CLINICAL AEROSPACE MEDICINE IN THE 21ST CENTURY. E.R. Moeller. Wright State University, Dayton, Ohio 45401.

INTRODUCTION. Advanced non-invasive diagnostic techniques will change the practice of care for the 21st Century flight surgeon. Cerebral and cardiovascular disease, even in the incipient stages, will be readily detectable at the time of the periodic physical examination. The same will be true for other potentially disqualifying conditions. Brief, highly sensitive and specific cognitive and psychomotor office-based testing will be accomplished at the time of examination, including the assessment of the sensory system. In the 21st century pilot population, the use of addictive substances will be virtually unknown, the result of education and screening (and rehabilitation programs when necessary). The self-destructive, suicidal additions (including nicotine, alcohol, amphetamines, and others) will be understood as incompatible with those who elect to undertake the privilege of flight. The 21st century approach will be that of individual assessment, emphasizing (1) Freedom from an impairing disease, (2) Capacity to perform as demonstrated by objective flight and high fidelity simulator assessment, and (3) Motivation to fly. CONCLUSION.

As a result of advances in medicine, aircraft design and airspace characteristics, various medical standards of the "Golden Age" 20th century will be dropped. These include uncorrected distant vision, color vision, pure tone audiometry (the spoken voice test substituted), upper date-of-birth limits, limits on persons requiring exogenous insulin (insulin pumps will be available), and certain other conditions. The main disqualifying conditions will be in the psychiatric and attitudinal realms.


The initial explorations of the planetary systems beyond the moon are likely to be undertaken in the first four decades of the 21st Century. Preparing for the social, psychological, and psychiatric problems to be faced must be initiated now if we are to adequately establish the means to cope with these matters properly and the counter measures to deal with those risks. Previous experience tells us that we will be facing these problems within complex technological systems. This paper will emphasize the nature of the work that must be undertaken in the next two decades.

ACCELERATION PHYSIOLOGY AND COUNTERMEASURES. B.N. Krutz, KRUG Life Sciences, San Antonio, TX 78279-0644.

Methods to enhance man's survivability in the sustained high or low G environments continue to be at the forefront of aerospace research. Several acceleration protection research efforts are being actively pursued in programs with high visibility. A new reentry G-suit for NASA which allows uniform O2 delivery to the lower extremities promises to increase O2-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 (NAP) reentry G-protection requirements. It is hypothesized that the low G levels encountered in these environments do not significantly increase hyperemia and thus the requirement for an AB is negated but the need to prevent blood pooling in hypovolemic crowed members is critical. The same O2-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 eG-level blood pressure and subsequent G-induced loss of consciousness (G-LOC). The ATAGS is now in the process of finding COMBAT EDGE, an ensemble which uses positive pressure for O2-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.

THERMAL STRESS IN AEROSPACE MEDICINE: HOT ISSUES, COLD FACTORS. S.A. Nimsley, Armstrong Laboratory, Brooks AFB TX 78235.

Heat and cold have been flight operations since humans first learned to fly. The challenges for today and tomorrow often relate to operational constraints and the whole effects of thermal stress on performance. Some current concerns:

1) Protection from climatic extremes. Survival support for crewmembers implies using only minimal equipment or supplies, and providing them in a manner which avoids interference with normal flying operations. An example is the design of antiexposure suits which prevent immersion hypothermia while still being worn in a manner which avoids interference with normal flying operations.

2) Protection from climatic extremes. Survival support for crewmembers implies using only minimal equipment or supplies, and providing them in a manner which avoids interference with normal flying operations. An example is the design of antiexposure suits which prevent immersion hypothermia while still being worn in a manner which avoids interference with normal flying operations.

3) Prevention of performance effects. Elimination of thermal stress may be required to ensure minimal performance of complex tasks and to maintain maximal tolerance for other environmental stressors such as acceleration and hypoxia. Where thermal control of the work space proves inadequate or impractical, personal countermeasures may be needed. Conclusion: Elimination of thermal stress as an adverse factor in aerospace operations demands intensive research involving collaboration among specialists in aerospace medicine and aircraft design, as well as experts in clothing and personal conditioning, human factors and sustained operations.

AEROSPACE MEDICINE RESEARCH IN THE 21ST CENTURY - AIRCRAFT PROTECTIVE EQUIPMENT. R.H. Harding, RAF Institute of Aviation Medicine, Parnborough, 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 play a part of the organism and atmospheric environment. 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 demand for oxygen support systems upon our understanding of more efficient on-board oxygen delivery), advanced head-mounted devices (eg the relatively simple protective halmet of today could so easily become a behemoth if the requirement for additional systems required for advanced warning systems for disorientation and other human factor influences is met. How is this to be achieved? As human and economic resources continue to be in short supply, there will be an increasing importance 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 AAnV will be vital.

Introduction. Prolonged exposure to microgravity has long been suspected to cause serious cardiovascular deconditioning, but has not been adequately documented with objective end-point measurements. Subjects (6 females) were studied repeatedly before a nine-day space mission (SLSI) and following return. In each case, the protocol consisted of three test periods (rest and two levels of exercise) during which steady state heart rate, blood pressure, and cardiac output (by a rebreathing technique based on that of Farth et al., Resp. Physiol., 28:141-159, 1976) were determined. Subjects were studied in both the erect and supine positions and averaged the average of 4-5 successive measurements. Results. Significant (P < 0.05) changes were found in the erect subjects, both at rest and exercise on the day of recovery; at rest, heart rate increased to 133% of pre-flight values while cardiac output dropped to 75%. Blood pressure was maintained. Calculated stroke volume decreased to 34%, while total peripheral resistance increased to 146%. These changes were also evident during exercise, although work did not cause further deterioration. Conclusions. 1) The subjects seemed able to vasocostrict sufficiently to maintain blood pressure in the face of the decreased cardiac output; 2) many other trends, which cannot be proven now because of the limited number of subjects, may become statistically significant after the number of subjects is increased by repeating the studies on the SLS2 mission.


Experiment 294 on the SLS-1 mission (3-5 June 91) examined the crew's adaption to microgravity with a complex set of measurements. Cardiac output, R wave triggered pressure and suction steps, autonomic function tests, and leg volume were measured before, during, and after flight. Significant changes were also evident during exercise, although work did not cause further deterioration. Conclusions. 1) The subjects seemed able to vasocostrict sufficiently to maintain blood pressure in the face of the decreased cardiac output; 2) many other trends, which cannot be proven now because of the limited number of subjects, may become statistically significant after the number of subjects is increased by repeating the studies on the SLS2 mission.


Hyperbaric oxygen therapy is becoming a mature medical entity. As 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. HBO equipment includes large sea-filled, water-tight 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 single-lock "monoplace" chambers filled with 100% oxygen. A new hybrid "single-atended-patient" type is filled with air instead of O2, allows the higher pressures, and has a small lock for an attendant. HBO 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 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 gynecology. Now 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 not accepted. Thermal burns heal faster and at considerably less cost when HBO is used adjunctively.

ECONOMIC AND ADMINISTRATIVE CHARACTERISTICS OF THE CLINICALLY BASED HYPERBARIC MEDICINE PROGRAM. Dick Clarke. Richland Memorial Hospital, Columbia, South Carolina.

No longer limited to regional referral centers, hyperbaric medicine facilities are now in place across the continent of health care institutions. The increasing acceptance of hyperbaric medicine as a useful adjunctive therapeutic modality in caring for selected patients is based on sound medical rationale and continues to develop as continuing clinical experience, and a requirement to reduce total health care costs. The free standing clinic concept has largely disappeared, primarily as a result of reimbursement policies. Hospital-based hyperbaric medicine is seen primarily as a hybrid, not as a specialty. HBO is primary care for gas lesion diseases (decompression sickness and embolism), and certain CO poisonings, and is well accepted in gynecology. Now 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 is not accepted. Thermal burns heal faster and at considerably less cost when HBO is used adjunctively.