Abstracts of Aero-Medical Literature

AIRCREW MEDICAL PROBLEMS

Physical Fitness, Flight Requirements and Age. RALPH F. GOLDMAN, Aerospace Medicine, Vol. 42, June 1971, Pp. 635-641, 26 Refs.

Muscular strength (estimated from dynamometric measurements of force exerted), cardio-respiratory capacity (determined as maximum work capacity or oxygen uptake) and relative body weight (assessed by anthropometric measures) are frequently used criteria of "physical fitness". These different aspects of fitness all alter predictably with age and can be altered by training. Considering the physical work involved in flight, it seems appropriate to consider to what degree physical fitness—and which aspects of it—should be important to an aircrewman. Excess weight may require premature replacement of an individual because of the decreased longevity associated with being overweight, but should not hinder flight performance as long as the man fits into his workspace, and agility and reach are unimpaired. The energy cost of flying only averages 125 kcal/hr. and even an average 65 year old in "fair" condition has a maximum work capacity at least 3 times that. Finally, the muscular forces required to fly modern aircraft are minimized by electro-mechanical control systems. It appears that these three well defined aspects of "physical fitness" are of little importance to aircrew, although strength may be important for groundcrew. The attitude of the "fit" individual in terms of a sense of well being, self confidence and youthful outlook may be one of the more important (and less readily demonstrated) facets of physical fitness.

(Author's abstract).

2

Epidemiological Aspects of Airport Medicine. J. G. CONSTANTINO. Aerospace Medicine, Vol. 42, Apr. 1971, Pp. 456-460, 7 Refs.

As air fares and travel time decreases, one can anticipate increased movement of people and animals throughout the world thus increasing the potential threat to spread of disease on a global basis. The danger exists not only for the highly developed and affluent country where communicable disease is probably no longer considered a serious health problem but also for the under-developed and poorer countries which face the risk of introduction of new diseases adding to their existing burden of harboring many endemic foci of disease. Fortunately most countries are unanimous in their thinking of the importance of public health due to the fear of disease spread. The Asian Influenza epidemic of 1957-58 demonstrated the devasting susceptibility of the human race to a slight change in the antigenic make-up of the influenza virus. It also illustrated brilliantly the value of international co-operation in monitoring an epidemic disease. In this constant moving era involving changes in political governments for better or worse, the public health picture also changes and we must be prepared to face this changing health situation on a co-operative, international level. One cannot ever become complacent about communicable diseases even when the local situation health-wise of a country is comparatively safe—the airplane has changed this. Although the magnitude and the realization of the problem of disease spread is at times frightening, in all due fairness public health authorities throughout the world as well as the various airlines engaged in international travel, are to be commended for their role in the curtailment of disease spread. There is still much to be done and we must maintain continued vigilance to insure that serious outbreaks of disease throughout the world do not occur in this dynamic era of jet travel.

(Author's abstract).

3

Control of Acute Mountain Sickness. G. W. GRAY, A. C. BRYAN, REGINA FRAYSER, C. S. HOUSTON and I. D. B. RENNIE Aerospace Medicine, Vol. 42, Jan. 1971, Pp 81-84, 11 Refs.

Clinical trials of acetazolamide versus placebo, and acetazolamide and furosemide were carried out at 17,500 feet (5,400 m.), on Mount Logan. Subject pretreated with acetazolamide before ascent were clinically well with minor symptoms of acute mountain sickness. Subjects started on furosemide on arrival at altitude quickly became medical casualties.

(Authors' abstract).

4

Aeromedical Transportation and General Aviation. HARRY L. GIBBONS and CARL

FROMHAGEN. Aerospace Medicine, Vol. 42, July 1971, Pp. 773-779, 35 Refs.

The advantages of aircraft in providing military medical evacuation are well documented. Training experience have resulted in a reliable and safe military medical evacuation system. Many studies have been done or are in process which pertain to civil emergency helicopter evacuation.

Fixed-wing secondary ambulance service is growing at a rapid rate without the benefit of studies such as those pertaining to helicopter primary ambulance service. Problems associated with this growth relate to equipment, crew training, and knowledge of the physiology of flight. Legislative and/or educational efforts are needed to assure optimum general aviation patient transportation.

(Authors' abstract).

5

Body Fat, Denitrogenation and Decompression Sickness in Men Exercising After Abrupt Exposure to Altitude. T. H. ALLEN, D. A. MAIO and R. W. BANCROFT. Aerospace Medicine, Vol. 42, May 1971, Pp. 518-524, 31 Refs.

Groups of men, numbering 147 in all, among whom body volume and mass had been determined took 883 exposures for as long at 4 hours at 35,000 ft. in oxygen or 27,000 ft. in oxygen or in 70:30:: oxygen: nitrogen while performing mild intermittent exercise. Forty men with less than 12 kg. of body fat suffered a low incidence of less intense decompression sickness than the 107 men with 12 or more kg. of body fat. This distinction as to influence of body fat on decompression sickness applied both in the basence and in the presence of denitrogenation for periods up to 3.5 hours when completely exposed in "shirt-sleeves" to oxygen at "ground level". After 4 hours of such denitrogenation 99% were protected including those with more than 12 kg. of fat.

(Authors' abstract).

6

Neurological Decompression Sickness: Report of Two Cases at Minimal Altitudes with Subsequent Seizures. JEFFERSON C. DAVIS, ROBERT TAGER, HARRY P. POLKOVITZ and ROBERT D. WORKMAN. Aerospace Medicine, Vol. 42, Jan. 1971, Pp. 85-88, 13 Refs.

The clinical manifestations, pathophysiology and treatment of altitude decompression sickness continue to pose a dilemma for the flight surgeon. This paper presents two cases with similar neurological manifestations and clinical courses resulting from exposure to altitudes of 19,000 feet and 28,000 feet respectively. Both cases suffered from long delay in reaching compression chambers, both were treated with the USN Table VI (minimal pressure 100% oxygen), both had grand mal seizures in the post-treatment period and both recovered fully.

(Authors' abstract).

7

Long-Term Prognosis of Transient Hypertension in Young Male Adults. POUL E. RØRBAEK MADSEN and JAN BUCH. Aerospace Medicine, Vol. 42, July 1971, Pp. 725-755, 16 Refs.

Sixty-nine young men with transient hypertension when accepted as pilot aspirants have been controlled 17 to 20 years later. In this group with primary transient hypertension the frequency of later problems of high blood pressure has been found to be significantly higher than in a control group of 216 pilots with normal blood pressure when accepted as pilot aspirants (11.6% *vs.* 2.3%). This is in accordance with the results of earlier investigations.

On account of too short a period of observation and few individuals controlled we find it necessary to stress the still existing uncertainty of the ultimate importance of transient hypertension.

Even though we do not consider it justified to assign to transient hypertension so great importance that this should in itself imply elimination of applicants for pilot education, it should always be taken into account as a negative factor where other partly disqualifying qualities are manifest.

(Authors' abstract).

8

Stress Responses as Criteria for Personnel Selection: Baseline Study. ROY B. MEFFERD, JR., HENRY B. HALE, IRA L. SHANNON, JOHN R. PRIGMORE and JAMES P. ELLIS, JR. Aerospace Medicine, Vol. 42, Jan. 1971, Pp. 42-51, 40 Refs.

This was an exploratory study of the feasibility of using physiological responses to an anticipated stressor, to the physical stress *per se*, and to recovery from the stress as a procedure for selecting personnel for jobs requiring emotional and physical stability in the face of stressful situations. Batteries of

physiological, chemical and of psychological tests were used to obtain baseline values. A number of potentially useful indicies of responsiveness were delineated and discussed.

(Authors' abstract).

9

Use of Heparin for the Therapeutic/Prophylactic Treatment of Decompression Sickness. ELIZABETH REEVES and ROBERT D. WORKMAN. Aerospace Medicine, Vol. 42, Jan. 1971, Pp. 20-23, 10 Refs.

The effectiveness of Heparin in the treatment of decompression sickness or as a prophylaxis against this disease has been tested in an animal model employing large dogs in which the bends threshold depth had been previously determined to within ± 2 ft. Each animal was compresed 5 to 10 ft. deeper than its bends threshold depth for 5 hrs. and brought to sea level pressure with "no-stop" decompression. Two series of experiments were done: (1) IV Heparin was injected following the development of signs of decompression sickness at sea level pressure. The anti-coagulant level was maintained at 3 times the normal level in all animals.

Heparin *plus* shallow recompression did not resolve signs of decompression sickness in 18 of the 19 animals. Therefore Heparin as a therapeutic/prophylactic treatment was not effective under the experimental conditions of this investigation.

(Authors' abstract).

VESTIBULAR FUNCTION AND ORIENTATION

10

Testing of the Vestibular System. ROBERT H. MATHOG and ROBERT L. CRAMER. Aerospace Medicine, Vol. 42, July 1971, Pp. 741-745, 17 Refs.

Since it appears that no single test can adequately describe normal function of the vestibular system a series of tests may be applied to obtain a better understanding of vestibular capability. Such tests, employing optokinetic, caloric, positional and rotational stimuli, appear to reflect function at different levels of neural integration, thereby giving a more accurate analysis of orientation mechanisms. The functional tests may provide information relative to the interaction of the vestibular system with visual and somatokinesthetic systems. The optokinetic evaluation may determine normal oculomotor function as well as defects throughout the reflex pathway. The caloric tests describe function at the receptor level, comparing one ear with the other, while rotational determinations evaluate the integration of responses under simultaneous stimulation. Techniques in administering and interpreting such vestibular tests are described.

(Authors' abstract).

11

Pilot Reports of Disorientation Across 14 Years of Flight. BRANT CLARK. Aerospace Medicine, Vol. 42, July 1971, Pp. 708-712, 19 Refs.

The purpose of this study was to compare recent incidents involving disorientation in flight reported by 336 Air Force, Army and Navy pilots with incidents reported by 137 pilots in 1956. The pilots reported their experiences using a check list and a written description of an experience with disorientation in the aircraft they were flying at the time. The latter included 40 incidents which occurred in support of operations in Vietnam. The reports of disorientations showed a striking similarity across types of aircraft flown over 14 years of flying, as well as with the incidents occurring in Vietnam. However, some variation in reports between aircraft types was noted. These reports of disorientation suggest that disorientation is currently experienced in a wide variety of flight operations and that it will continue to be experienced by aircraft pilots.

(Author's abstract).

12

Vestibular Nystagmus—A Differential Reaction. E. FLUUR and A. MELLSTROM. Oto-Laryngologica, Vol. 71, April 1971, Pp. 299-302, 13 Refs.

Galvanic polarization was applied to 20 adult spinalized cats in order to study the interplay between the two labyrinths during different stimulation conditions. The results have shown that it is the difference in activity between the two reflex acres which determines the direction and intensity of the reaction, *i.e.*, the vestibular reflex ares function in the same way as a differential amplifer.

(Authors' abstract).

13

Comparisons of Nystagmic Responses in Basic Airmen, Grounded Pilots and Active Pilots.

GREGORY J. MATZ and JAMES W. WOLFE. Aerospace Medicine, Vol. 42, June 1971, Pp. 627-629, 8 Refs.

The Dix-Hallpike bithermal caloric test and bidi-rectional rotary stimulations (10 °/sec.² acceleration for 16 seconds followed immediately by 10 °/sec.² deceleration for 16 seconds) were given to three groups: non-flying airmen, pilots actively engaged in flying, and pilots who had been grounded for at least six months for reasons other than diseases of the ear. Based on the two main contrasts of interest (paresis and preponderance), there were no significant differences between the groups for either variable, nor were there any differences in slow phase velocity in the rotational test. However, the analysis of variance did reveal a significant group by temperature interaction for velocity and frequency due to the grounded pilots responding in an opposite manner to the stimuli than the other groups. It was concluded that any habituation of the vestibulo-ocular reflex that might result from flying did not generalize to these test conditions.

(Authors' abstract).

FLIGHT SAFETY

14

Detection of Alcohol in Aviationand other Fatalities in Finland. ANTTI R. ALHA and VEIKKO TAMMINEN. Aerospace Medicine, Vol. 42, May 1971, Pp. 564-568, 18 Refs.

Alcohol examinations on autopsy cases in 1970 and on 41 pilots and others who died in aviation accidents between 1961 and 1970 are presented. The samples had been taken less than 5 days in ca 80% of the cases.

For determination of alcohol in the blood the Widmark and ADH methods were used side by side and the criterion of the primary interpretation of the results was the correspondence or discrepancy between the two results. Gas-chromatography was used for further investigation. According to possibilities and need, an alcohol examination was also performed on urine or organs. The battery of alcohol examinations offered good possibilities for interpreting the results as regards the presence of ethanol as either native, positive or complicated. In complicated cases (10%) either exogenous volatile agents other than ethanol or an evident putrefaction effect were detected. In cases of putrefaction, the time elapsed between death and the taking of the sample as well as special conditions were significant. For the purpose of avoiding these factors, samples should be taken as early as possible. As regards the results of the examinations, the aviation fatalities did not differ from the rest of the series.

In the aviation fatalities, 5 pilots and others in 3 aircraft accidents could be shown to have had ethanol in their blood, although in one of these there was no evidence of alcohol ingestion in the case report.

(Authors' abstract).

15

Effect of Earplugs on Passenger Speech Reception in Rotary-Wing Aircraft. C. E. WILLIAMS, J. R. FORSTALL and W. C. PARSONS. Aerospace Medicine, Vol. 42, July 1971, P. 750-752, 5 Refs.

Direct person-to-person speech communication is sometimes required in rotary-wing aircraft where high levels of noise make the use of hearing protective devices desirable. The question arises as to what effect earplugs would have on the intelligibility of speech in rotary-wing aircraft. Intelligibility test data obtained in flight as well as in a simulated flight situation indicate that the use of earplugs in rotary-wing aircraft will improve the reception of direct person-to-person speech communication. Moreover, their use will afford protection against the deafening, fatigue, and annoyance effects of the hazardous noise present in rotary-wing aircraft.

(Authors' abstract).

16

Re-Evaluation of Emergency Pressurization Requirements for Brief Flights above 50,000 Feet. CHARLES L. WILSON. Aerospace Medicine, Vol. 42, Feb. 1971, Pp. 183-185, 6 Refs.

Among diverse aeronautical mission requirements there are those in which valid provisions for emergency aircrew pressurization are distinctly indicated. On the other hand, the various liabilities of emergency aircrew pressurization equipment compel a continuing reconsideration of the need for such devices. Experience suggests that there is merit in waiving the requirement for capsule and suit pressure devices when the flight time slightly above 50,000 feet is infrequent and brief. In the initial design of aircraft, it appears economical in weight, design, and cost to require a pressure suit retrofit capability in the event that the mission requirements later change.

(Author's abstract).

17

Effect on Sleep of a Sleep Period Time Displacement. WILSE B. WEBB, HARMAN W. AGNEW, JR. and ROBERT L. WILLIAMS. Aerospace Medicine, Vol. 42, Feb. 1971, Pp. 152-155, 15 Refs.

Five young adult males slept from 0800 to 1600 and did performance tasks from 1100 to 0700 for four days. Electroencephalogram records for the displaced sleep periods were scored for sleep stages and compared with baseline sleep (1100-0700). The time awake after sleep onset was slightly increased. The effect on the total relative amounts of the sleep stages was minimal. The temporal distribution of the amounts of stage 4 and REM sleep obtained per hour was clearly affected but the cyclical character of REM in terms of time between periods was maintained. We infer from our data that observed decrements in performance due to time displacements are not likely to be due to disturbed sleep *per se*.

(Authors' abstract).

18

Aeromedical and Human Factors Aspects of Airports. THE INTERNATIONAL QUARANTINE, AIRPORT MEDICAL SERVICE and FLIGHT SANITATION SUB-COMMITTEE. Aerospace Medicine, Vol. 42, April 1971, Pp. 439-448, 9 Refs.

Thirty-four of the world's major civil airports were assessed by the sub-committee for the years 1968-1973 with respect to the following areas: (1) airport population, (2) airport medical facilities, (3) airport medical experiences, (4) aircraft accident victims treated in the past decade, (5) comments on certain problems in providing acute and preventive medical services at airports, (6) specific airport design features which have a bearing on medical factors, (7) selected specific human factors considerations, (8) future plans and requirements concerning jumbo jets, SST's air buses, air taxi aircraft, V/STOL and other types, and (9) comments on criteria for an "Airport Medical Design Guide." Detailed information on each of the above areas for these air ports was obtained by sub-committee members and consultants in a prescribed format. The findings are quite revealing to aviation medicine specialists, airport operators, the aviation industry and to all who have a responsibility and interest in air travel efficiency and safety. Shortcomings of existing facilities are pinpointed and recommendations are made to assure that future civil airport operations can be accomplished with efficiency and safety from the medical standpoint.

19

Physiological Aspects of Aircraft Accident Investigation. C. W. SEM-JACOBSEN. Aerospace Medicine, Vol. 42, Feb. 1971, Pp. 199-204, 12 Refs.

Today's fighter, helicopter, bomber and transport planes, to name the major categories, are flown by pilots. Thus human factors has to be considered in the operational design and use of these planes, whether military or commercial.

Inflight biomedical monitoring has improved our knowledge and understanding of the pilots, his limitations and capabilities, as well as demonstrated the great variability in the human stress tolerance.

Today it is possible to monitor pilots during operational missions, without interfering with the mission or the pilot's performance or comfort.

Physiological monitoring during operational flights should therefore vigorously be pursued to substantiate and expand our knowledge in our steady on-going stride to improve effectiveness and reduce accidents.

In case of sudden incapacitation, heart failures, etc., a dangerous signature in the date monitored may on line be used to trigger automatic warning devices. A "Dead Man's Button" is currently under development as a one or two step alarm system.

(Author's abstract).

20

Neuroendocrine and Metabolic Responses to Intermittent Night Shift Work. H. B. HALE, E. W. WILLIAMS, B. N. SMITH and C. E. MELTON, JR. Aerospace Medicine, Vol. 42, Feb. 1971, Pp. 156-162, 38 Refs.

Six men were studied nightly during three cycles of unaccustomed alternating shift work, with each cycle including five days on a morning shift (2400 to 0800 hours) and five days on an afternoon-evening shift (1500 to 2300 hours). Nuroendocrine and metabolic functions were appraised by means of determinations of urinary epinephrine, 17-hydroxycorti-costeroids (17-OHCS), urea, potassium, sodium and inorganic phosphate. Evidence was obtained of work-associated neuroendocrine and metabolic hyperactivity (nonspecific stress) which was most distinct during the first week of morning work. Relatively high values of urinary epinephrine and 17-OHCS were found during morning periods in the

weeks in which there was no morning work, indicating that the rotating shift schedule itself, not just the night work, acted as a stressor. An adaptive change was evident, since there was a lessening of the physiologic disturbance with each return to morning duty, as judged by urinary epinephrine, norepinephrine, 17-OHCS, and urea. Full adaptation was not attained, for the work-associated changes in potassium and inorganic phosphate reappeared with each return to morning duty, and there were no reductions in the magnitudes of either of these responses. The potassium and phosphate responses to morning work were both biphasic. Morning work consistently induced elevations in urinary potassium, and there were compensatory reductions in urinary potassium in the postwork (sleep) periods. Morning work consistently caused relative hypophosphaturia, and as an after-effect there was always relative hyperphosphaturia.

(Authors' abstract).

VISUAL PROBLEMS

21

Visual Vibration Response. RICHARD A. LEE and ALBERT I. King. Journal of Applied Physiology, Vol. 30, Feb. 1971, Pp. 281-286, 12 Refs.

Currently available data pertaining to vision in a vibratory environment are concerned with the ability of subject to read letters or numbers while being vibrated at discrete frequencies. This paper presents a unique method of measuring amplitude and phase of eye motion during whole body vibration. Gain-phase plots are presented for six subjects for the frequency range from 3 to 7 Hz. The graphs contain: (1) ratio of head motion to input motion; (2) phase of eye motion to head motion; (3) ratio of eye motion to head motion; and (4) phase between eye motion and head motion. Tabulated data include the average gain and phase values, the standard deviation and 95% confidence limits.

(Authors' abstract).

22

Flashblindness Recovery With and Without Protection in Simulated Flight Conditions. BRIAN WARD, W. H. BOWIE and WILLIAM H. CUSHMAN. Aerospace Medicine, Vol. 42, Feb. 1971, Pp. 149-152, 7 Refs.

Recovery from foveal flash blindness was measured using aircraft instrument reading criteria. The assumption was made that the pilot must be able to have useful vision outside the aircraft at night while wearing any protective device. Recovery of visual function to the levels required for the reading of vital instruments was recorded (*a*) without protection, (*b*) with the use of a monocular eye patch, and (*c*) using a 2% transmission gold coated visor and supplementary instrument illumination. Recovery time was shown to be least when the eye patch was employed. Suggestions are made as to the operational usefulness of these two different approaches to flashblindness protection.

(Author's abstract).

23

Pilot Vision During Final Approach-and-Landing in Tubojet Transport Operations. DAVID A. HODGSON. Aerospace Medicine, Vol. 42, Feb. 1971, Pp. 205-208, 4 Refs.

This paper examines the critical role of pilot vision during the final approach-and-landing phase in turbojet transport operations. A brief look at the statistics for fatal turbojet accidents reveals that visual and other non-precision approaches remain a problem as a cause or contributory cause.

An examination is made of the basic information, requirements for a pilot during final approach under visual and instrument conditions, together with the decisions and actions associated with this information. Emphasis is given to the landing geometry for third-generation jets.

Finally, some needed research pertaining to landing vision problems is identified. Areas of concern included information requirements, criteria for evaluating windshields, illusions, visual accommodation, and systemic physiological conditions.

(Authors' abstract).

24

Vision Loss From Windshield Tinting in a Night Visual Flying Accident. B. A. J. CLARK. Aerospace Medicine, Vol. 42, Feb. 1971, Pp. 190-195, 23 Refs.

A light aircraft with a tinted windshield crashed into a mountain in clear conditions on a moonless night. The pilot's visual capability within the last few minutes of flight is investigated by reference to published visual performance and sky luminance data, coupled with photometric measurements and visual and photographic observations of the crash

site and of the cabin of a similar aircraft. It is concluded that cabin lighting could have affected the pilot's vision during the two minutes in which the mountain might have been recognizable, and that the windshield tinting could have caused a further important loss of vision. The method presented is applicable to other aircraft and pilots in the night flying situation. Although the estimates of visual performance should be checked in simulated night flying conditions, there is little doubt that wind shield tinting represents an unnecessary hazard in night flying.

(Authors' abstract).

ENVIRONMENTAL FACTORS

25

Water Metabolism in Humans During Acute High-Altitude Exposure (4,300 m.). HARRY J. KRZYWICKI, C. FRANK CONSOLAZIO, HERMAN L. JOHNSON, WALTER C. NIELSEN, JR., and ROBERT A. BARNHART. Journal of Applied Physiology, Vol. 30, June 1971, Pp. 806-809, 14 Refs.

During 6 days of altitude exposure at 4,300 m. the following changes in body water compartment were observed. (*a*) Total body water was significantly decreased by 2.25 kg. during the 6-day altitude exposure. (*b*) Extra-cellular water appeared to increase by 1.27 kg. at altitude, although not significantly. (*c*) Intracellular water, in turn, was significantly decreased by 3.52 kg. at altitude which is contrary to some previous reports. Under the conditions of this study, with heavy physical activity prior to and during altitude exposure, and with fairly high food intakes (above 3,400 kcal./day) it appeared that hypo-hydration and diuresis still occurred during acute altitude exposure. This suggested that body water loss may have been an adaptive mechanism in acute altitude exposures.

(Authors' abstract).

26

Functional Changes of Cardiac Muscle in Adaptation to Two Types of Chronic Hypoxia. JOSEF SOUHRADA, BOHUSLAV MRZENA, OTAKAR POUPA and R. W. BULLARD. Journal of Applied Physiology, Vol. 30, Feb. 1971, Pp. 214-218, 33 Refs.

Tolerance to acute anoxia of the myocardium of laboratory rats adapted to the chronic hypoxia of simulated high altitude (9-11 weeks at 7,000 m.) and from animals adapted to long-term sider-openic anemia (21 weeks at blood hemoglobin values equivalent to 4-6 g./100 ml.) has been tested. Transient anoxia was induced in the rat heart-lung preparation (HLP) by ventilating the lungs with 95% nitrogen plus 5% CO_2 or 100% nitrogen. Two parameters, the resistance of heart function in anoxia (Rt.) and the recovery of static cardiac work (Rep. %) after the anoxia exposure, were measured to determine the tolerance of the working myocardium to acute oxygen lack. Increased tolerance of cardiac muscle of rats acclimated to altitude hypoxia and chronic sider-openic anemia was demonstrated. The presence of CO_2 during anoxia had a different effect on anoxic survival of hearts from rats adapted to chronic hypoxia and those of both controls and animals with sideropenic anemia. The possible mechanisms that may lead to increased tolerance of the myocardium to acute oxygen lack are discussed.

(Authors' abstract)

27

Effects of Continuous Positive-Pressure Ventilation on Gas Exchange in Acute Pulmonary Edema. FREDERICK W. CHENEY, JR., and WAYNE E. MARTIN. Journal of Applied Physiology, Vol. 30, Mar. 1971, Pp. 378-381, 11 Refs.

Acute pulmonary edema was induced in 12 dogs by injection of oleic acid into the pulmonary artery. Control measurements were made with the dogs breathing 100% oxygen and receiving continuous intermittent positive-pressure ventilation (IPPV) at a Vt of 15 ml./kg. Mean airway pressure was raised either by imposing an end-expiratory resistance of 10 cm. H_2O (CPPV) or by raising the tidal volume to high levels (38 ml./kg.) (HIPPV). During experimental pulmonary edema both CPPV and HIPPV were equally effective in raising Pao_2 from that seen with IPPV. Optimal Pao, volumes during acute pulmonary edema were related to the mean airway pressure rather than to tidal volume and were independent of the method of increasing the mean airway pressure.

(Authors' abstract).

28

Cost of Submaximal and Maximal Work During Chronic Exposure At 3,800 m. CHARLES E. BILLINGS, ROBERT BASON, DONALD K. MATHEWS, and EDWARD L. FOX. Journal of Applied Physiology, Vol. 30, Mar. 1971, Pp. 406-408, 6 Refs.

Twenty-five males were studied during 20 days of continuous residence at an elevation of 3,800 m.

They worked for up to 30 min. at ½ or 2/3 of their sea-level (230 m.) work capacity during 8 days at altitude. Oxygen uptake, ventilation, and heart rate were recorded several times during each work session. On the 17th and 19th days of exposures, maximal oxygen uptakes were determined. The time required to reach stable levels of oxygen uptake, ventilation, and heart rate during work did not change during 20 days at altitude. Terminal oxygen uptakes and ventilation volumes during work at ½ of sea-level capacity were higher on the 2nd and 5th days than at other times, while terminal heart rates declined steadily for 11 days. Work which required oxygen uptakes greater than 2 5 l/min. at 230 m. was always associated with lower oxygen uptakes at 3,800 m.

(Authors' abstract).

29

Susceptibility to Moderate Hypoxia in Aircrew With a History of Episodes of Impaired Consciousness in Flight. W. HARTZELL and P. D. NEWBERRY. Aerospace Medicine, Vol. 42, Jan. 1971, Pp. 93-97, 9 Refs.

Tolerance to hypoxia was compared in seven aircrew who reported unexplained impaired consciousness in flight at cabin altitudes above 12,000' (IICF), 10 aircrew who denied IICF, and 10 C.F.I.E.M. staff.

The seated subjects breathed 11% oxygen in nitrogen. Blood pressure was recorded. The test was stopped after 45 minutes, or sooner if necessary in the opinion of two experienced observers, or the subject.

Three of the seven aircrew in the test group were unable to complete the test. In contrast, all of the ten aircrew controls, and nine of the ten C.F.I.E.M. subjects completed the test. The mean B.P. of the hypoxia sensitive subjects was significantly lower than that of the aircrew control group ($p < 0.05$).

Aircrew who have reported IICF are less tolerant of moderate hypoxia than other aircrew. It is likely some IICF are caused by unsuspected, moderate hypoxia in susceptible individuals.

(Authors' abstract).

30

Immediate effects of Positive-Pressure Breathing on the Ventilatory Response to CO_2. D. C. FLENLEY, L. D. PENGELLY and J. MILIC-EMILI. Journal of Applied Physiology, Vol. 30, Jan. 1971, Pp. 7-11, 30 Refs.

Acute exposure of four conscious subjects to continuous mouth pressures up to +30 cm. water throughout the respiratory cycle for 4 breaths caused the tidal volume to fall during the pressure breathing, this fall being greater at higher pressures. End-expiratory lung volume increased along the relaxation pressure-volume curve of the respiratory system. When CO_2 mixtures were breathed before and during continuous positive pressure the tidal volume response to CO_2 was always decreased. However, since the frequency of breathing always increased, the impairment in minute volume response to CO_2 was less pronounced. In one subject this increase in frequency completely compensated for tidal volume decreases. Reduction in the length of inspiratory muscles by lung inflation, diaphragmatic flattening, and the decreased respiratory compliance at high lung volumes could explain this fall in tidal volume during continuous positive-pressure breathing.

(Authors' abstract).

31

Hyperbaric Respiratory Mechanics. EDWIN G. VAIL. Aerospace Medicine, Vol. 42, May 1971, Pp. 536-546, 23 Refs.

There is an urgent need for a closer look at hyperbaric respiratory mechanics. For nearly half a century, undersea physiology has been narcotized by the mythology of "nitrogen narcosis." There are no experimental facts which show an inert gas, in itself, is a narcotizing agent through biochemical action in the human body. A parametric analysis of respiratory mechanical and physiological deficiencies which occur in a hyperbaric environment show that all narcosis is caused by the increased density of the breathing mixture which, with expiratory effort, generates transpulmonary pressures in excess of Ptp. max. The resulting characteristic gas flow following elastic tube theory in the early phase of expiration causes closure and collapse of the subsegmental bronchi. This closure and collapse of the subsegmental bronchi is responsible for blocking gas exchange from alveoli and, thereby, producing hypoxia complicated by carbon dioxide retention. Hyperbaric hypoxia is much more serious than carbon dioxide retention in saturation divers. Graphs are presented which correlate the airway critical collapse pressure with maximum expiratory flow rates and the density of the breathing gas mixture. These graphs can be used to establish an optimal expiratory flow

rate at any diving depth to assure adequate alveolar ventilation.

(Author's abstract).

32

Rate of Development of Pulmonary O_2 Toxicity in Man During O_2 Breathing at 2.0 Ata. J. M. CLARK and C. J. LAMBERTSEN. Journal of Applied Physiology, Vol. 30, May 1971, Pp. 739-752, 56 Refs.

Rate of pulmonary oxygen toxicity development during continuous O_2 breathingat 2.0 Ata was determined in 11 normal subjects with change in VC as the toxicity index. By the 4th hr. of O_2 breathing, VC decreased in all but two subjects. VC reduction progressed throughout O_2 exposure and the first part of the postexposure period. Recovery of VC usually occurred within 1-3 days after the exposures, but required 11 days in one subject. Symptoms began within 3-8 hr. of O_2 breathing, as mild tracheal irritation and increased in intensity throughout the exposure. After 8-10 hr. of O_2 breathing, symptoms were characterized by uncontrollable coughing, dyspnea at rest, and a constant tracheobronchial burning sensation. Average lung volume changes of seven subjects at the end of O_2 breathing were: VC, —10.3%*; IC, —23.7%*; ERV, +14.7%*; $FIV_{1.0}$, —14.8%; $\%FIV_{1.0}$, —2.4%; MMIF, 20.8%; $FEV_{1.0}$, 9.3%; $\%FEV_{1.0}$, +4.3% and MMEF, +19.2%. Within 1-5 hr. after the exposures average changes in the same parameters for six subjects were: —16.3%*, —31.3%*; +24.2*, —25.8%*, —10.0%*, —38.0%*, —19.8%, —9.1% and —14.3% respectively (asterisk represents significant changes). Absence of significant changes in(A—a) Po_2 measured during O_2 breathing at 2.0 and 1.0 Ata at the end of and after the O_2 exposures indicates that progressive alveolaratelectasis or severe pulmonary edema is not a prominent feature of early pulmonary oxygen toxicity in man.

(Authors' abstract).

33

Respiratory Function During a Simulated Saturation Dive to 1,500 feet. J. B. MORRISON and J. T. FLORIO. Journal of Applied Physiology, Vol. 30, May 1971, Pp. 724-732, 30 Refs.

A simulated saturation dive was performed in a dry chamber complex. Two subjects were compressed to successive depths of 600, 1,000, 1,300 and 1,500 ft. Time spent at each depth was 24, 22 and 10 hr., respectively. The purpose of the dive was to better establish man's physiological state at depths in excess of 1,000 ft. a region beyond the limits of man's previous experience. Respiratory measurements were made at each depth both when the subjects were at rest and when they were performing a moderate work load. Compared with measurements at surface, there was, in general, and increase in ventilation and tidal volume, and a decrease in respiratory rate and heart rate at depth. Carbon dioxide production was unchanged or slightly lower at rest and unchanged or increased during exercise. It is concluded from the results that under these conditions there are no significant respiratory problems and man can exist with reasonable comfort.

(Authors' abstract).

34

Effect of Acetylasalicylic Acid and Ascorbic Acid on Oxygen Toxicity. SCOT SERRIL, DEVENIA JEFFERSON, JACQUELINE QUICK and CHARLES E. MENGEL. Aerospace Medicine, Vol. 42, April 1971, Pp. 436-438, 6 Refs.

With the use of hyperoxic environments in space capsules and for medical purposes, this study explored the effects of some common drugs with redox potential on oxygen toxicity. Acetylsalicylic acid and ascorbic acid were injected into chow-fed and tocopherol-deficient mice. In vitro lysis of RBCs by H_2O_2 increased from 40±2% to 64±7% in chow-fed and from 60±3% to 90±2% in tocopherol-deficient mice, 60 minutes following injection. A linear response between drug dose and H_2O_2 lysis existed. During exposure to 100% O_2 at 45 psia, drug-treated and tocopherol-deficient mice began seizures and died much sooner than did controls. These data (1) show increased RBC lytic sensitivity to H_2O_2 from mice treated with ASA and ascorbic acid, (2) demonstrated untoward effect of these drugs on in vivo hyperoxic exposure, (3) illustrate predictive use of in vitro H_2O_2 lysis for in vivo toxicity and (4) suggest some commonly ingested drugs could be detrimental to humans exposed to significant hyperoxia.

(Authors' abstract).

35

Changes in Aortic, Coronary, and Carotid Flows During +Gx Acceleration. H. L. STONE, H. F. STEGALL, M. B. KARDON, H. SANDLER and R. M. PAYNE. Journal of Applied Physiology, Vol. 30, Jan. 1971, Pp. 21-26, 14 Refs.

The principle cardiovascular alterations observed when an animal is exposed to increased gravitational force applied from sternum to backbone (+Gx) have been found to be a decrease in cardiac output, an increase in arterial pressure, and a decrease in arterial oxygen saturation. This sequence of events indicates that blood flow decreases through certain vascular beds in the face of a decreasing arterial oxygen saturation. In seven mongrel dogs, anesthetized with alpha-chloralose, measurements of ascending aortic, left circumflex coronary artery, and right common carotid flows as well as arterial and left ventricular pressures were made during exposure to 5, 10 and 15 +Gx for 120 sec. Ascending aortic flow and heart rate decreased, while the descending aortic pressure increased with each level of acceleration. The flow in the left circumflex artery did not change except at 15 +Gx, where it increased significantly. Common carotid flow decreased transiently but returned toward control levels before the 2-min acceleration exposure was completed. The coronary and possibly in part of the common carotid vascular beds are responding to the arterial hypoxemia of acceleration stress and are contributing very little to the increase in arterial pressure.

(Authors' abstract).

36

Influence of Acclimatization on Sweat Sodium Concentration. J. R. ALLAN and C. G. WILSON. Journal of Applied Physiology, Vol. 30, May 1971, Pp. 708-712, 16 Refs.

Experiments were undertaken to clarify the effects of heat acclimatization on the sodium concentration of sweat and to distinguish these from the effects of concomitant changes in sweat rate. Sweat samples were collected at different rates of sweating from three unacclimatized subjects, using a Perspex capsule containing filter papers. The subjects were then acclimatized to heat, using a passive hyperthermia technique, and a further series of sweat samples obtained at different rates of sweating. The weighed samples were analyzed for sodium concentration and the results used to plot sodium concentration against sweat rate before and after acclimatization. The results show significant reduction in sweat sodium concentration with acclimitization over a wide range of sweat rates. Possible mechanisms are discussed.

(Author's abstract).

37

Total Body Cooling in Warm Environments. F. SHVARTZ and D. BENOR. Journal of Applied Physiology, Vol. 31, July 1971, Pp. 24-27, 9 Refs.

Seven healthy young men attempted 11 work-heat tests at different ambient temperatures: 25°, 30°, 40°, 45° and 50°C. The test consisted of the subjects walking for 2 hr. at 3.5 km./hr. while wearing vapor-barrier suits. Except for those performed at 25°C., the tests were repeated with total body cooling. Cooling was effected by circulating cool water through 50 m. of tubing sewn into a garment that covered the entire body surface area except the face, hands, and feet. Cooling resulted in complete elimination of signs of heat stress and strain in all ambient temperatures. This required a removal of about 230 W/m² at 30°C to 465 W/m² at 50°C. In the absence of cooling, there was a rapid increase in heat strain that shortened tolerance time from 108 min. at 30°C to 28 min. at 50°C. When evaporative cooling is prevented, it is possible to eliminate heat strain completely with the removal of less heat than that reported here.

(Authors' abstract).

38

Effect of Body Cooling on Vigilance in Hot Environments. DAN BENOR and ESAR SHVARTZ. Aerospace Medicine, Vol. 42, July 1971, Pp. 727-730, 17 Refs.

Vigilance under acute heat stress was studied by testing simple reaction time to visual stimuli and auditory signal detection rate. Seven healthy adult men were exposed to ambient temperatures of 30 to 50°C for periods up to 2 hr. They were tested while walking on a treadmill and wearing an impermeable garment. A rapid elevation of body temperature was thus achieved. The tests were replicated with the subjects wearing a cooling suit. Reaction time was unaffected either by the rise in temperature or by the cooling. Signal detection rate deteriorated significantly. The deterioration was directly related both in speed and in point of onset to the environmental temperature. The discrepancy between reaction time and detection rate suggests a short term "mobilization" mechanism. The pattern of false reaction indicates a decline in sensitivity rather than criterion changes. Some psychological and practical implications of the results are discussed.

(Authors' abstract).