

In the 21st century, the hazards associated with flight by humans will be just as they have always been, and aircrew protective equipment will still be a vital part of the aeromedical weaponry. Thus, protection against pressure changes, hypoxia, accelerations, and other flight motion effects will still be needed; and research in these areas will continue to refine our already substantial body of knowledge. In this discussion paper, examples will be presented of the research needs for advanced oxygen systems (eg the innovative aircraft of the next century will depend for on-board oxygen delivery), advanced head-mounted devices (eg the relatively simple protective helmet of today could so easily become a behemoth if the requirement for additional systems proceeds unchecked and uncoordinated), for advanced personal protective clothing (eg the needs of pressure garments for altitude and G protection), and for advanced warning systems for disorientation and other human factor influences. But how is all this to be achieved? As human and economic resources continue to be in short supply, there will be an increasingly important place for collaborative research: no longer will it be possible, or desirable, for each laboratory to "go it" entirely alone. Standardization of research tools and methodologies will be essential, and the part played by memoranda of understanding and international bodies such as AGARD, ASCO and AAS will be vital.

Introduction. Prolonged exposure to microgravity has long been suspected to cause serious cardiovascular deconditioning, but has not been adequately documented. We studied a group of four subjects (three normal, one female) who were studied repeatedly before a nine-day space mission (SLS-I) and following reentry. Each subject was evaluated during each of five successful missions (letters A to E). Our goal was to quantify deconditioning during microgravity and the effects of return to Earth. To do this, we measured cardiovascular parameters immediately before, during and after the ten day SLS-I mission. We report here the cardiovascular changes associated with postflight baroreflex dysfunction and the potential causes of this dysfunction.

1. METHODS. The Cardiovascular Studies were conducted by M.J. Penderast and D.E. Watenpaugh, C.G. Blomqvist. The studies were divided into the following phases: 1) before, during, and after the ten day SLS-I mission, 2) many subjects, may become statistically significant after the number of subjects is increased by repeating the studies on SLS-II mission.

2. RESULTS. The cardiovascular changes associated with postflight baroreflex dysfunction may contribute. We studied the vagally mediated carotid baroreceptor function in all crewmembers. Excessive venous pooling did not appear to explain the observed deterioration in aerobic capacity and orthostatic intolerance. The cardiovascular changes associated with microgravity appear much more complex than previously believed.

3. CONCLUSIONS. 1) The subjects seemed able to vasocostrict sufficiently to maintain blood pressure in the face of the decreased carotid output; 2) many more studies would be needed to explain the complex changes associated with postflight baroreflex dysfunction and the potential causes of this dysfunction.

CARDIOVASCULAR ADAPTATION TO 0-G: RESULTS FROM SPACELAB LIFE SCIENCES ONE. F.A. Caffey, C.J. Buckley, L.A. Lane, R.P. Levine, D.E. Watenpaugh, C.G. Blomqvist, University of Texas Southwestern Medical Center, Dallas, Texas 75235-9034.

Introduction. Previous studies have suggested that cardiovascular changes during exposure to microgravity are due to changes in distribution of blood flow and volume. This study was designed to evaluate the cardiovascular changes associated with postflight baroreflex dysfunction and the potential causes of this dysfunction.

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LUNG FUNCTION TESTS ON SLS-I CREWMEMBERS. Harold J. B. Guy*, G.K. Franks* and J.H. Meat*, Univ. of California, San Diego 92121-9331.

INTRODUCTION. A headward fluid shift and reduction of topographic gradients should alter lung function at 0-G. METHOD. We tested resting lung function on the SLS-I crew repeatedly before, during (4 payload crew: days 2, 4, 5, 9, 3 orbiter crew: day 4), and after flight. RESULTS AND CONCLUSIONS. CO diffusing capacities (Dm), CO diffusing rates (Vd/Vt), and CO diffusing surface area (SA) were elevated and almost constant throughout the mission (-125% pre-flight standing control), and were higher than the control supine values. Membrane diffusing capacities (Dm) and surface area (SA) of the interstitial pulmonary edema at 0-G, at least at rest. Cardiac stroke volumes (N2) and CO2 were -150% of the pre-flight standing values on flight day 2, and fell slowly but, were still -125% control on day 9. This fall was steeper than those seen in head-down tilt studies. Vital capacities were only decreased on F02 (-95% control, similar to KC-135 0-G data). Resting lung volumes (FRC) were intermediate between standing and supine FRCs, consistent with the absence of gravitational depression and elevation of the diaphragm. Single breath N2 washout/ argon bolus tests showed Phase IV rises (argon + N2) at volumes near those seen pre-flight. Cardiogenic oscillations of N2 and CO2 were still -50% of pre-flight. The slope of the N2 alveolar plateau (phase III) was reduced -25%. Thus lung function is still far from urban, and always closure can still occur, at 0-G. Ongoing analyses of SLS-I, SLS-II and 2-d data will allow further definition of the sources of this inhomogeneity.


Hyperbaric oxygen therapy is becoming a mature medical entity. As an adjunctive therapy for a variety of conditions and the primary indication for a few, HBO as a field is experiencing healthy growth. Once over-promoted and poorly substantiated, HBO is slowly beginning to establish a much-needed base of controlled clinical trials; the changing attitude recognizes that HBO is adjunctive care in most cases. The American Board of Preventive Medicine has accepted HBO as a sub-specialty. An HBO equipment includes large steel, air-filled, 6-atmosphere "multiplace" chambers with multiple locks, compressors, a control panel, water deluge system for fire safety, and mask breathing system, as well as smaller, 3-atm, portable acrylic plastic single-lock "monoplace" chambers filled with 100% oxygen. A new hybrid single-attended-patient type is filled with air instead of O2, allows the higher pressures, and has a small lock for an attendant. Hyperbarics is increasing in DOD installations, with a major new Naval facility planned to supplement existing USAF and Army installations. Major HBO preparations were made—but fortunately were not needed—for Desert Storm. HBO is primary care for gas lesion diseases (decompression sickness and embolism) and certain CO poisonings, and is well accepted in gynecare. New advances focus on wound care, including convincing results in the use of HBO to reduce the need for leg amputations of diabetics. HBO can reduce by more than half the need for subsequent amputations. The use of HBO as adjunctive therapy for osteoradionecrosis, especially of the mandible, is now accepted. Thermal burns heal faster and at considerably less cost when HBO is used adjunctively.