A REVIEW OF ACCELERATION INJURIES ON HUMAN CENTRIFUGES IN THE UNITED STATES AND CANADA SINCE 1965. R. McSwain, J. Whistler, BMES Labs, Naval Air Development Center, Warminster, PA 18974-9906; W. Blankenship, American Optical, Akron, OH 44320; and T. Kaminsky, BMES Labs, Naval Air Development Center, Warminster, PA 18974-9906.

INTRODUCTION. In efforts to enhance a high performance fighter pilot’s tolerance of high sustained G+ (HSG), centrifuge training in which the subject undergoes a series of runs attaining a maximal G+ for 15s are commonly employed with minor if any complications. This paper, however, describes just such a routine centrifuge session resulting in the fracture of the subject's femoral neck. Thorough search of the literature revealed no similar mechanism of injury. CASE REPORT. A 30-year-old Air National Guard pilot in good health (no history of lower extremity disease) except for contact lens wear was prescreened and the capsule’s entry trajectory was numerically calculated. Only 19 of 46 clearly met all three criteria. Related injuries were minor and occurred in only 20%. CONCLUSION. The occurrence of NIDDM among cockpit crews was approximately 1/3 of general population despite the reported healthy lifestyle. This factor cannot be neglected, however, intensive supervision by us seems to be effective to ameliorate their glycemic control.
F-16 PILOT EXPERIENCE WITH COMBAT EJECTIONS DURING THE PERSIAN GULF WAR.

INTRODUCTION. Most experience with ejections from modern fighter aircraft has occurred in mishaps outside of true combat operations. During the Persian Gulf War, the 61st Tactical Fighter Wing lost 4 F-16C aircraft while on combat missions. All 4 pilots ejected safely, but under varying and different parameters. A questionnaire was developed to recall and elicit their ejection details, any problems or injuries they encountered, and their present condition.

RESULTS. All 4 pilots were given the questionnaire that allowed them to provide answers to 12 questions pertaining to their ejections. Questions ranged from recalling the parameters of their ejections to conscious recollections of the event and their assessment of how well the system worked. RESULTS. All 4 ejections occurred under different parameters. Two were at high altitudes. All 4 pilots were able to vividly recall their egress experience and recount some part of the event that was a surprise. None suffered any significant injury and one was wearing combat loose which remained in the ejection. All felt the seat and survival gear performed flawlessly. CONCLUSION. This was one of the first times that experience was obtained in the F-16 aircraft under combat operations in which the reason for emergency ejection might be different, e.g., frag damage, than in peacetime. In the experience of the authors, the F-16 egress system is reliable even in combat operations.

NEW HYPOTHESIS ABOUT +Gz-INDUCED UNCONSCIOUSNESS.

B. Betancourt, Hospital Militar Central, Bogotá.

INTRODUCTION. +Gz–induced loss of consciousness (G-LOC) is considered an effect of suddenly reduction of cerebral blood flow as a result of blood shift to lower body. However, the pathophysiologic mechanisms are poorly understood. I propose other prepathologic alterations and special mechanical explanation is suggested. Method. I reviewed the literature about the anatomic relationship between the intracranial structures, the hemodynamics, and the effects related to the cerebral hyperfusion, the effects of hypoxia-ischemia on neuronal function, and applied the laws of physics under +Gz–effects in the intracranial content. Results and conclusions. The laws of physics state that during the +Gz–induced changes the cerebrospinal fluid (CSF) displaces downwards against the spinal subarachnoidal space, the brain weight increases and displaces the CSF from the supratentorial basal space upward the cranial convexity. The whole brain descends and the inferior and medial hemispheric structures are compressed against rigid base of the skull and tentorium. The vessels of the Circle of Willis are elongated and collapsed. Moreover by viscoelastic properties of the brain, distortion of the cerebral tissue can occur. The +Gz mainly exposes critical brain areas (inferomedial surfaces of temporopolar lobes, diencephalic structures and midbrain), and explain G-LOC clinical picture.

INVESTIGATION OF A HELMET LIFT REDUCTION CONCEPT FOR IMPROVED WINDBLAST PROTECTION DURING EMERGENCY ESCAPE.

INTRODUCTION. The reduction of open ejection seatars is restricted by the occurrence of windblast injuries. These injuries, which include disruptions of the joints of the extremities, bruises on the head, neck and back, are directly attributable to the dynamic pressure of the airstream. A wind tunnel was constructed to study the ability of different windblast deflector configurations to reduce the windblast forces acting upon pilots during an ejection. METHODS. Seven deflector configurations were tested. Deflector sizes and angle, along with ejection seat attitude and wind tunnel dynamic range were varied. Total aerodynamic head/neck loading was measured with an instrumented manikin. Pressures surrounding the parasite headboard were also measured. RESULTS. Head/neck loading was reduced for some deflector configurations; furthermore, total aerodynamic seat/man coefficients were also reduced. Load distribution was related to deflector size, location, and orientation with respect to the airstream. CONCLUSION. Aircr, ejection subjected to emergency ejection underpotentially injurious aerodynamic loading upon entering the airstream. The windblast deflector concept provides a lightweight, easily deployable alternative for improving pilot egress and reducing the probability of windblast related injuries.

A FIRST ‘RUN EFFECT ON THE HUMAN CENTRIFUGE.

A. E. Torer and A. E. Tozer Royal Air Force Institute of Aviation Medicine, Farnborough, UK.

INTRODUCTION. Centrifuge subjects have previously reported that exposure to +Gz acceleration on the human centrifuge caused a greater loss in peripheral vision during the first run compared to subsequent runs at the same acceleration. Initial trials showed that six out of eight subjects exhibited a "first run" effect based upon visual loss criteria. It was therefore decided to study this phenomenon in greater detail and to assess the possible cause. METHODS. Seven subjects were exposed to five successive runs on the human centrifuge at their previously determined relaxed G tolerance (32.7°/4.65 Gz, with fifteen seconds at G). The time between runs was standardized at approximately three hours. Eye level blood pressure, heart rate, lower body blood volume and peripheral vision were continuously monitored during exposure to +Gz acceleration. RESULTS. Lower body blood volume and heart rate showed no significant differences between runs. A significant difference was clearly evident with peripheral vision and eye level blood pressure. Peripheral vision showed a 54% greater loss overall [p<0.001] during the first run (430 sec, mean loss) compared with subsequent runs (300 sec, mean loss). Eye level blood pressure showed an overall greater loss of 25% [p<0.001] during the first run (764mmHg/sec mean loss) compared with subsequent runs (641mmHg/sec mean loss). CONCLUSION. This study has established that a high proportion of centrifuge subjects experience a "first run" effect. This phenomenon manifests itself as a significantly greater loss in peripheral vision and eye level blood pressure under +Gz acceleration during the first run compared to those recorded in subsequent runs at the same acceleration. Both parameters appear to be independent of changes in lower body blood volume. The results from this study suggest that it is essential to be aware of this phenomenon when assessing relaxed G tolerances if gross errors are to be avoided. Further investigations will be necessary to determine the underlying cause.

A TWO-DIMENSIONAL ECHOCARDIOGRAPHIC STUDY OF LEFT VENTRICULAR CHARACTERISTICS IN PILOTS AT HIGH ALTITUDE.


INTRODUCTION. Left ventricular end-diastolic muscle volume (LVM) and weight (LVM) of pilots were studied with two dimensional echocardiography with modified Devereux formulae and were compared with those of groundcrew. Methods. Seven fliers were studied(mean age 28.6, Group A and 25 male groundcrew(mean age 28.6, Group B), without any CV anomalies, were examined with systolic time intervals (STI) indices and 2-dimensional echocardiographic data(Aloka SSD710) for left ventricular end-diastolic dimension(LD), interventricular septum end-diastolic thicknness(LVST), and left ventricular posterior wall diastolic thickness(LVWT) and the assessment of left ventricular volume and weight were derived with Wuhgan Medi- cal College(WMC)and Devereux formulae: LVM=(Ld+IVSTw+PWTh)-2/3. LVM=f+(Dd+IVSTw+PWTh)-2/3. 1.5 G WMC. RESULTS. No significant difference were found in STI parameters between A and B (p>0.05), but LVM and LVMW were significantly different [p<0.05] between the two groups. CONCLUSION. The correlation between results from WMC and Devereux formulae was 0.99. CONCLUSIONS: While A and B are not significantly different in STI parameters their LVM and LVMW are significantly different (p<0.01).
CARDIAC IMPEDANCE DIFFERENTIAL LOOP IN AIRCREW

G. Z. Li, X. Xing, L. Guo, Z. Zhang, General Hospital of Air Force, Beijing 100036, China

INTRODUCTION. Cardiac impedance differential loop (IDL) is a plot of impedance AY versus impedance differential of AT (Falke 1982). It is more informative and accurate than impedance differential of VTmax measured on a group of 50 groundcrew. The differences between these groups are shown in Table. Subjects were divided into 2 age groups. RESULTS. The importance and age related parameters are tabulated in the Table. It can be seen that ITT & T90% of aircrew are much shorter and IIA, IIIA/IIIb such greater than those of groundcrew. CONCLUSION. The unique feature here is that it is important to perform periodical medical examination at the young age because of screening & CONCLUSION. The unique feature here is that it is important to perform periodical medical examination at the young age because of screening & exclusion criterion.

Because of screening & exclusion criterion.

-CERTIFICATION-

The all pilots must undergo a thorough medical examination at the age of 40. The third step is to determine which maintenance system on the all pilot population. Three hundred pilots were examined, 22-40(N=54@) and 41-52(N=16@). The second step was to attach suitable medical examination at the young age because of screening & exclusion criterion.

Because of screening & exclusion criterion.

ARe _rouo 22-40(N=54@) ARe _rouo h1-52(N=16@)

ARe _rouo 22-40(N=54@) ARe _rouo h1-52(N=16@)

The studies carried out within this programme suggest that angiotensin converting enzyme (ACE) inhibitors and Ca-antagonists have been effectively and safely used in civilian aviators.

INTRODUCTION. Effective control of arterial hypertension in aviators still remains a problem. Diuretics and B-blockers may restrain exercise capability and have sedative effects. Newer classes of antihypertensive agents such as Ca-antagonists and ACE inhibitors have been proved clinically safe and effective. They present no adverse metabolic effect, they do not cause orthostatic hypotension or sedative effects. On the contrary ACE inhibitors may increase alertness.

Based on these considerations, these classes of drugs have been used in recent years in the treatment of hypertension in commercial aviators in Greece. The experience gained is presented in this paper. METHODS. By law, all commercial aviators in Greece are examined every six months in HAF Aeronautical Medical Centre, Athens GREECE.

HYPERTENSION MANAGEMENT IN AVIATORS OF A COMMERCIAL AIRLINE. I.T. Klymen, J. Przybylski. Instituto Nacional de Medicina Aeronautica y Espacial, Mexico, Mexico.

Anti-hypertensive drugs are used increasingly in the management of mild to moderate hypertension in aviators, and the central effects of these drugs must be considered when deciding the most appropriate therapy. We have studied, in a series of examinations over several years, the effects of beta-adrenoceptor antagonists, an angiotensin converting enzyme inhibitor, a calcium antagonist, and a diuretic on psychomotor performance, as well as on the electroencephalographic (EEG) study. With atenolol (50 to 100mg) and propranolol (40 to 160mg) there was electroencephalographic evidence of sedation, with propranolol short term memory was also impaired. Captopril (12.5 to 50mg) improved psychomotor performance and short term memory without any change in the EEG. Metoprolol (10 to 40mg) led to feelings of increased agitation with electroencephalographic evidence of arousal. Nifedipine (2.5 to 10mg) impaired psychomotor performance, but there was no change in short term memory or in the EEG.

The studies carried out within this programme suggest that angiotensin converting enzyme inhibitors are likely to have the least deleterious effect on central function in man.

**INTRODUCTION.** Changes in blood volume during space flight are thought to contribute to decrements in cardiovascular and orthostatic function. The purpose of this study was to determine whether gender affects red cell mass and plasma volume during a short exposure to simulated microgravity, and whether gender differences in orthostatic tolerance occur.

**METHODS.** Twenty-one volunteers (18 men and 3 women) were studied. Subjects underwent 13 days of 6° head-down bedrest. Plasma volume (PV) and red cell mass (RCM) were measured before bedrest and on bedrest day 13. On the same days, orthostatic tolerance (OT) was determined as the maximal pressure during a presyncope—limited lower body negative pressure test. RESULTS. Plasma volume (PV) and red cell mass (RCM) decreased (P < 0.01) during bedrest in both groups, with a greater PV decrease (P < 0.05) in men (6.3 ± 0.6 m/kg) than in women (4.1 ± 0.6 m/kg). Decreases in red cell mass were similar (1.7 ± 0.2 m/kg in men and 1.7 ± 0.2 m/kg in women). OT was similar for men and women before bedrest (-78 ± 6 mmHg in men vs. -70 ± 4 mmHg in women) and decreased by a similar degree (by an average of 11 mmHg in both groups) after bedrest. The changes in OT did not correlate with changes in plasma volume during bedrest (P = 0.02).

**CONCLUSION.** Thus, although female hormones may protect PV during bedrest, they do not appear to offer an advantage in terms of loss of orthostatic function.

---

**EFFECT OF ANTIORTHOSTATIC BEDREST (BR) ON GASTROINTESTINAL MUCOSAL BLOOD FLOW (GIM) OF NORMAL SUBJECTS** E. Patchell*, R. P. Tinter*, K. J. Peter*, and N. M. Cintara*. Naval Medical Research Laboratory, NASA/Johnson Space Center, Houston, TX, *KRUG Life Sciences, Inc., Houston, TX and *Philadelphia College of Pharmacy and Science, Philadelphia, PA.

**INTRODUCTION.** The combined effect of postural changes, fluid shifts, and diuresis associated with the absence of the gravity vector may decrease GIM during space flight. GIM can be estimated from the mouth-to-ear transit time (MCTT) of orally administered lactose (LACT). This test is used to assess changes in GIM in normal subjects and in patients with orthostatic intolerance and to establish reference values. Since BR mimics some of the physiological changes that occur during space flight, the effect of ten days of BR on GIM was evaluated from the MCTT of LACT. METHODS. Subjects were 12 non-smoking males between the ages of 35 and 50. After an 8 to 10 h fast, subjects ingested Cephalaxin (20 g solution) with a low-titer breakfast on four different days (45, 30, 25, and 20) before BR and on three separate days (4, 7, and 10) during BR. Blood H2O2 concentrations were measured before and at 10-min intervals for 4 h after breakfast using a Quintron breathalyzer, and MCTT was determined from these data. RESULTS. MCTT ranged between 50 and 100 min during ambulation and 80 and 210 min during BR with means of 79 min and 122 min, respectively. CONCLUSIONS. Mean MCTT during BR was 54% longer than during ambulation, suggesting that absorption and availability of orally administered medications and nutrients may be delayed or impaired as a result of decreased GIM during bedrest.