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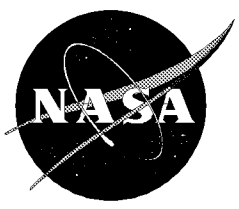
MARCH 2000

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES



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Typical Report Citation and Abstract

❶ 19970001126 NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA; Mar. 1996; 130p; In English
Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10' to 50', and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65' swept forebody serrations tended to roll together, while vortices from 40' swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

1. Document ID Number; Corporate Source
2. Title
3. Author(s) and Affiliation(s)
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AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 498)

MARCH 2000

51
LIFE SCIENCES (GENERAL)

Includes general research topics related to plant and animal biology (non–human); ecology; microbiology; and also the origin, development, structure, and maintenance, of animals and plants in space and related environmental conditions. For specific topics in life sciences see categories 52 through 55.

20000020485 Universities Space Research Association, Div. of Space Life Sciences, Houston, TX USA
Proceedings of the First Biennial Space Biomedical Investigators' Workshop
Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999; 692p; In English; First Biennial Space Biomedical Investigators' Workshop, 11-13 Jan. 1999, League City, TX, USA; See also 20000020486 through 20000020688
Contract(s)/Grant(s): NCC9-41; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

The First Biennial Space Biomedical Investigators' Workshop, held January 11-13, 1999, was unique in that it assembled, for the first time, a broad cross section of NASA-funded biomedical researchers to present the current status of their projects and their plans for future investigations. All principal investigators with active, or recently-completed ground-based projects in NASA's Biomedical Research and Countermeasures Program that were funded through NASA's Office of Life and Microgravity Sciences and Applications were invited. Included were individual investigators funded through NASA Research Announcements, investigators with NASA Specialized Centers of Research and Training, investigators with the recently established National Space Biomedical Research Institute (NSBRI), and NASA civil servant investigators. Seventy-seven percent of all eligible projects were presented at the workshop. Thus, these Proceedings should provide a useful snapshot of the status of NASA-funded space biomedical research as of January 1999. An important workshop objective was to achieve free and open communication among the presenting investigators. Therefore, presentation of new and incomplete results, as well as hypotheses and ideas for future research, was encouraged. Comments and constructive criticisms from the presenters' colleagues were also encouraged. These ground rules resulted in many lively and useful discussions, during both the presentation sessions and informal evening gatherings and breaks.
Author
Conferences; Life Sciences; Cardiovascular System; Immunology; Musculoskeletal System; Microgravity; Activity (Biology)

20000020487 NASA, Washington, DC USA
Life Sciences in NASA's Mission
Nicogossian, Arnauld E., NASA, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 4-11; In English; See also 20000020485; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The topics of agency and enterprise goals, OLMSA organization, life sciences relationship to NASA/HEDS strategic plans, budget allocated by the HEDS strategic plan goals, 1998 successes, exploration and the International Space Station, congressional budgets, OLMSA grants, biomedical research and countermeasures, medical care, biologically inspired technologies, and publication, education and outreach are all presented in viewgraph form.
CASI
Life Sciences; Gravitational Effects; Bioastronautics; Activity (Biology)

20000020488 NASA Johnson Space Center, Houston, TX USA
JSC, NASA Lead Center: Overview of Human Space Life Sciences Programs Office (HSLSPO)
Stegemoeller, Charles, NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 12-18; In English; See also 20000020485; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

An overview of the Human Space Life Sciences Programs Office (HSLSPO) presents the following topics in viewgraph form: Agency structure, objectives of the HSLSPO lead center implementation plan, HSLSPO relationship to Johnson Space Center (JSC) as lead center, HSLSPO programs and projects, biomedical research and countermeasures, HSLSPO relationship to the International Space Station (ISS), and BR&C ISS flight research content.
CASI
Life Sciences; NASA Space Programs; Organizations

20000020489 NASA Johnson Space Center, Houston, TX USA
The Human Space Life Sciences Critical Path Roadmap Project: A Strategy for Human Space Flight through Exploration-Class Missions
Sawin, Charles F., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 19-37; In English; See also 20000020485; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The product of the critical path roadmap project is an integrated strategy for mitigating the risks associated with human exploration class missions. It is an evolving process that will assure the ability to communicate the integrated critical path roadmap. Unlike previous reports, this one will not sit on a shelf - it has the full support of the JSC Space and Life Sciences Directorate (SA) and is already being used as a decision making tool (e.g., budget and investigation planning for Shuttle and Space Station mission). Utility of this product depends on many efforts, namely: providing the required information (completed risk data sheets, critical question information, technology data). It is essential to communicate the results of the critical path roadmap to the scientific community - this meeting is a good opportunity to do so. The web site envisioned for the critical path roadmap will provide the capability to communicate to a broader community and to track and update the system routinely.
Author
Life Sciences; Information Systems; Aerospace Engineering; Management Planning

20000020490 NASA Johnson Space Center, Houston, TX USA
NASA Johnson Space Center Biomedical Research Resources
Paloski, W. H., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 38-45; In English; See also 20000020485; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Johnson Space Center (JSC) medical sciences laboratories constitute a national resource for support of medical operations and life sciences research enabling a human presence in space. They play a critical role in evaluating, defining, and mitigation the untoward effect of human adaption to space flight. Over the years they have developed the unique facilities and expertise required to perform: biomedical sample analysis and physiological performance tests supporting medical evaluations of space flight crew members and scientific investigations of the operationally relevant medical, physiological, cellular, and biochemical issues associated with human space flight. A general overview of these laboratories is presented in viewgraph form.
CASI
Medical Science; Laboratories; Research Facilities

20000020491 NASA Ames Research Center, Moffett Field, CA USA
Hypergravity Facilities: Extending Knowledge Over the Continuum of Gravity
Souza, Kenneth A., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 46-56; In English; See also 20000020485; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Historical perspectives, reasons for gravitational research, key questions regarding centrifuges, particular centrifuge discussions, vestibular research facilities, the hypergravity facility for cell culture, the human research facility, as well as the center for bioinformatics are all topics discussed in viewgraph form.
CASI
High Gravity Environments; Research Facilities; Human Centrifuges

20000020492 California Univ., Dept. of Physiology and Biophysics, Irvine, CA USA
Task Force Report on Countermeasures, February 1997
Baldwin, Kenneth M., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 57-70; In English; See also 20000020485; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The subgroup and discipline consensus concerning: (1) define (nasa program management) the fitness standards and/or levels of acceptance of physiological homeostasis relative to the 1 g environment; (2) review and improve astronaut diets to insure adequate caloric intake and appropriate compatibility for mineral balance; (3) modify the exercise prescription, which should also impact cardiovascular homeostasis, to focus more on muscle and bone conservation; (4) numerous disciplines strongly endorse

the development of a human-powered gravity cycle; (5) integrate research and operational medical issues into the countermeasures plan; and (6) design countermeasure strategies that are effective, integrative, and appealing to insure astronaut compliance.
Derived from text
Standards; Fitness; Cardiovascular System; Compatibility; Countermeasures; Gravitation; Homeostasis; Physical Exercise

20000020493 National Academy of Sciences - National Research Council, Committee on Space Biology and Medicine, Washington, DC USA
A Strategy for Research in Space Biology and Medicine in the New Century
Osborn, Mary Jane, National Academy of Sciences - National Research Council, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 71-79; In English; See also 20000020485; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Physiological and psychological effect of spaceflight are: 1. Loss of weight-bearing bone and muscle: (1) studies should provide mechanistic Insights into development of effective countermeasures against bone and muscle deterioration during and after flight; (2) ground-based model systems should be used to investigate mechanisms of changes; (3) a database on the natural history of the microgravity-related bone loss and its reversibility In humans should be established in preflight, inflight and postflight recordings of bone mineral density; (4) hormone profiles should be obtained on humans before, during and following spaceflight; and (5) the relationship should be Investigated between exercise activity levels and protein energy balance inflight. 2. Vestibular function, the vestibular ocular reflex and sensorimotor integration: (1) highest priority should be given to experiments to determine the basis for compensatory mechanisms on earth and in space; (2) inflight recordings of signal processing following otolith afferent stimulation should be made by a trained physiologist serving as payload specialist; and (3) future studies should determine if and how exposure to microgravity affects mechanisms whereby new motor patterns are learned In response to sensory perturbations.
Derived from text
Research; Aerospace Medicine; Afferent Nervous Systems; Bone Demineralization; Countermeasures; Physiological Effects; Vestibules

20000020494 NASA Johnson Space Center, Houston, TX USA
Human Health and Performance Aspects of Mars Design Reference Mission of July, 1997
Charles, John B., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 80-93; In English; See also 20000020485; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The human element is the most complex element of the mission design Mars missions will pose significant physiological and psychological challenges to crew members Some challenges (human engineering, life support) must be overcome (potential "non-starters") Some challenges (bone, radiation) may be show-stoppers ISS will only Indirectly address Mars questions before any "Go/No Go" decision Significant amount of ground-based and specialized flight research will be required -- Critical Path Roadmap project will direct HSLSPO's research toward Mars exploration objectives
Author
Human Performance; Human Factors Engineering; Health; Physiology

20000020495 Massachusetts Inst. of Tech., Apollo Program, Cambridge, MA USA
National Space Biomedical Research Institute
Young, Laurence R., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 94-99; In English; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Mission Implementation Involves: developing countermeasures; defining and integrating the molecular, cellular, organ-level and whole-body responses to space flight; establishing and developing appropriate biomedical support technologies; transferring advances in knowledge and technology to the benefit of mankind in space and on earth; and ensuring open involvement in the Institute's activities.
Author
Countermeasures; Technology Assessment; Human Behavior

20000020501 NASA Johnson Space Center, Houston, TX USA
Barophysiology and Biophysics
Powell, Michael R., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 127-131; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Decompression is an important aspect of extravehicular activity (EVA). Errors can result in decompression sickness (DCS) if the protective measures are too liberal, while valuable on-orbit time is dissipated in prophylactic methodologies that are excessively conservative. Nucleation is an important consideration in many natural events, and its control is very important in many industrial procedures. The amount of Extravehicular Activity (EVA) that will be required during the construction of the International Space Station exceeds all of the other activity combined. The requirements in astronaut time and consumables (breathing oxygen and air) will be considerable. In an attempt to mitigate these requirements, Project ARGO was investigated in 1990 to investigate the effects of gravitational forces on the musculoskeletal system. This work has led to the present plans for the reduction of prebreathe duration. Over the past decade, research has been directed towards an understanding of the biophysical basis of the formation and growth of the decompression gas phase with the goal of improving the efficiency of the EVA process. In the past, we have direct work towards a more complete understanding of gas bubble formation and growth and exercise-enhanced washout during oxygen prebreathe.

Author

Biophysics; Decompression Sickness; Extravehicular Activity; Pressure Reduction; Physical Exercise; Oxygen; Musculoskeletal System; Gravitational Fields

20000020520 California Univ., San Diego, Dept. of Bioengineering, La Jolla, CA USA

Femoral Vein Ligation Increases Bone Mass in the Hindlimb Suspended Rat

Bergula, A. P., California Univ., San Diego, USA; Huang, W., California Univ., San Diego, USA; Frangos, J. A., California Univ., San Diego, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 194-197; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Bone remodeling in response to changing mechanical demands is well recognized. While it is generally accepted that the local mechanical environment contributes to the physiological maintenance of bone, several studies have suggested a role for interstitial fluid flow (IFF) in bone remodeling. Bone contains a porous network of canaliculi that has been shown to facilitate substantial and rapid transcortical IFF. Flow is steady in the absence of mechanical strain, but bending or compressive loads create pressure gradients which drive fluid from areas of compression to areas of tension. In vitro investigations of flow effects on bone demonstrate that fluid shear rapidly stimulates the release of nitric oxide and prostaglandin E(sub 2), two autocrine/paracrine factors associated with remodeling. These results suggest that the fluid shear stresses induced by increased IFF in bone may stimulate bone growth. Consequently, it has been hypothesized that changes in IFF due to intraosseous pressure changes influence bone remodeling. The goal of this study was to investigate the role of IFF in bone in vivo; the effect of venous ligation as a means to increase intramedullary pressure and IFF was observed in a model independent of mechanical strain, the hindlimb suspended rat.

Author

Bones; Compression Loads; IFF Systems (Identification); Physiology; Prostaglandins; Veins

20000020521 NASA Ames Research Center, Moffett Field, CA USA

The Effect of Skeletal Unloading on Bone Formation: Role of IGF-I

Bikle, D. D., Veterans Affairs Medical Center, USA; Kostenuik, P., Veterans Affairs Medical Center, USA; Holton, E. M., NASA Ames Research Center, USA; Halloran, B. P., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 198-199; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The best documented change in bone during space flight is the near cessation of bone formation. Space flight leads to a decrease in osteoblast number and activity, likely the result of altered differentiation of osteoblast precursors. The net result of these space flight induced changes is weaker bone. To understand the mechanism for these changes poses a challenge. Space flight studies must overcome enormous technical problems, and are necessarily limited in size and frequency. Therefore, ground based models have been developed to evaluate the effects of skeletal unloading. The hindlimb elevation (tail suspension) model simulates space flight better than other models because it reproduces the fluid shifts seen in space travel, is reversible, and is well tolerated by the animals with minimal evidence of stress as indicated by continued weight gain and normal levels and circadian rhythms of corticosterone. This is the model we have used for our experiments. Skeletal unloading by the hindlimb elevation method simulates a number of features of space flight in that bone formation, mineralization, and maturation are inhibited, osteoblast number is decreased, serum and skeletal osteocalcin levels fall, the ash content of bone decreases, and bone strength diminishes. We and others have shown that when osteoblasts or osteoprogenitor cells from the bones of the unloaded limbs are cultured in vitro they proliferate and differentiate more slowly, suggesting that skeletal unloading causes a persistent change in cell function which can be assessed in vitro. In contrast to the unweighted bones of the hindlimbs, no significant change in bone mass or bone formation is observed in the humeri, mandible, and cervical vertebrae during hindlimb elevation. The lack of effect

of hindlimb elevation on bones like the humeri, mandible, and cervical vertebrae which are not unloaded by this procedure suggests that local factors rather than systemic effects dominate the response of bone to skeletal unloading. We have focussed on the role of IGF- 1 as the local factor mediating the effects of skeletal unloading on bone formation. IGF-I is produced by bone cells and chondrocytes; these cells have receptors for IGF-I, and respond to IGF-I with an increase in proliferation and function (e.g. collagen, and glycosaminoglycan production, respectively). IGF-I production by bone is under hormonal control, principally by GH and PTH, and IGF-I is thought to mediate some if not all of the effects of GH and PTH on bone growth. Thus, systemic changes in hormones such as GH and PTH may still have effects which vary from bone to bone depending on the loading history. Author

Musculoskeletal System; Bone Mineral Content; Corticosteroids; Hormones

20000020522 Texas A&M Univ., College Station, TX USA

Alterations in pQCT-Derived Bone Geometry and Density Versus Mechanical Structural Properties of the Femoral Neck in Senescent Rats

Bloomfield, S. A., Texas A&M Univ., USA; Hogan, H. A., Texas A&M Univ., USA; Dresser, E. T., Texas A&M Univ., USA; Groves, J. A., Texas A&M Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 200-201; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Few data are available on the relationship of bone morphometry and bone mineral density (BMD) to mechanical properties of the femoral neck in senescent rats. Therefore, we studied femoral neck bone excised from young adult and senescent male Fischer rats using peripheral quantitative computed tomography (pQCT), followed by 3-point bending to failure to determine structural mechanical properties.

Author

Bones; Minerals; Density (Mass/Volume); Failure

20000020524 Indiana Univ. Medical Center, Indianapolis, IN USA

The Role of Calcium in the Response of Osteoblasts to Mechanical Stimulation

Duncan, R. L., Indiana Univ. Medical Center, USA; Farach–Carson, M. C., Delaware Univ., USA; Pavalko, F. M., Indiana Univ. Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 205-207; In English

Contract(s)/Grant(s): NAG5-4917; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

A major biomedical concern in the exploration and development of space is the rapid loss of bone associated with extended periods of spaceflight. Mineral content, bone formation, matrix protein production and total body calcium are all reduced during long-term periods of weightlessness. These effects of weightlessness appears to be due to decreases in the anabolic function of osteoblasts and osteocytes rather than changes in the resorptive activity of osteoclasts. Conversely, subjecting the skeleton to exogenous mechanical loading increases matrix protein synthesis and bone formation rate, a process which also appears mediated through osteogenic cells. Osteoblasts have been shown to respond to a number of types of mechanical stimulation. However recently we have demonstrated that osteoblasts respond to fluid shear, but not physiologic levels of mechanical strain, with increases in expression of the matrix protein, osteopontin. We have also shown similar responses in other markers for the anabolic response in bone. The expression of the early response gene, c-fos, and the inducible-isoform of the prostaglandin synthetic enzyme, cyclooygenase-2 (COX-2), both increase rapidly in response to fluid shear, but not strain. How osteoblasts and osteocytes perceive mechanical stimuli and convert this stimulus into a biochemical event within the cell is still unknown. However, examination of the cellular events following mechanical stimulation indicate that two of the earliest responses are a rapid increase in intracellular calcium ([Ca(2+)](sub i)) and a reorganization of the actin cytoskeleton. The increase in [Ca(2+)](sub i) is dependent on the presence of extracellular Ca(2+), suggesting the activation of membrane Ca(2+) channel. We have previously characterized a mechanosensitive, cation-selective channel (MSCC) in osteoblast-like clonal cells, which we postulate is important in this early response to mechanical loading. Using an antisense oligodeoxynucleotide strategy, we have tentatively identified this channel as an isoform of the alc subunit of the dihydropyridine-sensitive, voltage sensitive Ca(2+) channel (VSCC). However, a major component in this mechanically induced rise in [Ca(2+)](sub i) is the release of Ca(2+) from intracellular stores. The actin cytoskeleton also rapidly responds to fluid shear with an increase in stress fiber formation and a realignment of the cell parallel to the direction of flow. to ascertain whether these two observations are related and how they effect shear-induced gene expression, we examined the role of Ca(2+) channels and intracellular Ca(2+) release on cytoskeletal reorganization and the resultant increases in the expression and production of c-fos and COX-2 in response to fluid shear.

Derived from text

Calcium; Aerospace Medicine; Biochemistry; Bone Demineralization; Losses; Enzymes; Musculoskeletal System; Weightlessness

20000020525 California Univ., Lab. of Cell Growth, San Francisco, CA USA

Effect of Spaceflight on Extra Cellular Matrix in Osteoblasts Growth Activated Under Microgravity Conditions

Fulford, M. H., California Univ., USA; Gilbertson, V., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 208; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

To determine critical molecular events in osteoblast growth in spaceflight MC3T3-El osteoblasts were used to examine fibronectin (FN) MRNA levels, protein synthesis and FN extracellular matrix accumulation after growth activation in microgravity. FN is known to regulate adhesion, differentiation and function in adherent cells. We paid particular interest to the extracellular matrix since several investigators have reported in vivo and in vitro changes in osteoblast growth and cell shape in flight. to characterize fibronectin's role in these changes, quiescent osteoblasts were sera activated in microgravity with or without a 1-G gravity field. After activation and collection in spaceflight, samples were analyzed on ground. We were able to measure both transcription and translation of extracellular matrix genes in flown 0-g, 1-g conditions and in ground samples.
Author

Bones; Gravitational Fields; Protein Synthesis; Weightlessness

20000020526 NASA Ames Research Center, Moffett Field, CA USA

Effects of Spaceflight on Bone: The Rat as an Animal Model for Human Bone Loss

Halloran, B., California Univ., USA; Weider, T., California Univ., USA; Morey–Holton, E., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 209-210; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The loss of weight bearing during spaceflight results in osteopenia in humans. Decrements in bone mineral reach 3-10% after as little as 75-184 days in space. Loss of bone mineral during flight decreases bone strength and increases fracture risk. The mechanisms responsible for, and the factors contributing to, the changes in bone induced by spaceflight are poorly understood. The rat has been widely used as an animal model for human bone loss during spaceflight. Despite its potential usefulness, the results of bone studies performed in the rat in space have been inconsistent. In some flights bone formation is decreased and cancellous bone volume reduced, while in others no significant changes in bone occur. In June of 1996 Drs. T. Wronski, S. Miller and myself participated in a flight experiment (STS 78) to examine the effects of glucocorticoids on bone during weightlessness. Technically the 17 day flight experiment was flawless. The results, however, were surprising. Cancellous bone volume and osteoblast surface in the proximal tibial metaphysis were the same in flight and ground-based control rats. Normal levels of cancellous bone mass and bone formation were also detected in the lumbar vertebrae and femoral neck of flight rats. Furthermore, periosteal bone formation rate was found to be identical in flight and ground-based control rats. Spaceflight had little or no effect on bone metabolism! These results prompted us to carefully review the changes in bone observed in, and the flight conditions of previous spaceflight missions.
Author

Bone Demineralization; Bone Mineral Content; Losses; Metabolism; Tibia; Weightlessness

20000020528 Connecticut Univ., Health Center, Farmington, CT USA

Transgenic Markers of Lineage Progression in Mechanically Loaded Bones

Kalajic, I.; Terzic, J.; Mack, K.; Visnjic, D.; Mapta, A.; Gronowicz, G.; Clark, S.; Yeh, J.; Rowe, D.; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 214; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Bone formation and remodeling reflects the control of recruitment of osteo-progenitor cells to preosteoblasts, osteoblasts and osteocytes. These same cells also modify the osteoclast pathway. As a first step of appreciating the osteoprogenitor pathway, we have developed transgenic mice expressing a marker gene (CAT or GFP) under control of fragments of the COL1A1 promoter. This promoter appears to have a modular organization such that fragments can be utilized to produce transcriptional activity that is restricted to various connective tissues. As expressed in bone, Col3.6CAT is active in osteoblasts, periosteal cells and osteocytes, but not vascular smooth muscle cells, while the activity of Col2.3CAT is restricted to mature osteoblast. Preliminary data suggests that the pOBCol3.6CAT and pOBCol3.6GFP activity is restricted to the preosteoblast. The advantage of using transgenes to assess osteoblastic activity has been demonstrated in the OIM mouse. This model of human OI has high bone turnover due to defective matrix production as judged by diminished bone volume, low bone formation but high mRNA levels for Col1A1, BSP and OC extracted from OIM bone and high urinary excretion of DPD crosslinks. The ColCAT3.6 transgene was bred into the OIM line and its enzymatic and mRNA level assessed in the three genotypes. There was excellent correlation between the enzyme activity and mRNA levels facilitating easy assessment of osteoblastic activity in intact bone. Relative to the +/+ littermates, the CAT activity was increased 4x in oim/oim and 2x in the oim/+ mice. This contrasts with less than a 2x increase in endogenous mRNA levels of Col1A1, BSP or OC in the oim/oim mice and no significant increase in the oim/+ genotype. The CAT levels are highly

reflective of bone formation rates characteristic of growing and mature mice and demonstrate that in growing oim/oim mice maximal bone formation cannot exceed that of normal mice. This may explain why bone fractures are highest in rapidly growing children. The osteoprogenitor lineage cannot meet the concomitant demand of high turnover inherent to OI and the additional demand for longitudinal skeletal growth.
Derived from text
Bone Demineralization; Cardiovascular System; Crosslinking; Defects; Enzyme Activity; Musculoskeletal System; Physical Exercise

20000020529 Yale Univ. School of Medicine, Section of Plastic Surgery, New Haven, CT USA
Common Molecular Events by Hormones and Mechanical Strain Regulate Insulin-Like Growth Factor-1 Expression in Osteoblasts
McCarthy, T. L., Yale Univ. School of Medicine, USA; Chen, Y., Yale Univ. School of Medicine, USA; Ji, C., Yale Univ. School of Medicine, USA; Centrella, M., Yale Univ. School of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 215-217; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Mechanical load, hormones and growth factors control bone metabolism in vivo and in vitro. Often, small changes in any of these elements can disrupt balanced bone remodeling and skeletal integrity. Because mechanical load helps to maintain bone mass, bone integrity can diminish from disuse or loss of mechanical stimulation in microgravity. Insulin-like growth factor-I (IGF-I) is an important skeletal growth factor. Expression of IGF-I by osteoblasts is increased by activators of protein kinase A (PKA) like parathyroid hormone (PTH) or prostaglandin E(sub 2) (PGE(sub 2)). PGE(sub 2) is made by bone cells in response to certain hormones or mechanical load. We previously showed an important role for IGF-I on collagen matrix synthesis in coupled bone remodeling induced by PTH. In support of this, recent in vivo studies indicate that anabolic effects of PTH or its analogs occur by way of CAMP. Furthermore, a direct correlation between bone mass and serum IGF-I levels was noted in middle aged men with idiopathic osteoporosis, and among inbred strains of mice with significant differences in bone density. Whereas serum IGF-I principally derives from liver, a general decrease in the capability to express IGF-I also may be imposed on skeletal cells. This in effect produces a resistance to normal control mechanisms that occur in response to hormones and mechanical strain. Microgravity is thought to decrease bone formation without significantly altering resorption. Several research groups have predicted that loss of mechanical strain in microgravity may alter the synthesis or activity of local bone growth factors within the skeleton. Consistent with the quick induction of IGF-I by CAMP inducing hormones, work from the Chambers lab identified IGF-I as an early response gene stimulated by short duration compressive strain. Indomethacin, an inhibitor of PGE(sub 2) synthesis, blocked both the induction of IGF-I and the subsequent increase in skeletal collagen synthesis. These results indicate a key role for both factors in the anabolic response of the skeleton to mechanical loading. We recently defined a molecular link among cAMP, PKA, and IGF-I in hormone activated osteoblasts, predicting that shared mechanisms and downstream effectors may function in both hormone and strain activated IGF-I expression, which then directly influence new collagen synthesis and bone formation.
Author
Molecular Biology; Hormone Metabolisms; Insulin; Osteoporosis; Bones; Loads (Forces); Musculoskeletal System

20000020531 Saint Louis Univ. School of Medicine, Dept. of Pharmacological and Physiological Science, Saint Louis, MO USA
Developmental Regulation of the Collagenase-3 Promoter in Osteoblasts
Partridge, N. C., Saint Louis Univ. School of Medicine, USA; Yang, Y., Saint Louis Univ. School of Medicine, USA; DAlonzo, R. C., Saint Louis Univ. School of Medicine, USA; Winchester, S. K., Saint Louis Univ. School of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 222-223; In English
Contract(s)/Grant(s): NCC2-884; NAGW-4538; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Previously, we have shown that collagenase-3 MRNA is developmentally expressed in normal, differentiating rat osteoblasts. In vivo, the gene is expressed in a tissue-specific fashion in hypertrophic chondrocytes and osteoblasts and developmentally regulated. Our studies aim at determining the promoter elements and proteins binding to the promoter responsible for tissue and developmental regulation of collagenase-3.
Author
Cells (Biology); Bones; Collagens

20000020537 Mayo Clinic, Dept. of Orthopedics, Rochester, MN USA
Altered Bone Cell Metabolism During Spaceflight
Turner, Russell T., Mayo Clinic, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 236-238; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

My laboratory performs research which is directed toward understanding the cellular and molecular mechanisms by which mechanical usage influences bone mass, architecture and turnover. The goal of this research is to develop countermeasures to prevent disuse-induced bone fractures.

Author

Abnormalities; Bone Demineralization; Cells (Biology); Countermeasures; Research; Losses; Musculoskeletal System; Steady State

20000020543 Baylor Coll. of Medicine, Houston, TX USA

Direct Cloning of Genes Regulated by Mechanical Load

Abdellatif, M., Baylor Coll. of Medicine, USA; Schneider, M. D., Baylor Coll. of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 257; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

In an attempt to identify genes that are regulated during pressure overload hypertrophy; we resorted to subtraction hybridization between hearts from sham operated and aortically banded mice. In parallel, we also performed a subtraction between an adult and a neonatal heart, for comparison of pressure overload-induced and normal growth of the heart. This led to the identification of several known (75%) and unknown (25%) genes that were upregulated during both normal and pathological growth of the heart. In general, about 50 % of the known genes belong to one of three functional groups. I- Genes related to transcription, such as: histone H2A.Z, cardiac ankyrin-repeat protein (CARP), Bop2, high mobility group 2, and CDC 10.2- Genes related to translation, such as: quaking protein, p68 RNA helicase, mitochondrial rRNA and tRNA, ribosomal proteins L23a, L7a, S18, and L3, Heterogenous ribonucleoprotein C and F, elongation factor 1-alpha, and RNA helix-destabilizing protein. 3-Genes related to the cytoskeleton and regulation of its structure, such as: thymosin beta-4, Pr22, Cyr6l, desmin, OSF- 2, collagen, Mena+, tropoelastin, and integrin-linked kinase. The remainder of the genes included, approx. 25% repeats of the known genes and approx. 25% of genes belonging to other functional groups, which included the Ras related signaling molecule, RaplB, whose function is still unclear. While all genes tested by Northern analysis, were expressed at higher levels in both neonatal and hypertrophy hearts versus normal adult heart, the CARP was one exception that was upregulated during hypertrophy but had lower levels in the neonatal compared to the adult heart. In general, the subtraction method helped identify several genes, previously unknown for their role in hypertrophy, and some previously unknown even for their presence in the heart, such as the extra-cellular matrix protein, osteoblast specific factor-2. It also helped identify novel cardiac isoforms, as in the case of the quaking protein. The functional role of these genes in hypertrophy await further investigation.

Author

Cloning (Biology); Genes; Loads (Forces); Heart; Bones

20000020545 Johns Hopkins Medical Institutions, Dept. of Anesthesiology, Baltimore, MD USA

Vascular Reactivity in a Rat Model of Microgravity

Berkowitz, Dan E., Johns Hopkins Medical Institutions, USA; Marucci, Leo, Johns Hopkins Medical Institutions, USA; Asplund, Esther, Johns Hopkins Medical Institutions, USA; Winters, Bradford, Johns Hopkins Medical Institutions, USA; Szumski, Annette, Johns Hopkins Medical Institutions, USA; Nyhan, Daniel, Johns Hopkins Medical Institutions, USA; Shoukas, Artin, Johns Hopkins Medical Institutions, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 259; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Orthostatic intolerance in a major problem following exposure to prolonged bedrest and microgravity. The etiology of attenuated cardiac output (CO) and blood pressure (BP) responses is incompletely understood. Normal or accentuated norepinephrine (NE) response to an orthostatic challenge suggest that the abnormality may be in the end organ (vessels). to test the hypothesis that changes in vascular reactivity may be responsible for hypotension in vitro vessels responses were studied in vessel rings from normal and hind-limb unweighted (HLU) rats. Although the model is well accepted ground based model of microgravity we have verified in chronically instrumented rats (aortic flow probe and arterial line), that redistribution of blood volume/orthostatic stress (70 deg tilt) results in appropriate baroreceptor mediated responses (approx. 10% decrease in CO, approx. 8% increase in BP and approx. 5 - 10% increase in heart rate). Animals were euthanized following 21 days of HLU and 5mm aortic rings (just below the aortic arch), renal (500 mm), carotid and femoral arteries were harvested and placed in vessels chambers containing Krebbs solution. Dose responses to KCL and NE, phenylephrine (PE), U46619 (U4) (thromboxane analogue) were performed in 1/2 log doses. The starting diameter of the vessel rings was similar in all animals. There was a significant rightward shift in the KCl, NE, PE and U4 dose response with a decrease in the maximal response in aortic rings. While renal artery responses to KCL were similar, there were accentuated responses to alpha-1 AR agonists NE and PE in HLU animals. There are significant differences in the EC50 to agonists between carotid and femoral arteries but no differences between control and HLU animals has been demonstrated. Radioligand binding of [125I] HEAT, an alpha-1 AR specific ligand to membranes

prepared from rat aorta showed a approx. 60% reduction in receptor number in HLU animals. The change in both receptor dependent and independent contractile activity in aorta suggests that the vascular abnormality observed may be secondary to abnormalities of Ca(2+) mobilization or may represent abnormalities in the contractile machinery involved in excitation contraction coupling. (e.g. vessel atrophy). The reduction in alpha-1 AR receptor number may suggest a mechanism. This is provocative in light of the attenuated sympathetic traffic observed during microgravity/bedrest exposure, and the importance of NE in smooth muscle hypertrophy. The increase in alpha-1 AR specific responses in renal arteries suggests differential regulation of alpha-1 AR's in different vascular beds.
Author
Cardiovascular System; Microgravity; Bed Rest; Blood Pressure; Blood Volume; Cardiac Output; Attitude (Inclination); Physiological Responses

20000020552 Missouri Univ., Dept. of Veterinary Biomedical Sciences, Columbia, MO USA
Mechanisms Underlying Altered Arterial Baroreflex Function in Hindlimb Unloaded Rats
Hasser, E. M., Missouri Univ., USA; Moffitt, J. A., Missouri Univ., USA; Cunningham, J. T., Missouri Univ., USA; Heesch, C. M., Missouri Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 279-281; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Following prolonged periods of exposure to microgravity subjects experience a number of adverse cardiovascular consequences, including orthostatic intolerance. Several possible mechanisms could account for this orthostatic intolerance, including alterations in body fluid volumes, changes in vascular or cardiac responsiveness, and alterations in reflex control of the circulation. Normally, the primary adjustments to an orthostatic challenge require arterial baroreflex mediated increases in peripheral resistance, which are elicited through activation of the sympathetic nervous system to the the vasculature. We therefore hypothesized that hindlimb unloading to simulate exposure to microgravity in rats would result in attenuated baroreflex control of the sympathetic nervous system. A corollary hypothesis was that reflex control of sympathetic nerve activity to the viscera and to skeletal muscle would be impaired in a differential manner. We therefore conducted studies to evaluate arterial baroreflex control of renal (RSNA) and lumbar sympathetic nerve activity (LSNA) following hindlimb unloading in conscious rats. Additional experiments were carried out to evaluate the afferent and/or central nervous system mechanisms involved in alterations in baroreflex function.
Author
Activity (Biology); Afferent Nervous Systems; Arteries; Body Fluids; Cardiovascular System; Musculoskeletal System; Reflexes

20000020553 Oregon Health Sciences Univ., Div. of Nephrology and Hypertension, Portland, OR USA
Dietary Calcium, Blood Pressure and Vascular Function Following Space Flight
Hatton, D., Oregon Health Sciences Univ., USA; McCarron, D., Oregon Health Sciences Univ., USA; Yue, Q., Oregon Health Sciences Univ., USA; Roullet, C., Oregon Health Sciences Univ., USA; Xue, H., Oregon Health Sciences Univ., USA; Otsuka, K., Oregon Health Sciences Univ., USA; Chapman, J., Oregon Health Sciences Univ., USA; Phanouvong, T., Oregon Health Sciences Univ., USA; Roullet, J., Oregon Health Sciences Univ., USA; Watanabe, M., Oregon Health Sciences Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 282; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Deficits in calcium intake are associated with increased blood pressure, decreased bone mineralization and impaired calcium metabolism. Calcium losses due to exposure to microgravity may result in a similar constellation of outcomes.
Author
Calcium Metabolism; Blood Pressure; Microgravity; Diets; Bone Demineralization

20000020561 California Univ., Coll. of Medicine, Irvine, CA USA
Peripheral Vascular Hyporesponsiveness and Elevated Cerebrovascular Myogenic Tone in Simulated Microgravity: Role of Nitric Oxide-Dependent and -Independent Mechanisms
Purdy, R. E., California Univ., USA; Ding, Y., California Univ., USA; Duckles, S. P., California Univ., USA; Geary, G. G., California Univ., USA; Krause, D. N., California Univ., USA; Vaziri, N. D., California Univ., USA; Sangha, S. D., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 300-302; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Microgravity was simulated in the present study using hindlimb unweighting (HU) in rats. We have shown previously that 20 days of HU causes hyporesponsiveness of peripheral arteries to norepinephrine (NE; 1). This was explored further by investigating the role of both nitric oxide dependent and independent mechanisms. Reduced contraction to NE can be due to up-regulation of a vasodilator mechanism, for example, increased activity of either endothelial constitutive nitric oxide synthase

(ecNOS) or inducible nitic oxide synthase (iNOS). Such changes were studied in the carotid and femoral arteries. Reduced contraction to NE may also be caused by a decrease in coupling at one or more steps between alpha adrenoceptor stimulation and activation of the contractile apparatus. Coupling was studied in the abdominal aorta in which nitric oxide mechanisms have been shown to have no role in HU-mediated hyporesponsiveness to NE (1). In both real and simulated microgravity, there is an acute cephalad fluid shift and an increase in cerebral perfusion pressure. Adaptation to this increased pressure was studied using isolated middle cerebral arteries from control and HU rats (2). Myogenic tone was increased in HU vessels, consistent with the development of a protective mechanism to prevent overperfusion of the brain vasculature. It is suggested (see Discussion) that peripheral vascular hyporesponsiveness and elevated cerebrovascular myogenic tone interact synergistically to cause postural intolerance.
Author
Cardiovascular System; Microgravity; Stimulation; Cerebrum; Brain Circulation; Adaptation

20000020562 Texas Univ., Rogers Magnetic Resonance Center, Dallas, TX USA
Myocardial Performance and Metabolism in Mice With a Null Mutation in Cytochrome C Oxidase Subunit VIAH
Radford, N. B., Texas Univ., USA; Wan, B., Texas Univ., USA; Szczepaniak, L., Texas Univ., USA; Babcock, E. E., Texas Univ., USA; Richman, A., Texas Univ., USA; Storey, C. S., Texas Univ., USA; Li, J. L., Texas Univ., USA; Li, K., Texas Univ., USA; Moreadith, R. W., Texas Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 303-304; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Several lines of evidence suggest that cytochrome c oxidase (COX) subunit VIaH may modulate COX activity, thus exerting regulatory control over oxidative energy production with potential consequences for myocardial mechanical performance. to test this hypothesis in the intact heart, a murine line with a null mutation in COXVIaH was created and an assessment of systolic, diastolic and metabolic performance was made.
Author
Myocardium; Metabolism; Mice; Cytochromes

20000020570 Baylor Coll. of Medicine, Houston, TX USA
Determination of Whether Immune Clearance and Protection From Mucosal Virus Infection are Altered in Ground-Based Mouse Models of Space Flight
Conner, M. E., Baylor Coll. of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 329-330; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We are using anti-orthostatic suspension of mice to determine whether the mucosal immune system is adversely affected in this ground-based model of space flight. Although this model does not simulate all aspects of space flight, it is an accepted ground-based model for studies on a number of parameters including alterations of the immune system. We will utilize rotavirus and the well-characterized immune response to rotavirus in different mouse strains. The effect of space flight or anti-orthostatic suspension on the immune system has been established by examining isolated aspects of the immune system by the use of soluble protein antigens or mitogens or by using viruses or bacteria that establish systemic infections. In all studies, systemic but not mucosal immune responses were evaluated. It is important to evaluate the mucosal response, as -80% of all pathogens invade across mucosal surfaces, so it is the first line of an immunological defense. Many important pathogens, including viruses that cause respiratory and gastrointestinal diseases, produce localized infections at mucosal surfaces.
Author
Immunity; Viruses; Bacteria; Diseases; Physiological Responses; Protection

20000020572 Southern Univ., Dept. of Chemistry, Baton Rouge, LA USA
New Stratetgies for the Detection of E.Coli
Elayan, N., Southern Univ., USA; Xu, Y., Southern Univ., USA; Theegala, C., Southern Univ., USA; Suleiman, A., Southern Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 334; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Conventional methods for the detection and determination of bacteria involve incubation and culturing techniques, which are tedious and time consuming. Methodologies were or are being evaluated utilizing antibodies in conjunction with piezoelectric, electro-chemical, fiberoptic, and membrane-based sensors.
Author
Procedures; Detection; Bacteria; Antibodies

20000020575 NASA Johnson Space Center, Houston, TX USA

Latent Viruses: A Space Travel Hazard??

Ling, P. D., Baylor Coll. of Medicine, USA; Peng, R. S., Baylor Coll. of Medicine, USA; Pierson, D., NASA Johnson Space Center, USA; Lednicky, J., Baylor Coll. of Medicine, USA; Butel, J. S., Baylor Coll. of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 338-339; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

A major issue associated with long-duration space flight is the possibility of infectious disease causing an unacceptable medical risk to crew members. Our proposal is designed to gain information that addresses several issues outlined in the Immunology/Infectious disease critical path. The major hypothesis addressed is that space flight causes alterations in the immune system that may allow latent viruses which are endogenous in the human population to reactivate and shed to higher levels than normal which can affect the health of crew members during a long term space-flight mission. We will initially focus our studies on the human herpesviruses and human polyomaviruses which are important pathogens known to establish latent infections in the human population. Both primary infection and reactivation from latent infection with this group of viruses can cause a variety of illnesses that result in morbidity and occasionally mortality of infected individuals. Effective vaccines exist for only one of the eight known human herpesviruses and the vaccine itself can still reactivate from latent infection. Available antivirals are of limited use and are effective against only a few of the human herpesviruses. Although most individuals display little if any clinical consequences from latent infection, events which alter immune function such as immunosuppressive therapy following solid organ transplantation are known to increase the risk of developing complications as a result of latent virus reactivation. This proposal will measure both the frequency and magnitude of viral shedding and genome loads in the blood from humans participating in activities that serve as ground based models of space flight conditions. Our initial goal is to develop sensitive quantitative competitive PCR- based assays (QC-PCR) to detect the herpesvirus Epstein-Barr virus (EBV), and the polyomaviruses SV40, BKV, and JCV. Using these assays we will establish baseline patterns of viral genome load in the blood and viral shedding from normal volunteers in a longitudinal study over I year in length. As a comparison, we will measure patterns of viral genome loads and shedding from individuals who are severely immunosuppressed, in whom herpesvirus reactivation or primary infection with a herpesvirus is known to cause complications. In addition, we will proceed to testing ground based analogs in collaboration with Dr. Duane Pierson (Lyndon B. Johnson Space Center). This will include measuring samples obtained from individuals living and working in the extreme environment of Antarctica. We expect to detect viral shedding or reactivation from most of the test groups, although the magnitude of shedding or reactivation cannot be predicted. The data accumulated from studies in this proposal should allow us to evaluate whether events that simulate certain aspects of space flight reactivate viral infections severe enough in nature that they may compromise the success of long-term space flight missions. These studies will also provide a foundation to monitor viral reactivation and shedding from crew members participating in actual space flight missions. We will present data showing the establishment of our QC-PCR assay for detection of EBV.

Derived from text

Flight Conditions; Hazards; Health; Infectious Diseases; Immunology; Long Duration Space Flight; Viral Diseases

20000020576 Montana State Univ., Dept. of Microbiology, Bozeman, MT USA

Rapid Assessment of Bacterial Activity in Spacecraft Water Systems

Lisle, John T., Montana State Univ., USA; Pyle, B. H., Montana State Univ., USA; Broadway, S. C., Montana State Univ., USA; McFeters, G. A., Montana State Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 340; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Maintaining and monitoring the microbiological quality water supplies on the shuttle and space station is imperitive for crew health. to achieve these goals, rapid methods for the detection of bacteria that may indicate the presence of a health threat or deterioration of water quality are needed. We have used fluorescent antibodies, in conjunction with a suite of intracellular fluorescent stains, to identify the drinking water quality indicator and pathogen Escherichia coli and assess its physiological activity at the level of a single cell. This approach was used to assess the influence of starvation on physiological activity based upon membrane potential (Rh l23), membrane integrity (LIVE/DEAD BacLight kit), respiratory activity (CTC) and intracellular esterase activity (Scan RDI). Each assay was performed in less than one hour. Growth dependent assays were also used to assess substrate responsiveness (DVC), ATP activity (MicroStar) and culturability (R2A agar). This study demonstrates this suite of stains can rapidly assess multiple indices of physiological activity allowing decisions to be made concerning the microbiological quality of spacecraft water in a more timely fashion relative to traditional culture-based methods.

Author

Activity (Biology); Antibodies; Detection; Deterioration; Escherichia; Health; Potable Water; Supplying; Water Quality

20000020577 Rice Univ., Inst. of Biosciences and Bioengineering, Houston, TX USA

Gene Regulation by Mechanical Forces in Vascular Cells

McIntire, Larry V., Rice Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 341-342; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Exposure of endothelial cells to shear stress in vitro produces marked alteration in cell morphology, consistent with the proposed in vivo role of shear stress. Moreover, shear stress- mediated regulation of endothelial gene expression has been demonstrated for proteins with key roles in maintaining homeostasis, cell migration, and in cell growth. It has been recently suggested that vascular smooth muscle cells (VSMC) may also be responsive to shear stress. In vivo studies of VSMC growth rates after balloon catheter injury have demonstrated an inverse correlation between growth rates and calculated shear stress forces. In vitro studies have confirmed the in vivo observations and demonstrated that the synthesis of transforming growth factor-(beta)1 (TGF-(beta)1), tissue plasminogen activator (tPA), heme oxygenase- 1, nitric oxide, and prostaglandins increased under shear stress. Consistent with these observations, modeling studies supported the concept that VSCM in the normal vasculature are exposed to significant shear stresses, in the order of 1-10 dyn/ sq cm, due to interstitial fluid flow driven by transmural pressure gradients. On the basis of these findings, the present study was designed to determine whether shear stress also mediates gene expression in VSMC, ultimately leading to the pathologic proliferation of VSMC at sites of disturbed blood flow in the vasculature and perhaps control of vessel wall homeostasis under normal physiological conditions. The human protease activated receptor-1 (PAR-1) gene was chosen because: 1) PAR-1 expression is known to be increased dramatically after experimental injury in animal models, after percutaneous transluminal coronary angioplasty in patients and in human atherosclerosis and 2) the known roles of thrombin on VSMC function and proliferation state can be modulated by regulation of PAR-1 expression.

Author

Arteriosclerosis; Blood Flow; Cardiovascular System; Catheterization; Cell Division; Homeostasis; Shear Stress; Gene Expression

20000020580 NASA Johnson Space Center, Houston, TX USA

Reactivation of Latent Viruses in Space

Pierson, D. L., NASA Johnson Space Center, USA; Mehta, S. K., Enterprise Advisory Services, Inc., USA; Tyring, S. K., Texas Univ., USA; Lugg, D. J., Australian Antarctic Div., Australia; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 348-349; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Reactivation of latent viruses is an important health risk for people working and living in physically isolated extreme environments such as Antarctica and space. Preflight quarantine does not significantly reduce the risk associated with latent viruses, however, pharmaceutical countermeasures are available for some viruses. The molecular basis of latency is not fully understood, but physical and psychosocial stresses are known to initiate the reactivation of latent viruses. Presumably, stress induced changes in selected hormones lead to alterations in the cell- mediated immune (CMI) response resulting in increased shedding of latent viruses. Limited access to space makes the use of ground-based analogs essential. The Australian Antarctic stations serve as a good stress model and simulate many aspects of space flight. Closed environmental chambers have been used to simulate space flight since the Skylab missions and have also proven to be a valuable analog of selected aspects of space flight.

Author

Viruses; Space Flight; Closed Ecological Systems; Contamination; Health; Physiological Responses

20000020581 Montana State Univ., Dept. of Microbiology, Bozeman, MT USA

Bacterial Biofilms in Microgravity

Pyle, Barry H., Montana State Univ., USA; Broadaway, S. C., Montana State Univ., USA; Johnsrud, C. K., Montana State Univ., USA; Storfa, R. T., Montana State Univ., USA; McFeters, G. A., Montana State Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 350; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Human life support systems planned for future long-term space flight missions will require high quality water to minimize the risk of infectious disease and system deterioration. It has been demonstrated that some bacteria may grow more rapidly and can become less susceptible to antimicrobial agents under conditions of microgravity. Also, humans suffer immunosuppression with prolonged space flight. This study was planned to determine the effect of spaceflight and microgravity on biofilm formation by waterborne bacteria and the efficacy of iodine in preventing biofouling. A strain of Burkholderia cepacia, which had been isolated from a NASA Shuttle Orbiter water system, was used to represent oligotrophic bacteria which are likely to be found in water treatment and distribution systems on spacecraft. The results indicated that B. cepacia can form biofilms in a weightless

environment. Thus, disinfection and management of spacecraft water systems must take into account the well-known difficulties of controlling attached bacteria.
Author
Bacteria; Microgravity; Microorganisms; Water Treatment; Water Management; Weightlessness; Deterioration; Antiinfectives and Antibacterials

20000020584 NASA Johnson Space Center, Houston, TX USA
Lytic Replication of Epstein-Barr Virus During Space Flight
Stowe, R. P., Texas Univ., USA; Pierson, D. L., NASA Johnson Space Center, USA; Barrett, A. D. T., Texas Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 356; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Reactivation of latent Epstein-Barr virus (EBV) may be an important threat to crew health during extended space missions. Cellular immunity, which is decreased during and after space flight, is responsible for controlling EBV replication in vivo. In this study, we investigated the effects of short-term space flight on latent EBV reactivation.
Author
Health; Viruses; Hazards

20000020585 Beth Israel Deaconess Medical Center, Lab. for Cell and Molecular Biology, Boston, MA USA
Inhibition of Erythropoiesis in Simulated Microgravity
Sytkowski, A. J., Beth Israel Deaconess Medical Center, USA; Davis, K. L., Beth Israel Deaconess Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 357; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The microgravity conditions experienced in space flight have been show to have adverse effects on hematopoietic cells leading to anemia and reduced immune responsiveness. The cellular basis for these effects is unknown. We have now begun to investigate potential mechanisms responsible for the reduced erythropoiesis encountered in microgravity.
Author
Microgravity; Simulation; Hematopoietic System

20000020587 California Univ., Dept. of Physiology and Biophysics, Irvine, CA USA
Myosin Heavy Chain Gene Expression in Developing Neonatal Skeletal Muscle: Involvement of the Nerve, Gravity, and Thyroid State
Baldwin, K. M., California Univ., USA; Adams, G., California Univ., USA; Haddad, F., California Univ., USA; Zeng, M., California Univ., USA; Qin, A., California Univ., USA; Qin, L., California Univ., USA; McCue, S., California Univ., USA; Bodell, P., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 363-364; In English
Contract(s)/Grant(s): NAG2-942; NIH-NS-33483; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The myosin heavy chain (MHC) gene family encodes at least six MHC proteins (herein designated as neonatal, embryonic, slow type I (beta), and fast IIa, IIx, and IIb) that are expressed in skeletal muscle in a muscle-specific and developmentally-regulated fashion. At birth, both antigravity (e.g. soleus) and locomotor (e.g., plantaris) skeletal muscles are undifferentiated relative to the adult MHC phenotype such that the neonatal and embryonic MHC isoforms account for 80 - 90% of the MHC pool in a fast locomotor muscle; whereas, the embryonic and slow, type I isoforms account for approx. 90% of the pool in a typical antigravity muscle. The goal of this study was to investigate the role of an intact nerve, gravity and thyroid hormone (T3), as well as certain interactions of these interventions, on MHC gene expression in developing neonatal skeletal muscles of rodents.
Author
Gene Expression; Musculoskeletal System; Thyroid Gland; Gravitation; Antigravity

20000020588 Baylor Coll. of Medicine, Houston, TX USA
Ectopic Expression of Porcine HV-GHRH by a Synthetic Myogenic Vector Elicits Enhanced GH and IGF-1 Secretion and Animal Growth
Akli–Draghia, Ruxandra, Baylor Coll. of Medicine, USA; Deaver, Daniel R., Pennsylvania State Univ., USA; Fiorotto, Marta L., Baylor Coll. of Medicine, USA; Schwartz, Robert J., Baylor Coll. of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 368; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The tremendous importance of growth hormone stimulating therapies for growth, geriatric associated pathology, or to prevent muscle atrophy in microgravity environments provides a strong incentive to develop myogenic vector systems to drive the expression of peptides like growth hormone releasing hormone (GHRH), strong upstream stimulator of GH.
Author
Geriatrics; Growth; Microgravity; Muscles; Pituitary Hormones

20000020596 Texas A&M Univ., Muscle Biology Lab., College Station, TX USA
Intracellular Calcium Transients in Mouse Soleus Muscle After Hindlimb Unloading and Reloading
Ingalls, C. P., Texas A&M Univ., USA; Warren, G. L., Texas A&M Univ., USA; Armstrong, R. B., Texas A&M Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 385; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Unloading of the antigravity skeletal muscles by space flight or hindlimb suspension initiates a rapid and significant loss of skeletal muscle mass and strength. Furthermore, skeletal muscles atrophied by unloading have an increased susceptibility to contraction-induced muscle injury, so reloading of these muscles may compound existing mass and strength deficits. The mechanisms responsible for the reductions in skeletal muscle mass and strength following unloading and subsequent reloading are not fully understood. The objective of this study was to determine if altered intracellular Ca(2+) handling contributes to the force loss in the soleus muscle after unloading and/or subsequent reloading of mouse hindlimbs.
Author
Calcium; Cells (Biology); Transient Response; Muscles; Antigravity

20000020597 Presbyterian Hospital of Dallas, Dallas, TX USA
Impaired Utilization of Exogenous Substrates by Rat Skeletal Muscle After Hindlimb Suspension
Lujan, B. F.; Bertocci, L. A.; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 386-387; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Chronic exposure to the microgravity of spaceflight causes severe skeletal muscle atrophy. Although much is known about the structural consequences of this atrophy, the metabolic effects of this atrophy are much more ambiguous: literature reports of the effects of disuse atrophy on the activities of many of the enzymes involved in exercise metabolism, and the linkage of these changes to indices of the patterns of substrate utilization, are quite contradictory. We speculated that this was due in part to methodological limitations. to address this, we used a combination of H-1 and C-13 nuclear magnetic resonance (NMR) spectroscopy plus a carefully controlled animal model to assess the effect of severe disuse atrophy on the relative utilization of exogenous and endogenous oxidizable substrate in resting versus contracting rat hindlimb muscle.
Author
Utilization; Rats; Physical Exercise; Musculoskeletal System; Metabolism; Enzymes; Limbs (Anatomy)

20000020598 Baylor Coll. of Medicine, Houston, TX USA
Alterations in Neuromuscular Junctions Associated with Muscle Atrophy Induced by Hindlimb Unloading
Mosier, D. R., Baylor Coll. of Medicine, USA; Siklos, L., Baylor Coll. of Medicine, USA; Gooch, C. L., Baylor Coll. of Medicine, USA; Gordon, S., Texas Univ. Health Science Center, USA; Booth, F. W., Texas Univ. Health Science Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 388-389; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Many alterations in motor unit structure and function occur with exposure to microgravity during spaceflight, and could lead to impairment of motor performance. In particular, morphologic changes suggestive of denervation and remodeling have been reported at neuromuscular junctions in atrophying muscle, both in space-flown animals and in rodent models of limb immobilization. However, the anatomic extent and physiologic significance of these alterations is unclear. to begin to address these questions, we assayed neuromuscular junctions electrophysiologically using intracellular micropipette recordings and stimulated single-fiber electromyography, in parallel with electron microscopic studies of end-plates, in hindlimb muscles of ICR mice following a 3-week period of unloading by tail suspension.
Author
Neuromuscular Transmission; Atrophy; Unloading; Limbs (Anatomy); Electromyography

20000020602 California Univ., Dept. of Physiological Science, Los Angeles, CA USA
Mechanical and Inflammatory Components of Muscle Injury Following Modified Muscle Loading
Tidball, J. G., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 397-399; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The ability of personnel to function following space flight is limited by debilitating muscle weakness, pain, and inflammation that develop following return to gravitational loading. It has been proposed previously that muscle injury that occurs during muscle loading following periods of reduced loading can result from direct mechanical damage to the muscle or through the actions of inflammatory cells that invade the muscle during the reloading period, but these possibilities have not been tested experimentally. In this investigation, we are examining the contribution of inflammatory cells to muscle injury that occurs following modified muscle use and determining the mechanisms through which inflammatory cells induce muscle injury. We have used the rat hindlimb suspension model followed by muscle reloading by normal weight-bearing activity to examine muscle inflammation in vivo and employed co-cultures of specific inflammatory cell populations with rat muscle cells to perform further studies of the mechanisms of muscle cell injury. The goal of these studies is to characterize the specific inflammatory cell derived mediators of muscle injury during loading following periods of reduced loading, so that therapeutic approaches can be designed to reduce muscle injury following return to gravitational loading after space flight.
Author
Injuries; Muscles; Cells (Biology); Loads (Forces)

20000020603 Brown Univ., Dept. of Pathology, Providence, RI USA
Tissue Engineering Organs for Space Biology Research
Vandenburgh, H. H.; Shansky, J.; DelTatto, M.; Lee, P.; Meir, J.; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 400-401; In English
Contract(s)/Grant(s): NAG2-914; NAG2-1205; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Long-term manned space flight requires a better understanding of skeletal muscle atrophy resulting from microgravity. Atrophy most likely results from changes at both the systemic level (e.g. decreased circulating growth hormone, increased circulating glucocorticoids) and locally (e.g. decreased myofiber resting tension). Differentiated skeletal myofibers in tissue culture have provided a model system over the last decade for gaining a better understanding of the interactions of exogenous growth factors, endogenous growth factors, and muscle fiber tension in regulating protein turnover rates and muscle cell growth. Tissue engineering these cells into three dimensional bioartificial muscle (BAM) constructs has allowed us to extend their use to Space flight studies for the potential future development of countermeasures.
Author
Tissues (Biology); Musculoskeletal System; Atrophy; Microgravity; Culture Techniques

20000020634 California Univ., Lawrence Berkeley Lab., Life Sciences Div., Berkeley, CA USA
Comparison of Gamma and Iron Particle Irradiation Induced Remodeling of Extra Cellular Matrix in Murine Liver
Barcellos–Hoff, M. H., California Univ., Lawrence Berkeley Lab., USA; Wang, C., California Univ., Lawrence Berkeley Lab., USA; Ravani, S. A., California Univ., Lawrence Berkeley Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 480-482; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Cells in tissues exist in complex microenvironments that mediate phenotype and cell interactions. Microenvironments, which includes the insoluble extracellular matrix (ECM) and soluble cytokines, also modulate cellular response to stimuli, which in turn may modify the microenvironment. Our studies have demonstrated rapid and global remodeling of the microenvironment in irradiated murine mammary gland and have identified characteristics of the High ionizing high energy particles (HZE)-irradiated remodeling that are distinct from those following sparsely ionizing radiation. The hypothesis is that certain effects of HZE particles cause specific modifications of tissue microenvironment as compared to reference gamma-radiation. This in turn is postulated to contribute to the functional and carcinogenic cellular effects of HZE exposure. Identification of HZE-induced changes in the microenvironment will provide insight into how fundamental cellular effects are integrated into multicellular tissue responses. The goal of this study was to evaluate early (1 hr - 7 day) temporal and spatial changes in the composition of the irradiated liver microenvironment as a function of radiation quality and dose or particle fluence. Comparison of liver to mammary gland in terms of microenvironment remodeling may provide insight into mechanisms. Tissue-dependent changes are most likely to be the result of particular cellular response to radiation and may reveal specific mechanisms that underlie tissue sensitivity to radiation of various qualities important to the environment in space.
Author
Gamma Rays; Iron; Irradiation; Radiation Effects; Particle Energy; Exposure; Dosage

20000020636 California Univ., Lawrence Berkeley Lab., Life Sciences Div., Berkeley, CA USA
Proton Irradiation Alters Expression of FGF-2 In Human Lens Epithelial Cells
Blakely, E. A., California Univ., Lawrence Berkeley Lab., USA; Bjornstad, K. A., California Univ., Lawrence Berkeley Lab., USA; Chang, P. Y., California Univ., Lawrence Berkeley Lab., USA; McNamara, M. P., California Univ., Lawrence Berkeley

Lab., USA; Chang, E., California Univ., Lawrence Berkeley Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 484; In English
Contract(s)/Grant(s): NASA Order W-18758; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We are investigating a role for proton radiation-induced changes in FGF-2 gene expression as part of the mechanism(s) underlying lens cell injury. Radiation injury to the human lens is associated with the induction of cataract following exposure to protons.
Author
Proton Irradiation; Radiation Injuries; Cells (Biology); Epithelium

20000020637 SRI International Corp., Menlo Park, CA USA
Heavy Ion Induced Genetic Damage in Transgenic Animals
Chang, P. Y., SRI International Corp., USA; Lutze–Mann, L., New South Wales Univ., Australia; Walker, V., New York State Dept. of Health, USA; Torous, D., Litron Labs., USA; Winegar, R. A., SRI International Corp., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 485-487; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The radiation environment in space is complex in that it contains a variety of densely ionizing particles that are capable of producing DNA damage. The long-term radiation risks are dependent on the types of molecular injuries and the subsequent processing of these lesions. We are using transgenic mice containing lacz reporter genes in every cell to evaluate the tissuespecific responses at the molecular level after heavy particle radiation. The lacz target gene has also been introduced into p53 knockout transgenic mice to obtain animals that are either hemizygous (p53+/-lacZ) or nullizygous (p53-/-lacZ) with regard to their p53 status. The use of these animals allows us to evaluate the influence of p53 genetic background on radiation-induced genetic damage. We evaluated the induced lacZ mutation frequency (MF) in three tissues: liver, brain and spleen. Using the same animals, we also measured hprt in splenic lymphocytes and cytogenetic damage in erythrocytes.
Author
Heavy Ions; Genetics; Damage; Animals; Radiation Damage

20000020639 NASA Johnson Space Center, Houston, TX USA
NSBRI Radiation Effects: Carcinogenesis in Sprague-Dawley Rats Irradiated with Iron Ions, Protons, or Photons
Dicello, J. F., Johns Hopkins Univ., USA; Cucinotta, F. A., NASA Johnson Space Center, USA; Gridley, D. S., Loma Linda Univ., USA; Howard, S. P., Wisconsin Univ., USA; Novak, G. R., Johns Hopkins Univ., USA; Ricart–Arbona, R., Johns Hopkins Univ., USA; Strandberg, J. D., Johns Hopkins Univ., USA; Vazquez, M. E., Brookhaven National Lab., USA; Williams, J. R., Johns Hopkins Univ., USA; Zhang, Y., Johns Hopkins Univ., USA; Zhou, H., Johns Hopkins Univ., USA; Huso, D. L., Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 490-492; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Our ability to confidently develop appropriate countermeasures for radiations in space in terms of shielding and design of a spacecraft, the mission scenario, or chemoprevention is severely limited by the uncertainties in both the risk itself and the change in that risk with intervention. Despite the fact that the risk of carcinogenesis from exposures of personnel to radiations on long-term missions is considered one of the worst hazards in space, only a limited amount of in-vivo data exist for tumor induction from exposures to protons or energetic heavy ions (HZEs) at lower doses. The most extensive work remains the landmark study. for tumor development in the harderian gland of the mouse. The objective of this study is to characterize the level of risk for tumor induction in another relevant animal model. Subsequent experiments are designed to test the hypothesis that the level of risk can be reduced by pharmaceutical intervention in the promoting and progressing stages of the disease rather than in the initiating stage. The work presented here results from a cooperative effort on the part of investigators from two projects of the Radiation-Effects Team of the National Space Biomedical Research Institute (NSBRI). The collaborating projects are the Core Project which is investigating the risk of carcinogenesis in Sprague-Dawley rats and the Chemoprevention Project which is investigating the ability of Tamoxifen to reduce the number of malignant tumors in the irradiated animals. Research at the cellular and subcellular levels is being conducted in two other projects of the Radiation-Effects Team, Cytogenetics with J. R. Williams as Principal Investigator and Mutations from Repeated DNA Sequences. Results for these other projects also are being presented at this Workshop.
Author
Radiation Effects; Carcinogens; Rats; Iron; Irradiation; Ionizing Radiation; Photons; Protons; Countermeasures

20000020652 Johns Hopkins Univ., Oncology Center, Baltimore, MD USA
Cytogenetic Damage from Photons, Fe-Ions and Protons: Modulation by Dose-Rate and Cell Type
Williams, J. R., Johns Hopkins Univ., USA; Houming, Z., Johns Hopkins Univ., USA; Dicello, F. E., Johns Hopkins Univ., USA;

Zhang, Y., Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 528; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We examined the induction of chromosome damage in multiple cell types irradiated with graded acutely-delivered doses of photons, Fe-ions and protons. Further we have compared the effects of photons delivered at -50 Gy/hr to effects when irradiation is delivered at 0.25 Gy/hr.

Author

Cytogenesis; Damage; Photons; Iron; Metal Ions; Protons

20000020656 California Univ., Section of Neurobiology, Physiology and Behavior, Davis, CA USA

Gender Differences in the Responses of Rhesus Monkeys to 2G

Barger, L. K., California Univ., USA; Fuller, C. A., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 538-540; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Organisms exposed to alterations in the gravitational environment demonstrate several physiological and behavioral responses. Among the affected physiological systems is the Circadian Timing System (CTS). The CTS coordinates an animal's physiology and behavior, ensuring that the body is in the proper state for anticipated activities. We know from previous research that exposure to spaceflight affects the circadian rhythms of organisms ranging from unicells to primates. Different rhythms do not respond in the same fashion, producing an internal desynchronization between the various circadian rhythms. Desynchronization between internal rhythms may be linked to reduced capabilities in the performance of simple tasks and to psychological abnormalities. There is a preponderance of women among those treated for psychological disorders, including those linked to circadian dysfunction. This has been attributed to various physiological, psychological and sociological differences, but no innate underlying cause has yet been proved. Moreover, women now form a substantial part of the space research program and are frequent space travelers. Therefore, it is important to characterize the responses of females to an altered force environment. We undertook this study to elucidate the response of multiple physiological and behavioral circadian rhythms of a non-human primate to an altered force environment. Male and female responses to chronic centrifugation were characterized and examined for gender differences. Additionally, when studying the circadian rhythms of females, menstrual cyclicity may play a major role. It has been shown that reproductive cyclicity has a significant influence on the regulation of circadian rhythms in rodents. An extensive study had not been undertaken using a menstrual animal such as the Rhesus monkey (Macaca mulatta) as a biomedical model. It was important to define the cycling status of our female subjects and examine the effects of menstrual cyclicity on physiological and behavioral circadian rhythms in female Rhesus monkeys before beginning the chronic centrifugation study.

Author

Abnormalities; Circadian Rhythms; Exposure; Monkeys; Physiological Responses

20000020671 NASA Ames Research Center, Moffett Field, CA USA

Biona-C Cell Culture pH Monitoring System

Friedericks, C., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 576; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Sensors 2000! is developing a system to demonstrate the ability to perform accurate, real-time measurements of pH and CO2 in a cell culture media in Space. The BIONA-C Cell Culture pH Monitoring System consists of S2K! developed ion selective sensors and control electronics integrated with the fluidics of a cell culture system. The integrated system comprises a "rail" in the Cell Culture Module (CCM) of WRAIR (Space Biosciences of Walter Read Army Institute of Research). The CCM is a Space Shuttle mid-deck locker experiment payload. The BIONA-C is displayed along with associated graphics and text explanations. The presentation will stimulate interest in development of sensor technology for real-time cell culture measurements. The transfer of this technology to other applications will also be of interest. Additional information is contained in the original document.

Author

Cells (Biology); Culture Techniques; pH; Sensors; Fabrication; Carbon Dioxide

20000020676 NASA Ames Research Center, Moffett Field, CA USA

NASA Ames Research Center R and D Services Directorate Biomedical Systems Development

Pollitt, J., NASA Ames Research Center, USA; Flynn, K., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 581; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The Ames Research Center R&D Services Directorate teams with NASA, other government agencies and/or industry investigators for the development, design, fabrication, manufacturing and qualification testing of space-flight and ground-based

experiment hardware for biomedical and general aerospace applications. In recent years, biomedical research hardware and software has been developed to support space-flight and ground-based experiment needs including the E 132 Biotelemetry system for the Research Animal Holding Facility (RAHF), E 100 Neurolab neuro-vestibular investigation systems, the Autogenic Feedback Systems, and the Standard Interface Glove Box (SIGB) experiment workstation module. Centrifuges, motion simulators, habitat design, environmental control systems, and other unique experiment modules and fixtures have also been developed. A discussion of engineered systems and capabilities will be provided to promote understanding of possibilities for future system designs in biomedical applications. In addition, an overview of existing engineered products will be shown. Examples of hardware and literature that demonstrate the organization's capabilities will be displayed. The Ames Research Center R&D Services Directorate is available to support the development of new hardware and software systems or adaptation of existing systems to meet the needs of academic, commercial/industrial, and government research requirements. The Ames R&D Services Directorate can provide specialized support for: System concept definition and feasibility Mathematical modeling and simulation of system performance Prototype hardware development Hardware and software design Data acquisition systems Graphical user interface development Motion control design Hardware fabrication and high-fidelity machining Composite materials development and application design Electronic/electrical system design and fabrication System performance verification testing and qualification.

Author

Biotelemetry; Design Analysis; Fabrication; Performance Tests; Data Acquisition; Feasibility Analysis; Hardware; Motion Simulators; Workstations

20000020686 Nebraska Univ., Dept. of Physiology and Biophysics, Omaha, NE USA

Head-Out Water Immersion in the Primate as a Model for the Cardiovascular/Renal Effects of Micron-G

Cornish, Kurtis G., Nebraska Univ., USA; Hughes, Kathryn, Nebraska Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 263-266; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The objectives of this research were: 1) Develop a non-human primate model that simulates the cardiovascular deconditioning that is exhibited by the astronauts; 2) Determine how in the baroreflex control of blood pressure is altered during and after 72 hrs of simulated microgravity; 3) Determine if there is an alteration in the control of blood volume during simulated microgravity; 4) Investigate possible counter measures that could be used in order to prevent the orthostatic hypotension that has been observed in the astronauts.

Author

Water Immersion; Hypotension; Cardiovascular System; Blood Pressure; Models

20000020763 Edgewood Research Development and Engineering Center, Aberdeen Proving Ground, MD USA

SERDP: Advanced Biotelemetry for Resource Management on Military Lands (CS-759) *Final Report*

Seegar, William S.; Fuller, Mark R.; Jan. 1999; 123p; In English; Prepared in cooperation with the Department of Interior, Raptor Research and Technical Assistance Center, Boise, ID and Center for Conservation Research and Technology, Univ. of Maryland Baltimore County, MD.

Report No.(s): AD-A371079; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The process of natural resource management and planning begins with a thorough inventory and description of a natural system's flora and fauna. This information is critical for the development and implementation of effective integrated natural resource management plans. Such plans, in turn, allow land managers, such as the U.S. Department of Defense, to maintain biodiversity, conserve natural resources, and comply with applicable environmental laws and regulations in concert with mission requirements. Advanced biotelemetry capabilities that incorporate the latest innovations in microelectronics, GIS, remote sensing, and computer modeling offer great promise in helping to define and characterize human effects on species and ecological communities and to identify strategies to ensure their sustain ability in the face of expanding human enterprise.

DTIC

Bioinstrumentation; Land Use; Computerized Simulation; Resources Management; Radio Telemetry; Biological Diversity; Biotelemetry; Remote Sensing; Earth Resources

20000020997 California Inst. of Tech., Pasadena, CA USA

Enzyme catalysts for a biotechnology-based chemical industry *Final Report, 1993 Sep. - 28 Sep. 1998*

Arnold, F. H.; Nov. 16, 1998; 7p; In English

Report No.(s): DE99-002094; DOE/CH/10578-T5; No Copyright; Avail: Department of Energy Information Bridge, Hardcopy

Enzymes have enormous potential for reducing energy requirements and environmental problems in the chemicals and pharmaceutical industries. The explosion of tools that has come out of molecular biology during the last 20 years has made it possible to evolve enzymes for features never required in nature. Scientists can speed up the rate and channel the direction of evolution by controlling mutagenesis and the accompanying selection pressures. Darwinian evolution carried out in the test tube offers a unique opportunity for biotechnology: the ability to tailor enzymes for optimal performance in a wide range of applications. Thus it is possible, for example, to evolve enzymes that carry out reactions on nonnatural substrates or even to carry out reactions for which there is no counterpart in nature. Due to the vast size of the potential sequence space, however, explorations by directed evolution must be guided by sound principles and workable strategies. During the course of this group, this laboratory has continued to make significant progress in the evolution of industrial enzymes as well as in developing general methods for in vitro evolution.
NTIS
Catalysts; Enzymes; Biotechnology; Molecular Biology

20000021349 Prins Maurits Lab. TNO, Rijswijk, Netherlands
Characterisation of Bacteria by Matrix-Assisted Laser Desorption/Ionisation and Electrospray Mass Spectrometry *Final Report*
vanBaar, B. L. M., Prins Maurits Lab. TNO, Netherlands; December 1999; 122p; In English
Contract(s)/Grant(s): A98/D/420; TNO Proj. 014.11019
Report No.(s): TD99-0176; PML-1999-A83; Copyright; Avail: Issuing Activity, Hardcopy
Chemical analysis for the characterisation of micro-organisms is rapidly evolving, after the recent advent of new ionisation methods in mass spectrometry: electrospray (ES) and matrix-assisted laser desorption/ionisation (MALDI). These methods allow quick characterisation of micro-organisms, either directly or after minimum sample preparation. This report provides a brief introduction to ES and MALDI mass spectrometry and a discussion of micro-organism characterisation capabilities. Some attention is devoted to the analysis of mixtures of proteins, lipids and other compounds, to the combination of polymerase chain reaction technology and mass spectrometry, and to the analysis of whole bacteria and their lysate. The review of results produced hitherto is concluded with an outlook on future developments.
Author
Chemical Analysis; Bacteria; Microorganisms; Ionization; Procedures

20000021578 Edgewood Research Development and Engineering Center, Aberdeen Proving Ground, MD USA
Use of Fourier Transform Infrared Spectroscopy in the Detection of Bacteria *Final Report, Jun. - Oct. 1998*
Lochner, J. M., Edgewood Research Development and Engineering Center, USA; Samuels, Alan P., Edgewood Research Development and Engineering Center, USA; Paterno, Dorothea A., Edgewood Research Development and Engineering Center, USA; Dec. 1999; 21p; In English
Report No.(s): AD-A372492; ECBC-TR-069; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy
In recent years, analytical techniques such as Fourier Transform Infrared Spectroscopy (FTIR) and Mass Spectrometry hyphenated techniques such as GC/MS and HPLC/MS have been used to characterize microbiological materials. Instrumentation has improved over the years, because W. W. Coblentz initiated the use of IR for these types of studies around 1911. Recently, we have investigated the use of a Nicolet/Spectra Tech accessory called the "Thunderdome(TM)" to characterize/ differentiate various biological media. We discuss the utility of this data in assessing the applicability of active and passive FTIR as a detection and discrimination tool for the remote sensing of hazardous biological materials. The Thunderdome(TM) is a single reflectance Horizontal Attenuated Total Internal Reflectance (HATR) accessory that has a spherical sampling surface, usually a Germanium crystal, and is perfect for strong absorbers or "rugged" sampling surfaces. Time consuming sample preparation processes are eliminated. Samples were grown on nutrient agar media and cultured for 2 days. Samples were applied directly to the Thunderdome(TM) with a sterile cotton swab. The FTIR spectra was generated on the following bacteria: Agar (blank); Bacillus subtilis (vegetative); Bacillus subtilis (spores); Ochrobactrum anthropi (a gram negative organism); and Staphylococcus aureus (a gram positive organism). A Nicolet 800 FTIR instrument with a 680 Workstation was used. The Thunderdome(TM) is found to be a quick, forgiving accessory that allows samples to be applied with minimal effort and spectra to be generated in less than 1 min.
DTIC
Infrared Spectroscopy; Fourier Transformation; Liquid Chromatography; Microbiology; Remote Sensing; Gas Chromatography

20000024842 Colorado Univ., Boulder, CO USA
Effects of Space Flight, Clinorotation, and Centrifugation on the Growth and Metabolism of Escherichia coli
Brown, Robert B.; Jul. 28, 1999; 218p; In English
Report No.(s): AD-A372320; FY99-545; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

Previous experiments have shown that space flight stimulates bacterial growth and metabolism. An explanation for these results is proposed, which may eventually lead to improved terrestrial pharmaceutical production efficiency. It is hypothesized that inertial acceleration affects bacterial growth and metabolism by altering the transport phenomena in the cells external fluid environment. It is believed that this occurs indirectly through changes in the sedimentation rate acting on the bacteria and buoyancy-driven convection acting on their excreted by-products. Experiments over a broad range of accelerations consistently supported this theory. Experiments at I g indicated that higher concentrations of excreted by products surrounding bacterial cells result in a shorter lag phase. Nineteen additional experiments simulated 0 g and 0.5 g using a clinostat, and achieved 50 g, 180 g, and 400 g using a centrifuge. These experiments showed that final cell density is inversely related to the level of acceleration. The experiments also consistently showed that acceleration affects the length of the lag phase in a non-monotonic, yet predictable, manner. Additional data indicated that E. coli metabolize glucose less efficiently at hypergravity, and more efficiently at hypogravity. A space-flight experiment was also performed. Samples on orbit had a statistically significant higher final cell density and more efficient metabolism than did ground controls. These results. which were similar to simulations of 0 g using a clinostat, support the theory that gravity only affects bacterial growth and metabolism indirectly, through changes in the bacteria's fluid environment.
DTIC
Centrifuging; Metabolism; Escherichia

20000024847 Yale Univ., Dept. of Molecular Biophysics, New Haven, CT USA
Archaea: From Genomics to Physiology and the Origin of Life
Vothknecht, Ute C., Yale Univ., USA; Tumbula, Debra L., Yale Univ., USA; Trends in Cell Biology; April 1999; ISSN 0962-8924; Volume 9, pp. 159-161; In English; Bridging the Gap Between Bacteria and Eukarya, 9-14 Jan. 1999, Taos, NM, USA
Contract(s)/Grant(s): NAG2-6024; Copyright; Avail: Issuing Activity

This document represents a report on a meeting about Archaea. The meeting had an unusually diversified mix of topics all related to Archaea highlighting their differences and similarities with other kingdoms of life. Thus, a large number of scientists from others areas of biology participated in this conference. One-third of the speakers (11 of 33) represented laboratories whose main interests have not been archaea and who have not previously participated in similar symposia or workshops. Thus, this symposium provided a unique opportunity for archaeal researchers to interact in a wider forum. Because of the broad range of topics covered, the conference also introduced many of the participants to new areas of archaeal research. The discussions of genomics, molecular mechanisms of transcription, metabolic pathways and evolution were at a very high level. Talks and posters provided detailed discussions of the state of the current knowledge in RNA processing, transcriptional initiation, chromatin structure, aminoacyl-tRNA synthetases, autotrophic CO2 fixation, Upid biosynthesis and a wide range of other topics. In addition to providing overviews, major areas of scientific argument were clearly delineated, particularly in the discussions of genomics and evolution. Some of the questions raised included: how representative are individual gene trees of organismal evolution, how prevalent is horizontal evolution, how reliable are functional assignments in genomics? On these topics, the different points of view were well represented. The future of any field depends on the enthusiasm and intellectual engagement of young scientists working in the area. Therefore, the participation of 29 graduate and postdoctoral students (out of about 135 participants) was a highlight of the meeting. This was the consequence of funding contributions by NSF and NASA.
Author
Biological Evolution; Ribonucleic Acids; Archaebacteria

20000024888 Marquette Univ., Milwaukee, WI USA
Bion 11 Spaceflight Project: Effect of Weightlessness on Single Muscle Fiber Function in Rhesus Monkeys *Final Report*
Fitts, Robert H., Marquette Univ., USA; Romatowski, Janell G., Marquette Univ., USA; Widrick, Jeffrey J., Marquette Univ., USA; DeLaCruz, Lourdes, Marquette Univ., USA; [1999]; 2p; In English
Contract(s)/Grant(s): NAG2-636; No Copyright; Avail: Issuing Activity; Abstract Only

Although it is well known that microgravity induces considerable limb muscle atrophy, little is known about how weightlessness alters cell function. In this study, we investigated how weightlessness altered the functional properties of single fast and slow striated muscle fibers. Physiological studies were carried out to test the hypothesis that microgravity causes fiber atrophy, a decreased peak force (Newtons), tension (Newtons/cross-sectional area) and power, an elevated peak rate of tension development (dp/dt), and an increased maximal shortening velocity (V(sub o)) in the slow type I fiber, while changes in the

fast-twitch fiber are restricted to atrophy and a reduced peak force. For each fiber, we determined the peak force (P(sub o)), V(sub o), dp/dt, the force-velocity relationship, peak power, the power-force relationship, the force-pCa relationship, and fiber stiffness. Biochemical studies were carried out to assess the effects of weightlessness on the enzyme and substrate profile of the fast- and slow-twitch fibers. We predicted that microgravity would increase resting muscle glycogen and glycolytic metabolism in the slow fiber type, while the fast-twitch fiber enzyme profile would be unaltered. The increased muscle glycogen would in part result from an elevated hexokinase and glycogen synthase. The enzymes selected for study represent markers for mitochondrial function (citrate synthase and 0-hydroxyacyl-CoA dehydrogenase), glycolysis (Phosphofructokinase and lactate dehydrogenase), and fatty acid transport (Carnitine acetyl transferase). The substrates analyzed will include glycogen, lactate, adenosine triphosphate, and phosphocreatine.
Author
Biochemistry; Microgravity; Muscles; Muscular Function; Physiology; Weightlessness; Twitching; Bioastronautics

20000024898 Fourth Military Medical Univ., Dept. of Aerospace Philosophy, Xi'an, China
Differentiated Remodeling Changes of Medium-Sized Arteries from Different Body Parts in Tail-Suspended Rats and Their Reversibility
Mao, Qin–Wen, Fourth Military Medical Univ., China; Zhang, Li–Fan, Fourth Military Medical Univ., China; Ma, Jin, Fourth Military Medical Univ., China; Space Medicine and Medical Engineering; Apr. 1999; ISSN 1002-0837; Volume 12, No. 2, pp. 92-96; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The aim of the present study was to test whether medium-sized arteries in different body parts are differentially directed to achieve stimulus-specific remodeling to adapt local hemodynamic changes induced by tail-suspension, and to examine whether these structural changes are reversible. Morphological changes of femoral, anterior tibial, common carotid, and basilar arteries from 4 weeks tail-suspended (SUS-4), 1 week recovered (REC-1), and control (CON) rats were studied using van Gieson-Orcein staining method. For the hindquarter arteries, like the femoral and anterior tibial arteries, the lumen diameter (d) and medial tissue area (A) of SUS-4 group were significantly decreased (P is less than 0. 05, P is less than 0. 01) as compared with that of CON group, and that of REC-1 group were not fully recovered though the differences were not significant. With respect to arteries in the neck region and the brain, the remodeling changes were just in an opposite direction. In SUS-4 group, the d and A of both common carotid and basilar arteries were significantly increased (P is less than 0. 05, Pis less than 0. 01) as compared with that of CON, and not fully restored after 1 week recovery. The structures of medium-sized arteries in different body parts remodel differentially in response to local hemodynamic changes during simulated weightlessness and these changes were reversible.
Author
Arteries; Cardiovascular System; Hemodynamic Responses; Rats; Bioastronautics; Aerospace Medicine; Weightlessness Simulation

20000024899 Fourth Military Medical Univ., Dept. of Aerospace Physiology, Xi'an, China
Echocardiographic Assessment of Left Ventricular Structure and Function After Simulated Weightlessness in Rats
Bao, Jun–Xiang, Fourth Military Medical Univ., China; Zhang, Li–Fan, Fourth Military Medical Univ., China; Shang, Hui–Hua, Fourth Military Medical Univ., China; Yu, Zhi–Bin, Fourth Military Medical Univ., China; Qian, Yun–Qiu, Fourth Military Medical Univ., China; Space Medicine and Medical Engineering; Apr. 1999; ISSN 1002-0837; Volume 12, No. 2, pp. 88-91; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective was to investigate whether the changes in rat after simulated weightlessness are similar to those in astronauts after flight. The effects of 4 weeks tail-suspension on left ventricular structure and function in rats were examined by echocardiography. After 4 weeks of simulated weightlessness, the thickness of both the anterior and posterior wall in left ventricle (LV) showed a general trend of decrease, but these changes were not statistically significant; the end-systolic and enddiastolic internal dimensions (ESD and EDD respectively) of LV decreased significantly) and the endsystolic volume, end-diastolic volume and stroke volume (ESV, EDV and SV respectively) were all reduced; so did the relevant indices of them. There were no significant differences in ejection fraction (EF) and fractional shortening (FS) between the tail-suspended and control groups. The left ventricular mass (LVM) and its index (LVMI) were decreased. The peak velocities of blood flow of aorta, pulmonary artery and mitral valve did not show any significant change after simulated weightlessness. Medium-term simulated weightlessness may lead to a significant decrease in left ventricular internal dimension, ventricular volume, and mass, and a trend of decrease in mean left ventricular wall thickness. These changes in rats are similar to those observed in astronauts postflight.
Author
Aorta; Arteries; Astronauts; Heart Function; Heart Valves; Rats; Weightlessness Simulation; Aerospace Medicine

20000024900 Institute of Aviation Medicine, Beijing, China

Effects of Tea Polyphenols on Cardiac Function and Myocardial Ultrastructure in Rats after Repeated +Gz Stress

Zhan, Hao, Institute of Aviation Medicine, China; Dong, Hua–Jin, Academy of Military Medical Sciences, China; Space Medicine and Medical Engineering; Apr. 1999; ISSN 1002-0837; Volume 12, No. 2, pp. 79-83; In English

Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

To observe the effects of tea polyphenols (TP) on cardiac function and myocardial ultrastructure in rats after repeated +10 Gz stress. In this study twenty four male Wistar rats were randomly divided into three groups (n = 8 each): group A (control), group B (+10 Gz), group C (+Gz with TP). Group B and C were repeatedly exposed to +10 Gz (each for 30 s, onset rate about 0.5 G/s, 3 times/day with +1 Gz 1 min intervals, 3 days/week, 4 weeks in total), but group A was only submitted to +1 Gz. TP (200 mg./kg(exp -1)) was given orally to group C about 1 hour prior to the +Gz experiment, and distilled water was given to group A and B. The function of the isolated rat working hearts and myocardial ultrastructure were observed. The results were that a significant decrease of left ventricular systolic pressure (LVSP) and injury of myocardial structure in rats were demonstrated after repeated +10 Gz stress. But TP could remarkably elevate the LVSP and improve myocardial ultrastructural injury in +10 Gz stressed rats. These results indicated that repeated high G exposure may produce cardiac structural and functional injuries in rats which might be partly related to free radical metabolism; and antioxidant TP had significant protective effects on the hearts of +Gz stressed rats.

Author

Acceleration Stresses (Physiology); Antioxidants; Heart Function; Myocardium; Phenols

20000025052 Ohio State Univ., Dept. of Plant Biology, Columbus, OH USA

Development of Gravity Sensitive Plant Cells (Ceratodon) in Microgravity *Final Report, 1 May 1998 - 31 Aug. 1999*

Sack, Fred D., Ohio State Univ., USA; [1999]; 6p; In English

Contract(s)/Grant(s): NAG2-1217; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Protonemata of the moss Ceratodon are tip-growing cells that grow up in the dark. This cell type is unique compared to cells in almost any other organism, since the growth of the plant cell itself is completely oriented by gravity. Thus, both the processes of gravity sensing and the gravity response occur in the same cell. Gravity sensing appears to rely upon amyloplasts (starch-filled plastids) that sediment. This sedimentation occurs in specific zones and plastid zonation is complex with respect to plastid morphology, distribution, and gravity. Microtubules restrict the extent of plastid sedimentation (i.e., they are load-bearing). Light also is important since apical cells have a phytochrome-based positive phototropism, light quality influences plastid zonation and sedimentation (photomorphogenesis), and red light suppresses gravitropism at higher but not lower light intensities. Many of these processes were examined in a 16 day spaceflight experiment, "SPM-A" space moss" or "SPAM)) on STS-87 that landed in December, 1997. The work described here involves the definition of a second flight experiment that builds upon the data and questions arising from STS-87. Effort was directed towards further definition of an experiment for the Shuttle (dubbed "SOS" for "Son of SPAM"). Our current target is STS 107 that is scheduled to fly in January 2001. This definition addressed two goals of the STS107 experiment. The goals of the current experiment were to determine whether the cytoskeleton plays a role in maintaining and generating an apical (non-random) plastid distribution in microgravity and to determine the development and extent of clockwise spiral tip-growth in microgravity.

Derived from text

Gravitropism; Microgravity; Phototropism; Bryophytes; Gravitational Effects; Cells (Biology); Vegetation Growth; Exobiology

20000025187 NASA Langley Research Center, Hampton, VA USA

Dynamics of Active Separation Control at High Reynolds Numbers

Pack, LaTunia G., NASA Langley Research Center, USA; Seifert, Avi, Tel-Aviv Univ., Ramat-Aviv, Israel; [2000]; 16p; In English; 38th; Aerospace Sciences, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2000-0409; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A series of active flow control experiments were recently conducted at high Reynolds numbers on a generic separated configuration. The model simulates the upper surface of a 20% thick Glauert-Goldschmied type airfoil at zero angle of attack. The flow is fully turbulent since the tunnel sidewall boundary layer flows over the model. The main motivation for the experiments is to generate a comprehensive data base for validation of unsteady numerical simulation as a first step in the development of a CFD design tool, without which it would not be possible to effectively utilize the great potential of unsteady flow control. This paper focuses on the dynamics of several key features of the baseline as well as the controlled flow. It was found that the thickness of the upstream boundary layer has a negligible effect on the flow dynamics. It is speculated that separation is caused mainly by the highly convex surface while viscous effects are less important. The two-dimensional separated flow contains unsteady waves

centered on a reduced frequency of 0.9, while in the three dimensional separated flow, frequencies around a reduced frequency of 0.3 and 1 are active. Several scenarios of resonant wave interaction take place at the separated shear-layer and in the pressure recovery region. The unstable reduced frequency bands for periodic excitation are centered on 1.5 and 5, but these reduced frequencies are based on the length of the baseline bubble that shortens due to the excitation. The conventional works well for the coherent wave features. Reproduction of these dynamic effects by a numerical simulation would provide benchmark validation.
Author
Active Control; Airfoils; Boundary Layer Flow; Fluid Dynamics; High Reynolds Number; Three Dimensional Flow; Turbulence; Zero Angle of Attack

20000025201 Idaho Univ., Dept. of Biological Sciences, Moscow, ID USA
Rat Gestation During Space Flight: Outcomes for Dams and Their Offspring Born After Return to Earth
Wong, Andre M., Idaho Univ., USA; DeSantis, Mark, Idaho Univ., USA; Integrative Physiological and Behavioral Science; Oct.-Dec. 1997; Volume 32, No. 4, pp. 322-342; In English
Contract(s)/Grant(s): NCC3-862; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Sprague-Dawley rats were studied to learn whether gestation in the near-zero gravity, high radiation environment of space impacts selected mammalian postnatal events. Ten rats spent days nine to twenty of pregnancy aboard the space shuttle orbiter Atlantis (STS-66). Their movement was studied shortly after return to Earth; subsequently, several of their offspring were cross-fostered and examined through postnatal day 81 (P81) for whole body growth and somatic motor development. Values for the flight animals were compared to ground-based control groups. Relative to controls, the pregnant flight rats showed a marked paucity of locomotion during the first few hours after returning to Earth. There was greater likelihood of perinatal morbidity for the offspring of flight dams when compared to the control groups. Whole body weight of surviving offspring, averaged for each group separately, showed typical sigmoidal growth curves when plotted against postnatal age. The flight group for our study had a larger ratio of female to male pups, and that was sufficient to account for the lower average daily weight gained by the flight animals when compared to the control groups. Walking was universally achieved by P13 and preceded eye opening, which was complete in all pups by P17. Thus, both of these developmental horizons were attained on schedule in the flight as well as the control rats. Characteristic changes were observed in hind limb step length and gait width as the pups grew. These patterns occurred at the same time in each group of rats. Therefore, prenatal space flight from days nine to twenty of gestation did not interfere with the establishment of normal patterns for hind paw placement during walking.
Author
Embryology; Microgravity; Weightlessness; Ontogeny; Biogeny; Bioastronautics

20000025542 Idaho Univ., Moscow, ID USA
Development of Sensory Receptors in Skeletal Muscle ***Final Report***
DeSantis, Mark, Idaho Univ., USA; [2000]; 10p; In English
Contract(s)/Grant(s): NCC2-862; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The two major goals for this project is to (1) examine the hindlimb walking pattern of offspring from the Flight dams as compared with offspring of the ground control groups from initiation of walking up to two months thereafter; and (2) examine skeletal muscle.
CASI
Muscles; Musculoskeletal System; Sensory Perception; Receptors (Physiology); Sense Organs; Central Nervous System

20000025562 Institute of Space Medico-Engineering, Beijing, China
Effects of 2450 MHz Microwave Irradiation of Different Duration on Central Transmitters in Mice
Chen, Jian, Institute of Space Medico-Engineering, China; Yang, Yu–Hua, Institute of Space Medico-Engineering, China; Jiang, Rui, Institute of Space Medico-Engineering, China; Pu, Jing–Sui, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 220-222; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective is to investigate the mechanism of effects of microwave irradiation on central nervous system (CNS). 72 male LACA mice were irradiated with 2450 MHz microwave for 2,7 or 14 days respectively with the same total incident power density of 5 mW/sq cm. After exposure, every group showed an increase of monoaminoxidase (MAO) in the cerebral cortex as compared with the control (P is less than 0.001). The norepinephrine (NE) content were significantly reduced after two-day or two-week exposure(P is less than 0. 05). The 5-hydroxyindoleacetic acid (5-HIAA) content, the main metabolite of 5-hydroxytryptamine

(5-HT), were significantly increased after two-day or 7 day exposure (P is less than 0.001). The metabolic abnormity of neurotransmitters in the central nervous system may be one of the factors causing disorders in the microwave operators.
Author
Irradiation; Microwaves; Neurotransmitters

20000025563 Institute of Space Medico-Engineering, Beijing, China
Effect of Short Time High-Intensity Noise on Hearing Organ in Guinea Pigs
He, Yan–Jun, Institute of Space Medico-Engineering, China; Li, Dao–De, Institute of Space Medico-Engineering, China; Zheng, Su–Xian, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 217-219; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective is to investigate the effects of high-intensity noise on hearing organ. 24 guinea pigs were randomly divided into three groups (8 each): normal control group, 115 dB(A) noise exposure group and 118 dB (A) noise exposure group. Changes of eardrum, hair cell and hearing threshold were observed in guinea pigs after 3 minute exposure to 115 dB(A) and 118 dB(A) pinknoise level. The result is: (1) No obvious damage of eardrum was found in both two noise exposure groups with otoscopy; but obvious temporary threshold shift (TTS) of hearing was observed in both groups; (2) Significant damage of hair cell was observed in both exposure groups by morphological analysis of the cochlea (P is less than 0.01); (3) TTS in both exposure groups didn't recover to the pre-experiment level within half an hour; (4) TTS and damage of hair cell were more severe in 118 dB(A) noise-exposure group than those in 115 dB(A) group (P is less than 0.05). Short time 115 dB(A) noise exposure can cause damage on hearing organ.
Author
Noise Intensity; Time Dependence; Hearing; Noise (Sound); Organs

20000025564 Institute of Aviation Medicine, Beijing, China
Cardiovascular Response to High Sustained +Gz Stress in Dogs
Shi, Lu–Jiang, Institute of Aviation Medicine, China; Zhang, Hong–Jin, Institute of Aviation Medicine, China; Tang, Wei–Ping, Institute of Aviation Medicine, China; Li, Guang–Dao, Institute of Aviation Medicine, China; Tan, Cheng, Institute of Aviation Medicine, China; Song, Lei, Institute of Aviation Medicine, China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 214-216; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

In this report we investigate features of electrocardiography (ECG) and arterial pressure in dog during and after +Gz stress. Six anesthetized dogs were catheterized for the measurement of ascending aortic pressure (AP) and common iliac arterial pressure (CIAP). A lead of ECG was monitored continuously. Then, dogs were placed supine in rotatable platform on one arm of an 1.7 m radius centrifuge. The animals were exposed serially to acceleration profiles of up to +7 Gz, consisting of a slow onset to peak acceleration, 90 s peak G, and a rapid decline back to control. A recovery time of at least 20 min was allowed after each acceleration profile. The results are: (1) The amplitude of P-wave was influenced by the magnitude of the acceleration (2.3 +/- 0.2 mV at rest vs. 4.5 +/- 0.5 mV at +3 Gz, 4.8 +/- 0.3 mV at +5 Gz and 5.3 +/- 0.7 mV at +7 Gz, respectively P is less than 0.05); (2) It appeared that arteria mean pressure increased and pulse pressure decreased in CIAP during high +Gz stress; (3) AP increased greatly after +Gz stress(17.29 +/- 5.59/11.31 +/- 3.86 kPa at rest vs. 27.53 +/- 6.12/20. 62 +/- 1.86 kPa 30s after +7 Gz P is less than 0.01). We conclude that (1) The change of the amplitude of P-wave reflected the atrial displacement which may be the reason of arrhythmia; (2)The perfusion pressure is an important physiological parameter to the cardiovascular dysfunction during high +Gz stress; (3) Greatly higher AP after +Gz stress could be a feature of vascular exhaustion.
Author
Physiological Responses; Acceleration Stresses (Physiology); Electrocardiography; Pressure Measurement; Heart Function; Arteries

20000025572 Fourth Military Medical Univ., Dept. of Aerospace Physiology, Xi'an, China
Changes in Lumen Diameters of Vessels in Arteriolar Network in Rat Soleus Muscle After Simulated Weightlessness
Mao, Qin–Wen, Fourth Military Medical Univ., China; Zhang, Li–Fan, Fourth Military Medical Univ., China; Ma, Jin, Fourth Military Medical Univ., China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 177-180; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective is to elucidate whether simulated weightlessness can induce changes in lumen diameters of vessels in arteriolar networks in hindlimb muscles and whether these changes are reversible. Changes in lumen diameters of the vessels in the arteriolar

network in soleus muscle of 4 wk tail-suspended (SUS-4), 1 wk (REC-1) and 5 wk (REC-5) recovered rats were examined and compared with that of control (CON) rats by use of the method of intra-arterial infusion of a carbon suspension. The lumen diameters of the feeding arteries and arcade arterioles, and the transverse arterioles of the order of both V and II in the SUS-4 group were reduced by 31%, 29%, 28%, and 41%, respectively, as compared with that of the CON group (P is less than 0.01). The diameters of these arterioles in REC-1 group were partially restored but remained significantly less than that of the CON group (P is less than 0.05, or P is less than 0.01). In REC-5 group, except for the transverse arterioles of order II, the diameters of all the other arterioles were fully recovered. These findings indicate that a 4 wk simulated weightlessness might induce atrophic changes in the arterioles of the hindlimb muscles. It also suggests that structural changes in arteriolar network might be an important mechanism accounting for postflight orthostatic intollerance.
Author
Weightlessness Simulation; Lumens; Arteries; Diameters; Musculoskeletal System

20000025574 Fourth Military Medical Univ., Dept. of Aerospace Physiology, Xi'an, China
Alterations of Arterial Vasoconstrictor Responsiveness in Rats During and After Tail-Suspension
Ma, Jin, Fourth Military Medical Univ., China; Zhang, Li–Fan, Fourth Military Medical Univ., China; Yang, Tian–De, Fourth Military Medical Univ., China; Zhang, Le–Ning, Fourth Military Medical Univ., China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 169-172; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective is to characterize the time course of alterations in vasoconstrictor properties of arteries during simulated weightlessness, and to examine whether these alterations are reversible. The tail-suspended rat model was used to simulate weightlessness, and the alterations in vasoconstrictor response were examined in vitro using isolated arterial rings. Compared with that of controls, contractile tension evoked by KCI and phenylephrine (PE) were lower in abdominal aortic, mesenteric and femoral arterial rings from 2 wk tail-suspended rats (P is less than 0.05); after 4 wk tail-suspension, the responses of mesenteric and femoral arterial rings to KCI or PE were further decreased (P is less than 0.05); but contraction responses of arterial rings from 8 wk tail-suspended rats were similar to that of 4 wk simulated microgravity rats. The reversibility of altered arterial vasoreactivity after 4 wk tail-suspension was observed for 5 wk. Vasoreactivity of abdominal aortic rings was recovered after first week of recovery, but it took five weeks that altered vasoreactivity of mesenteric and femoral artery got back to normal. The alterations in constrictor properties of arteries are dependent on both the duration of tail-suspension and the position of artery, the diminished vasoconstrictor properties appear to reach a new steady state after 4 wk tail-suspension, and the changes are reversible.
Author
Arteries; Vasoconstriction; Revisions

20000026303 Wyle Labs., Inc., Life Sciences, Houston, TX USA
KC-135 and Other Microgravity Simulations
Noel, Skinner C., Wyle Labs., Inc., USA; August 1999; 163p; In English; See also 20000026304 through 20000026336; Original contains color illustrations
Contract(s)/Grant(s): NAS9-97005
Report No.(s): NASA/CR-1999-208922; NAS 1.26:208922; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This document represents a summary of medical and scientific evaluations conducted aboard the KC-135 from June 20, 1998 to June 20, 1999. Included is a general overview of KC-135 activities manifested and coordinated by the Life Sciences Research Laboratories. A collection of brief reports that describes tests conducted aboard the KC-135 follows the overview. Principal investigators and test engineers contributed significantly to the content of the report describing their particular experiment or hardware evaluation. Although this document follows general guidelines, each report format may vary to accommodate differences in experiment design and procedures. This document concludes with an appendix that provides background information concerning the KC-135 and the Reduced-Gravity Program.
Author
C-135 Aircraft; Experiment Design; Life Sciences; Microgravity; Weightlessness Simulation; Parabolic Flight; Aerospace Medicine; Bioastronautics

20000026319 Texas Univ., Austin, TX USA
Undergraduate Program Flights: The Effects of Microgravity on Multidrug Resistance
Buchli, Jennifer, Texas Univ., USA; Afghanipour, Tony, Texas Univ., USA; Boone, John, Texas Univ., USA; Boyer, Darren, Texas Univ., USA; Dinh, Dustin, Texas Univ., USA; Hueske, Emily, Texas Univ., USA; John, Jeremy, Texas Univ., USA; Martin, Angela, Texas Univ., USA; Sanampudi, Jay, Texas Univ., USA; Piepmeier, Ed, Texas Univ., USA; KC-135 and Other

Microgravity Simulations; August 1999, pp. 80-84; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Response to drugs is predicated on transport mechanisms, expression, and activation of cellular receptors and enzymes. This mechanism of transverse migration of drugs across membranes is of fundamental importance to understanding drug delivery, because all drugs must cross membranes of one kind or another. The purpose of this experiment was to identify the effect that microgravity may have on multidrug resistance in leukocytes. Multidrug resistance (MDR) is the ability of a cell to withstand a broad spectrum of chemically related drugs following selection by only one drug. Studies conducted on MDR activity, because of its intrinsic complexity, provide insight into cellular function and drug action. The condition of microgravity was incorporated in developing a model to enhance our understanding of basic molecular mechanisms associated with drug action. The cytoskeleton is highly sensitive to changes in the microgravity environment. Cytoskeletal interactions with surface proteins are critical to the function of proteins as drug efflux pumps. The activities of surface proteins that are involved in MDR, such as the P-glycoprotein, are linked to membrane fluidity and the cytoskeleton. The experiment conducted was designed to analyze the cellular response associated with Doxorubicin activity in leukocytes under short-term weightlessness.

Derived from text

Drugs; Microgravity; Weightlessness; Cell Membranes (Biology); Aerospace Medicine; Pharmacology

20000026320 Vermont Univ., Burlington, VT USA

Undergraduate Program Flights: High Altitude Drosophila Science Experiment

Barnett, Dan, Vermont Univ., USA; Carroll, Megan, Vermont Univ., USA; Chung, Dan, Vermont Univ., USA; Nutting, Noel, Vermont Univ., USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 85-88; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Undergraduates of the University of Vermont (LTVM) are participating in NASA's Student Launch Program conducting biomedical science aboard a Nike-Orion sounding rocket. UVM was selected along with two other sounding projects from across the country. The UVM project--"Effects of a Sounding Rocket Flight on Drosophila"--is a biological experiment to confirm earlier findings that young male Drosophila fruit flies exposed to micro-gravity have an acceleration in their aging. The theory is that aging is the consequence of increased locomotion and the objective of the experiment is to measure the activities of the flies during the flight. Previous experiments have theorized that male Drosophila exposed to micro-gravity space flight have shortened life spans due to their increased motility and, in turn, their metabolic rates. Important advances in the understanding of the aging process, including humans, could be obtained through comprehending the changes experienced by the flies under these reduced gravity conditions. Increased motility is believed to be due to Drosophila's negative geotaxis response. A negative geotaxis response is an inherent trait of the Drosophila to move in the opposite direction of the Earth's gravitational vector when stimulated. This negative geotaxis response is primarily manifested as a walking response. This trait is present in nearly all Drosophila, although various levels of negative geotaxis are prevalent. Three Drosophila types with respect to negative geotaxis activity are to be evaluated: Normal vs. Hyperactive vs. Non. Within these different types, different characteristics will be taken into consideration: Males vs. Females as well as Young vs. Old. During the brief exposure to micro-gravity, the time course of the increased activity was examined as to whether the negative geotaxis response is the cause of the increased activity. Other parameters such as temperature and acceleration were measured to determine the exact conditions that the Drosophila experienced.

Derived from text

Drosophila; Gravitational Effects; Life Span; Microgravity; Aging (Biology); Gravitational Physiology; Bioastronautics

20000026324 Massachusetts Inst. of Tech., Cambridge, MA USA

Undergraduate Program Flights - NIMBLE: A Non-Invasive Microgravity Biomedical Life-Sciences Experiment

Carr, Christopher, Massachusetts Inst. of Tech., USA; Walker, Elizabeth, Massachusetts Inst. of Tech., USA; Pinson, David, Massachusetts Inst. of Tech., USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 108-110; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The objectives of this project are to verify the effects of micro- and hypergravity on the heart rate on humans to test the usability of the wearable computer-based bio-monitoring system. Passively collected pulse-oximetry and ECG data will be used to test the effects of micro-and hypergravity on the heart rate of humans. A workload task, which requires the flight crew to integrate information from the external and internal (on-screen) environments, will be used in conjunction with a subjective evaluation to test the hypothesis of system usability.

Derived from text

Gravitational Effects; Microgravity; Oximetry; Aerospace Medicine; Medical Equipment; Electrocardiography

20000026336 NASA Johnson Space Center, Houston, TX USA
Background Information About the KC-135 and the Reduced-Gravity Program
KC-135 and Other Microgravity Simulations; August 1999, pp. a-2; In English; See also 20000026303; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The Reduced-Gravity Program, operated by the NASA/Johnson Space Center (JSC), provides engineers, scientists, and astronauts alike, a unique opportunity to perform testing and training in a weightless environment but without ever having to leave the confines of the earth's orbit. Given the frequency of Space Shuttle missions and the anticipated construction and eventual habitation of the New International Space Station, the Reduced-Gravity Program provides a truly ideal environment to test and evaluate space hardware and experimental procedures prior to launch. The Reduced-Gravity Program was established in 1959 to investigate the reactions of humans and hardware during operations in a weightless environment. A specially modified KC-135 turbojet (KC-135A), flying parabolic arcs, produces periodic episodes of weightlessness lasting 20-25 secs. The KC-135 is sometimes also flown to provide short periods of lunar (1/6) and Martian (1/3) gravity.
Derived from text
C-135 Aircraft; Gravitation; Microgravity; Parabolic Flight; Weightlessness Simulation

52
AEROSPACE MEDICINE

Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects on those environments. For psychological and behavioral effects of aerospace environments see 53 Behavioral Science. For the effects of space on animals and plants see 51 Life Sciences.

20000020486 NASA Lewis Research Center, Cleveland, OH USA
Quantifying Biomechanical Characteristics of Jumping Exercises in 1G and in Simulated and True Microgravity
Davis, B. L., Cleveland Clinic Foundation, USA; DAndrea, S. E., Barry Univ., USA; Perusek, G., NASA Lewis Research Center, USA; Orlando, T., Cleveland Clinic Foundation, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 365-367; In English; See also 20000020485
Contract(s)/Grant(s): NAG5-4086; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Exercise in microgravity is one of the most promising countermeasures to the dual problems of space flight-induced bone loss and muscle atrophy. Although exercise in microgravity has been studied extensively from a metabolic standpoint, little research has focused on the efficacy of different forms of exercise for maintaining musculoskeletal integrity. Exercise protocols have not been effective in preventing muscle atrophy and bone loss during space flight, especially in the lower extremities. In 1-G, however, animal experiments have clearly indicated that: (1) certain bone strains and strain rates do stimulate bone deposition, and (2) repetitive loading of the lower extremity can increase osteonal bone formation even as proximally as the vertebral column. Such studies have also indicated that a relatively small number of appropriate loading cycles may lead to bone deposition. This suggests that an optimal exercise regimen might be able to maintain bone and muscle integrity during space flight. Since there is evidence that the bones and muscles of the lower limbs are particularly affected by space flight, the present study addressed two major aims: (1) quantify externally applied impact loads and rates of loading under the feet during tethered jumping exercises, and (2) determine the amount of eccentric and concentric whole-muscle activity during these jumping exercises in true and in simulated zero-gravity.
Author
Activity (Biology); Biodynamics; Bone Demineralization; Countermeasures; Gravitation; Impact Loads; Muscular Function; Physical Exercise

20000020498 Texas Univ., Baromedical Lab., Houston, TX USA
Role of Inflammatory Reponse in Experimental Decompression Sickness
Butler, B. D., Texas Univ., USA; Little, T., Texas Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 116-119; In English
Contract(s)/Grant(s): NAG9-215; NAGW-4479; NAG9-6176; NAG9-1040; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Decompression to altitude can result in gas bubble formation both in tissues and in the systemic veins. The venous gas emboli (VGE) are often monitored during decompression exposures to assess risk for decompression sickness (DCS). Astronauts are at risk for DCS during extravehicular activities (EVA), where decompression occurs from the Space Shuttle or Space Station atmospheric pressure of 14.7 pounds per square inch (PSI) to that of the space suit pressure of 4.3 PSI. DCS symptoms include

diffuse pain, especially around joints, inflammation and edema. Pathophysiological effects include interstitial inflammatory responses and recurring injury to the vascular endothelium. Such responses can result in vasoconstriction and associated hemodynamic changes.The granulocyte cell activation and chemotaxin release results in the formation of vasoactive and microvascular permeability altering mediators, especially from the lungs which are the principal target organ for the venous bubbles, and from activated cells (neutrophils, platelets, macrophages). Such mediators include free arachidonic acid and the byproducts of its metabolism via the cyclooxygenase and lipoxygenase pathways (see figure). The cyclooxygenase pathway results in formation of prostacyclin and other prostaglandins and thromboxanes that cause vasoconstriction, bronchoconstriction and platelet aggregation. Leukotrienes produced by the alternate pathway cause pulmonary and bronchial smooth muscle contraction and edema. Substances directly affecting vascular tone such as nitric oxide may also play a role in the respose to DCS. We are studying the role and consequent effects of the release inflammatory bioactive mediators as a result of DCS and VGE. More recent efforts are focused on identifying the effects of the body's circadian rhythm on these physiological consequences to decompression stress. al

Author

Decompression Sickness; Aeroembolism; Bronchi; Cardiovascular System; Extravehicular Activity; Leukocytes; Pressure Reduction; Vasoconstriction

20000020499 Pennsylvania Univ. Medical Center, Environmental Biomedical Research Data Center, Philadelphia, PA USA

Quantitative Prediction of Pulmonary Oxygen Poisoning Stress in Human Exposures to Changing Degrees of Inspiratory Hyperoxia

Lambertsen, C. J., Pennsylvania Univ. Medical Center, USA; Clark, J. M., Pennsylvania Univ. Medical Center, USA; Hopkin, E., Pennsylvania Univ. Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 120-123; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Redevelopment and improved validity have been accomplished, for graphic and mathematical modeling of rates and magnitudes of pulmonary mechanical function decrements, in varied degrees and duration of hyperoxic exposures. The original (1968) IFEM predictive model of Unit Pulmonary Toxic (O2) Dose and Cumulative Pulmonary Toxic Dose, in use over 30 years, was derived with the then limited usable data of two experiment series at .83 and .98 ATA 02 and one series at 2.0 ATA. The present redevelopment program has included extensive additional data for series of prolonged exposures at 1, 1.5, 2.0, 2.5 and 3.0 ATA O2, involving use of 101 subjects overall.

Author

Quantitative Analysis; Pulmonary Functions; Oxygen; Toxicity; Human Behavior; Hyperoxia

20000020506 NASA Johnson Space Center, Houston, TX USA

Effects of Promethazine on Performance During Simulated Shuttle Landings

Harm, D. L., NASA Johnson Space Center, USA; Putcha, L., NASA Johnson Space Center, USA; Sekula, B. K., Enterprise Advisory Services, Inc., USA; Berens, K. L., Wyle Labs., Inc., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 148-149; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Promethazine (PMZ) is the antimotion sickness drug of choice in the U.S. Space Shuttle program; however, virtually nothing is known about the bioavailability and performance effects of this drug in the microgravity environment. PMZ has detrimental side effects on human performance on Earth that could affect Shuttle operations. In a recent ground-based study we examined: 1) the effects of promethazine (PMZ) on Shuttle landing performance using the portable inflight landing operations trainer (PILOT), and 2) saliva and urine samples to determine the pharmacokinetics of PMZ. The PILOT performance data is presented here.

Author

Training Devices; Promethazine; Pilot Performance; Motion Sickness Drugs; Microgravity; Human Performance; Antiemetics and Antinauseants

20000020519 NASA Ames Research Center, Moffett Field, CA USA

Bone Density and High Salt Diets in a Space Flight Model

Arnaud, S. B., NASA Ames Research Center, USA; Navidi, M., Lockheed Martin Engineering and Science Services, USA; Liang, M. T. C., Bowling Green State Univ., USA; Wolinsky, I., Houston Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 192-193; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

High salt diets accelerate bone loss with aging in patients with postmenopausal osteoporosis except when calcium supplementation is provided. We have observed that the decrease in mineral content of growing femurs in juvenile rats, exposed to a space flight model which unloads the hind limbs , is substantially less in animals fed excess salt. to determine whether excess

dietary salt has the same effect on the skeleton of the mature animal whose response to unloading is increased resorption and bone loss rather than impaired growth, we carried out a metabolic study in mature rats with hindlimbs unloaded by tailsuspension.
Author
Bone Demineralization; Osteoporosis; Musculoskeletal System; Minerals; Calcium

20000020523 Johns Hopkins Univ., Applied Physics Lab., Laurel, MD USA
Compact, High Precision, Multiple Projection DEXA Scanner for Measurement of Bone and Muscle Loss During Prolonged Spaceflight
Charles, H. K., Jr., Johns Hopkins Univ., USA; Beck, T. J., Johns Hopkins Medical Institutions, USA; Feldmesser, H. S., Johns Hopkins Univ., USA; Magee, T. C., Johns Hopkins Univ., USA; Pisacane, V. L., Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 202-204; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The purpose of the Dual Energy X-ray Absorptiometry (DEXA) project is to design, build, and test an advanced X-ray absorptiometry scanner capable of being used to monitor the deleterious effects of weightlessness on the human musculoskeletal system during prolonged spaceflight. The instrument is based on the principles of dual energy X-ray absorptiometry and is designed, not only to measure bone mineral density and volume and to decompose soft tissue into measurements of fat and lean mass but also, to use those measurements to derive structural properties (cross sections, moments of inertia) permitting an assessment of the biomechanical upon consequences of microgravity on bone and/or muscle mass and the potential risk upon returning to planetary gravity levels. Multiple projection technology, coupled with axial translation, will be employed to provide geometric properties in three dimensions suitable for a three-dimensional structural analysis of the scanned region. The structural analysis will then be combined with bone models and projected loading scenarios to determine risk of fracture. The instrument will employ advanced fabrication techniques to minimize volume and mass (100 kg current target with a long-term goal of 60 kg) of the scanner as appropriate for the space environment, while maintaining the required mechanical stability for high-precision measurement. The unit will have the precision required to detect changes in bone mass and geometry as small as 1% and changes in muscle mass as small as 5%.
Author
Design Analysis; Fabrication; Performance Tests; X Rays; Absorption Spectroscopy; Weightlessness; Structural Analysis; Musculoskeletal System; Bone Demineralization; Scanners

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Effects of Spaceflight on the Attachment of Muscle to the Tibia, Fibula and Calcaneus
Johnson, R. B., Mississippi Univ. Medical Center, USA; Tsao, A. K., Mississippi Univ. Medical Center, USA; St.John, K. R., Mississippi Univ. Medical Center, USA; Betcher, R. A., Mississippi Univ. Medical Center, USA; Tucci, M. A., Mississippi Univ. Medical Center, USA; Parsell, D. E., Mississippi Univ. Medical Center, USA; Dai, X., Mississippi Univ. Medical Center, USA; Zardiackas, L. D., Mississippi Univ. Medical Center, USA; Benghuzzi, H. A., Mississippi Univ. Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 211-213; In English
Contract(s)/Grant(s): NCC2-863; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Microgravity significantly reduces transmission of ground-reaction forces to bones, promoting atrophy. There is little information available concerning the effects of microgravity on bones at sites where anti-gravity muscles are attached (tendon-bone junctions). This study evaluates the effects of microgravity on the origin and insertion sites of anti-gravity muscles on the rat tibia, fibula and calcaneus. Changes in the strength of those tendon-bone junctions could predispose the animal to injury following spaceflight.
Author
Tibia; Tendons; Muscles; Gravitation; Bones; Atrophy

20000020530 Baylor Coll. of Medicine, Dept. of Cell Biology, Houston, TX USA
Novel Receptor-Based Countermeasures to Microgravity-Induced Bone Loss
OMalley, B. W., Baylor Coll. of Medicine, USA; Smith, C. L., Baylor Coll. of Medicine, USA; Weigel, N. L., Baylor Coll. of Medicine, USA; Brown, E. M., Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 218-221; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Manned space flight has opened new frontiers for human exploration, but humans in a microgravity environment for an extended time experience numerous physiological changes, including bone loss. Weight-bearing exercise contributes significantly to bone health, and it is likely reduced mechanical load is a major cause of microgravity-induced osteopenia. However, changes in the levels of systemic factors regulating bone formation and resorption [growth factors, calcium, steroids

and 1,25-dihydroxyvitamin D (1,25-D)] occur in humans and animals in microgravity, and it is likely that these alterations also negatively influence bone. The biological actions of these hormones are mediated by their receptors [estrogen receptor (ER), vitamin D receptor (VDR) and Ca(2+)0 -sensing receptor (CaR)], which play key roles in the normal 0 bone turnover that is necessary for skeletal health. These receptors control: (1) differentiation of osteoblast (OB) and osteoclast (OC) precursors, (2) functions of mature OBs and OCs and/or (3) other cells within the bone and bone marrow microenvironment controlling (1) and (2) (e.g. stromal cells and monocytes). Thus, we hypothesize that appropriate use of novel ER-, VDR- and CaR-based therapeutics will mitigate the reduced bone formation and increased bone resorption that contribute to microgravity-induced bone loss. Indeed, synergistic interactions among these receptors may enhance the actions of any one used alone.
Author
Countermeasures; Microgravity; Bone Demineralization; Bone Marrow; Musculoskeletal System

20000020532 Pennsylvania State Univ., Center for Locomotion Studies, University Park, PA USA
Exercise Countermeasures for Bone Loss During Space Flight: A Method for the Study of Ground Reaction Forces and their Implications for Bone Strain
Peterman, M., Pennsylvania State Univ., USA; McCrory, J. L., Pennsylvania State Univ., USA; Sharkey, N. A., Pennsylvania State Univ., USA; Piazza, S., Pennsylvania State Univ., USA; Cavanagh, P. R., Pennsylvania State Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 224-227; In English
Contract(s)/Grant(s): NAGW-4421; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Effective countermeasures to prevent loss of bone mineral during long duration space flight remain elusive. Despite an exercise program on MIR flights, the data from LeBlanc et al. (1996) indicated that there was still a mean rate of loss of bone mineral density in the proximal femur of 1.58% per month (n=18, flight duration 4 - 14.4 months). The specific mechanisms regulating bone mass are not known, but most investigators agree that bone maintenance is largely dependent upon mechanical demand and the resultant local bone strains. A plausible hypothesis is that bone loss during space flight, such as that reported by LeBlanc et al. (1996), may result from failure to effectively load the skeleton in order to generate localized bone strains of sufficient magnitude to prevent disuse osteoporosis. A variety of methods have been proposed to simulate locomotor exercise in reduced gravity. In such simulations, and in an actual microgravity environment, a gravity replacement load (GRL) must always be added to return the exercising subject to the support surface and the resulting skeletal load is critically dependent upon the magnitude of the GRL. to our knowledge, GRLs during orbital flight have only been measured once (on STS 81) and it is likely that most or all prior treadmill exercise in space has used GRLs that were less than one body weight. McCrory (1997) has shown that subjects walking and running in simulated zero-G can tolerate GRLs of 1 if an appropriate harness is used. Several investigators have attempted to measure in vivo strains and forces in the bones of humans, but have faced ethical and technical limitations. The anteromedial aspect of the tibial midshaft has been a common site for the placement of strain gauges; one reason to measure strains in the anterior tibia is that this region is surgically accessible. Aamodt et al. (1997) were able to measure strains on the lateral surface of the proximal femur only because their experimental subjects were already scheduled for hip surgery. Lu et al. (1997) used an instrumented massive proximal femoral prosthesis along with electromyographic measurements to demonstrate that femoral forces depend on muscular activity. These analyses of in vivo bone mechanics are valuable. The invasive nature of the procedures involved, however, limits both the number of subjects and the number of strain gauge locations. Further, the results of these studies may be confounded by the inclusion of subjects with pathological conditions. Gross et al. (1992) measured strain at three locations on the equine third metacarpal and used those data to construct a computer model of the internal strain environment of the bone. An analogous placement of multiple gauges in living humans would be difficult and potentially hazardous because of the depth of soft tissue overlying the tibia and femur.
Derived from text
Countermeasures; Bone Demineralization; Space Flight; Computerized Simulation; Femur; Gravitation; Physical Exercise

20000020533 State Univ. of New York, Musculo-Skeletal Research Lab., Stony Brook, NY USA
Expression of Novel Gene Products Upregulated by Disuse is Normalized by an Osteogenic Mechanical Stimulus: Evidence for the Molecular Basis of a Low Level Biomechanical Countermeasure for Osteoporosis?
Rubin, C., State Univ. of New York, USA; Zhi, J., State Univ. of New York, USA; Xu, G., State Univ. of New York, USA; Cute, M., State Univ. of New York, USA; McLeod, K., State Univ. of New York, USA; Hadjiargyrou, M., State Univ. of New York, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 228-231; In English
Contract(s)/Grant(s): NAG5-3950; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The National Research Council's report entitled: A Strategy for Space Biology and Medical Science, highlighted several areas of fundamental scientific investigation which must be addressed to make long-term space exploration not only feasible, but safe. This "Goldberg Strategy," as well as several subsequent reports published by the NRC's Space Studies Board (e.g.,

Assessment of Programs in Space Biology and Medicine, Smith et. al., 1991), suggests that the principal hurdle to man's extended presence in space is the osteopenia which parallels reduced gravity. Ironically, the most significant risk to the skeleton may only be realized on return to normal gravitational fields, and full recovery of bone mass may never occur. Effective counter-measures to this microgravity induced bone loss are thus essential. Considering the similarities of space and aging induced osteopenia, an indisputable benefit of such a prophylaxis would be its potential as a treatment for the bone loss which plagues over 25 million people in the U.S. The osteogenic potential of mechanical strain is strongly frequency dependent, with sensitivity increasing up through at least 60 Hz (cycles per second). One hundred seconds per day of a 1 Hz cyclic loading will inhibit disuse osteopenia only if sufficient in magnitude to engender 1000 microstrain (mu(epsilon)) in the tissue. When loading is applied at 30 Hz, however, mechanical strains on the order of 5O mu(epsilon) (approx. 1% of the peak strains which occur in bone during vigorous functional activity), can stimulate bone formation in a duration dependent manner. In longer term animal studies, strains of less than 10 mu(epsilon), induced non-invasively via a whole body vibration, will stimulate bone formation on the surfaces of trabeculae, increase bone density, and improve strength. Finally, preliminary results from a double blind prospective clinical trial shows promise in inhibiting the bone loss which parallels the menopause. Based on these observations, we propose that these high frequency, low magnitude, mechanical strains effectively serve as a "surrogate" for musculoskeletal ground reaction forces, and thus represent an ideal countermeasure to the osteopenia which parallels microgravity conditions. The specific goal of this NASA funded work is to identify genes in bone upregulated by disuse, and to determine the efficacy of an osteogenic mechanical stimulus to downregulate their expression.

Author

Genes; Aerospace Medicine; Biodynamics; Bone Demineralization; Countermeasures; Microgravity; Musculoskeletal System

20000020534 Johns Hopkins Univ., Baltimore, MD USA

Skeletal Structural Consequences of Reduced Gravity Environments

Ruff, C. B., Johns Hopkins Univ., USA; Beck, T. J., Johns Hopkins Univ., USA; Newman, D., Johns Hopkins Univ., USA; Oden, M., Johns Hopkins Univ., USA; Shaffner, G., Johns Hopkins Univ., USA; LeBlanc, A., Johns Hopkins Univ., USA; Shackelford, L., Johns Hopkins Univ., USA; Rianon, N., Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 232-233; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Human physical activity in terrestrial environments is enabled by muscle forces acting through the levers of the long bones to move the body's mass against the earth's gravitational field. The loading forces generated in the skeleton are believed to be the stimulus for structural adaptation of bone to maintain skeletal strains within certain intrinsic limits. Exceeding strain set limits with consistent strenuous exercise is believed to stimulate new bone formation while strains consistently below set limits, as in disuse or microgravity, cause bone loss. The removal of mechanical stimulus in disuse or exposure to microgravity results in the rapid loss of muscle mass followed by the slower but inexorable loss of bone. In prolonged space-flight, astronauts and cosmonauts experience highly variable patterns of bone loss, probably because of variations in the effects of microgravity as well as local variations in the efficacy of exercise countermeasures. The main consequence of loss of bone is an increase in bone fragility, but the structural consequences of bone loss, i.e., the risk of catastrophic failure, cannot be ascertained by conventional metrics of skeletal bone mass. The principle goals of this project are to use engineering methods to assess the structural consequences of prolonged weightlessness. Work involves the extraction of structural information from bone mass data on astronauts, cosmonauts and bed-rest subjects as well as the use of x-ray computed tomography on the tail suspended rat model.

Author

Human Reactions; Bone Demineralization; Countermeasures; Exposure; Losses; Microgravity; Musculoskeletal System; Physical Exercise

20000020535 Johns Hopkins Univ., Baltimore, MD USA

The Effects of Partial Mechanical Loading and Ibandronate on Skeletal Tissues in the Adult Rat Hindquarter Suspension Model of Microgravity

Schultheis, Lex, Johns Hopkins Univ., USA; Shapiro, Jay, Walter Reed Army Medical Center, USA; Bloomfield, Sue, Texas A&M Univ., USA; Fedarko, Neal, Johns Hopkins Univ., USA; Thierry–Palmer, Myrtle, Morehouse School of Medicine, USA; Ruff, Christopher, Johns Hopkins Univ., USA; Ruiz, Jennifer, Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 234; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The elimination of weight bearing force in microgravity uncouples bone formation from bone resorption resulting in net bone loss. Gravity imposed mechanical loading can mitigate these effects of diminished mechanical strain. However quantitative assessment of gravity titration as a mechanical countermeasure in a ground-based animal model has not yet been studied. We will determine the level of mechanical loading required to maintain bone remodeling in the face of weightlessness as well as the role of antiresorptive agents under this condition. Graded mechanical loading on forepaws starting at 50% body weight vs. unloaded

hindlimbs is applied through a novel servo-controlled platform that is the floorplate of each cage. An infrared optical system quantitatively resolves a total displacement of 2 mm caused by a 100 gram weight to within 5%. The activity of the animals is monitored continuously. The relationship between ground reaction forces and humerus bone strain is being concurrently investigated. Critical parameters under investigation include the magnitudes, repetition rates and frequency (Fourier) spectrum of applied forces and their associated bone strain history. Antiresorptive agents have been shown to decrease bone resorption and to increase bone mass. Ibandronate is a third- generation bisphosphonate which can be administered intravenously at 3 month intervals with little systemic toxicity. Using the rat adult (250-300 gm) hindquarter 35-day suspension model, parameters of bone biomechanics, bone mineral density, bone histomorphology and biochemistry are measured. Assessment includes vitamin D metabolites, and 24 hour urine catecholamine production and dry adrenal mass as parameters of stress. Ten simultaneous animal suspension systems are operational. Continuously monitored impact profiles have been recorded during suspension with 50% weight bearing and in free roaming controls. Bone mineral density has been recorded using peripheral quantitative computed tomography (pQCT). Bone marrow stromal fibroblasts (osteoprogenitor cells) have been isolated from suspended and control animals. We hypothesize that the combination of a critical amount mechanical loading and an antiresorptive agent will maintain normal bone remodeling in the face of microgravity.

Author

Adrenal Gland; Biochemistry; Biodynamics; Bone Demineralization; Bone Marrow; Countermeasures; Gravitation; Humerus

20000020536 NASA Johnson Space Center, Houston, TX USA

Bone Loss in Space: Shuttle/MIR Experience and Bed Rest Countermeasure Program

Shackelford, L. C., NASA Johnson Space Center, USA; LeBlanc, A., Baylor Coll. of Medicine, USA; Feiveson, A., NASA Johnson Space Center, USA; Oganov, V., Institute of Biomedical Problems, USSR; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 235; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Loss of bone mineral during space flight was documented in the 1970's Skylab missions. The USSR space program made similar observations in the 1980's. The Institute of Biomedical Problems in Moscow and NASA JSC in 1989 began to collect pre- and post-flight bone mineral density (BMD) using Hologic QDR 1000 DEXA scanners transferred from JSC to Moscow and Star City. DEXA whole body, hip, and lumbar spine scans were performed prior to and during the first week after return from 4- to 6-month missions (plus one 8-month mission and one 14- month mission) on the Mir space station. These data documented the extent and regional nature of bone loss during long duration space flight. of the 18 cosmonauts participating in this study between 1990 and 1995, seven flew two missions. BMD scans prior to the second flight compared to the first mission preflight scans indicated that recovery was possibly delayed or incomplete. Because of these findings, NASA and IBMP initiated the study "Bone Mineral Loss and Recovery After Shuttle/Mir Flights" in 1995 to evaluate bone recovery during a 3-year post-flight period. All of the 14 participants thus far evaluated lost bone in at least one region of the spine and lower extremities during flight. Of the 14, only one to date has exhibited full return to baseline BNM values in all regions. The current study will continue until the last participant has reached full bone recovery in all regions, has reached a plateau, or until three years after the flight (2001 for the last mission of the program). Bone mineral density losses in space and difficulty in returning to baseline indicate a need for countermeasure development. In late 1996 NASA JSC and Baylor College of Medicine were approved to conduct two countermeasure studies during 17 weeks of bed rest. In 1997 the studies were begun in the bed rest facility established by NASA, Baylor College of Medicine, and The Methodist Hospital in Houston. To date, three bed rest controls, five resistive exercisers, and four subjects taking alendronate (a bisphoshonate that inhibits osteoclastic resorption of bone) have completed 17 weeks bed rest. In contrast to information currently available from space flight (n=28) and bed rest (n= 12) in which all individuals experienced bone loss in at least one region, one of four subjects taking alendronate and one of five subjects performing heavy resistive exercise at bed rest fully maintained bone density in all regions of the spine and lower extremities. Overall results of both countermeasures which will be presented are encouraging. The study will be completed by mid to late 2000 with 10 subjects in each of three groups.

Author

Bone Demineralization; Bed Rest; Countermeasures; Losses; Physical Exercise

20000020538 NASA Ames Research Center, Moffett Field, CA USA

Non-Invasive Investigation of Bone Adaptation in Humans to Mechanical Loading

Whalen, R., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 239-241; In English

Contract(s)/Grant(s): NCC2-5088; NCC2-5186; RTOP 199-26-12-35; DVA Proj. B802-RA; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Experimental studies have identified peak cyclic forces, number of loading cycles, and loading rate as contributors to the regulation of bone metabolism. We have proposed a theoretical model that relates bone density to a mechanical stimulus derived from average daily cumulative peak cyclic 'effective' tissue stresses. In order to develop a non-invasive experimental model to test the theoretical model we need to: (1) monitor daily cumulative loading on a bone, (2) compute the internal stress state(s) resulting from the imposed loading, and (3) image volumetric bone density accurately, precisely, and reproducibly within small contiguous volumes throughout the bone. We have chosen the calcaneus (heel) as an experimental model bone site because it is loaded by ligament, tendon and joint contact forces in equilibrium with daily ground reaction forces that we can measure; it is a peripheral bone site and therefore more easily and accurately imaged with computed tomography; it is composed primarily of cancellous bone; and it is a relevant site for monitoring bone loss and adaptation in astronauts and the general population. This paper presents an overview of our recent advances in the areas of monitoring daily ground reaction forces, biomechanical modeling of the forces on the calcaneus during gait, mathematical modeling of calcaneal bone adaptation in response to cumulative daily activity, accurate and precise imaging of the calcaneus with quantitative computed tomography (QCT), and application to long duration space flight.

Author

Bone Demineralization; Bone Mineral Content; Mathematical Models; Residual Stress; Loading Rate; Cyclic Loads

20000020539 NASA Johnson Space Center, Houston, TX USA

Renal Stone Risk During Space Flight

Whitson, Peggy A., NASA Johnson Space Center, USA; Pietrzyk, Robert A., Wyle Life Sciences, USA; Sams, Clarence F., NASA Johnson Space Center, USA; Pak, Charles Y. C., Texas Univ. Health Science Center, USA; Jones, Jeffrey A., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 242; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Space flight produces a number of metabolic and physiological changes in the crewmembers exposed to microgravity. Following launch, body fluid volumes, electrolyte levels, and bone and muscle undergo changes as the human body adapts to the weightless environment. Changes in the urinary chemical composition may lead to the potentially serious consequences of renal stone formation. Previous data collected immediately after space flight indicate changes in the urine chemistry favoring an increased risk of calcium oxalate and uric acid stone formation (n = 323). During short term Shuttle space flights, the changes observed include increased urinary calcium and decreased urine volume, pH and citrate resulting in a greater risk for calcium oxalate and brushite stone formation (n = 6). Results from long duration Shuttle/Mir missions (n = 9) followed a similar trend and demonstrated decreased fluid intake and urine volume and increased urinary calcium resulting in a urinary environment saturated with the calcium stone-forming salts. The increased risk occurs rapidly upon exposure to microgravity, continues throughout the space flight and following landing. Dietary factors, especially fluid intake, or pharmacologic intervention can significantly influence the urinary chemical composition. Increasing fluid intake to produce a daily urine output of 2 liters/day may allow the excess salts in the urine to remain in solution, crystals formation will not occur and a renal stone will not develop. Results from long duration crewmembers (n = 2) who had urine volumes greater than 2.5 L/day minimized their risk of renal stone formation. Also, comparisons of stone-forming risk in short duration crewmembers clearly identified greater risk in those who produced less than 2 liters of urine/day. However, hydration and increased urine output does not correct the underlying calcium excretion due to bone loss and only treats the symptoms and not the cause of the increased urinary salts. Dietary modification and promising pharmacologic treatments may also be used to reduce the potential risk for renal stone formation. Potassium citrate is being used clinically to increase the urinary inhibitor levels to minimize the development of crystals and the growth of renal stones. Bisphosphonates are a class of drugs recently shown to help in patients with osteoporosis by inhibiting the loss of bones in elderly patients. This drug could potentially prevent the bone loss observed in astronauts and thereby minimize the increase in urinary calcium and reduce the risk for renal stone development. Results of NASA's renal stone risk assessment program clearly indicate that exposure to microgravity changes the urinary chemical environment such that there is an increased risk for supersaturation of stone-forming salts, including calcium oxalaie and brushite. These studies have indicated specific avenues for development of countermeasures for the increased renal stone risk observed during and following space flight. Increased hydration and implementation of pharmacologic countermeasures should largely mitigate the in-flight risk of renal stones.

Derived from text

Body Fluids; Bone Demineralization; Calcium; Chemical Composition; Countermeasures; Losses; Metabolism; Microgravity; Muscles

20000020540 NASA Ames Research Center, Moffett Field, CA USA

Bone Proteoglycan Changes During Skeletal Unloading

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USA; Arnaud, S., NASA Ames Research Center, USA; Grindeland, R., NASA Ames Research Center, USA; Grzesik, W., North Carolina Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 243-244; In English Contract(s)/Grant(s): NAG2-1188; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Skeletal adaptability to mechanical loads is well known since the last century. Disuse osteopenia due to the microgravity environment is one of the major concerns for space travelers. Several studies have indicated that a retardation of the mineralization process and a delay in matrix maturation occur during the space flight. Mineralizing fibrillar type I collagen possesses distinct cross-linking chemistries and their dynamic changes during mineralization correlate well with its function as a mineral organizer. Our previous studies suggested that a certain group of matrix proteoglycans in bone play an inhibitory role in the mineralization process through their interaction with collagen. Based on these studies, we hypothesized that the altered mineralization during spaceflight is due in part to changes in matrix components secreted by cells in response to microgravity. In this study, we employed hindlimb elevation (tail suspension) rat model to study the effects of skeletal unloading on matrix proteoglycans in bone.
Author

Bone Demineralization; Unloading; Proteins; Musculoskeletal System; Microgravity

20000020541 Texas Univ., Dallas, TX USA

The Effects of Twelve Weeks of Bedrest on Bone Histology, Biochemical Markers of Bone Turnover, and Calcium Homeostasis in Eleven Normal Subjects

Zerwekh, J. E., Texas Univ., USA; Ruml, L. A., Texas Univ., USA; Gottschalk, F., Texas Univ., USA; Pak, C. Y. C., Texas Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 245-247; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Gravity is recognized as an important factor in the normal growth and maintenance of the skeletal system. The mechanism(s) by which gravity affects skeletal growth and remodeling are not known, but in its absence, such as during space flight or prolonged immobilization, the result is a rapid loss of bone mineral. If of sufficient duration and magnitude, such losses of bone mineral could lead to fracture. In addition, increased urinary concentration of stone-forming salts would increase the risk for kidney stone formation. In order to prevent such losses during skeletal unloading, effective countermeasures must be directed at preventing the underlying defect in bone metabolism. In order to better understand the nature of the skeletal defect(s) which contribute to this loss of bone mineral, we examined the effects of twelve weeks of bedrest on bone metabolism and calcium homeostasis in eleven normal volunteers. This was accomplished via the use of bone histomorphometry and measurement of calcitropic hormones and biochemical markers of bone turnover.
Author

Bed Rest; Musculoskeletal System; Histology; Biochemistry; Homeostasis

20000020542 NASA Johnson Space Center, Houston, TX USA

Cardiovascular Session Summary

Raven, Peter, University of North Texas Health Science Center, USA; Schneider, Sue, NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 249-256; In English; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

It was apparent that the bed-rest and spaceflight data indicated that decreases in plasma volume and cardiac atrophy along with cardiac remodeling were fundamental changes which predisposed many astronauts to post flight orthostatic intolerance. Despite the recently acquired in-flight and post-flight muscle sympathetic nerve activity findings suggesting that the sympathetic nerve responses were appropriate there remains significant contrary data from bed-rest studies, post- flight stand tests and hind-limb unweighted rat studies that suggest that the vasoconstrictive responses were compromised at least insufficient in susceptible individuals. The key issues raised is whether a diminished increase in sympathetic activity from baseline without changes in 254 First Biennial Space Biomedical Investigators'Workshop Cardiovascular peak response or receptor adaptations is an abnormal response or is an individual variance of response to the accentuated decrease in stroke volume. Data relating autonomic neural control of heart rate were presented to suggest that the vagal and sympathetic control of heart rate was attenuated. Also, bed-rest and space flight induced attenuated baroreflex control of heart rate was shown to be restored to pre-bedrest function by one bout of maximal dynamic exercise. However, these data were confounded by relying on the use of R-R interval as a measure of efferent responses of the baroreflex during a condition in which the baseline heart rate was changed. Clearly the idea that the autonomic control of heart rate may be changed by microgravity needs further investigation. This direction is suggested despite the fact that in the triple product (HR x SV x TPR = MAP) assessment of the regulation of arterial blood pressure during orthostasis the role of the HR reflex may be less influential than that associated. with cardiac atrophy (SV changes) and aberrant sympathetic vasoconstriction (resistance) changes. Although sympathetic nerve activity responses in-flight and post-flight on neurolab appeared appropriate, enough bed-rest and post-flight stand test data, along with animal model data suggest that vasoconstriction

was compromised. The mechanism of this compromised vasoconstriction needs to be delineated. Other major findings concerning microgravity and physiological regulatory systems are that: I . Thermoregulatory adaptation appear to suggest some decrements in the control of cutaneous vasodilation and sweating; 2. Calcium resorption and dietary calcium need to be defined for differing durations of spaceflight, especially as the effects of excess calcium on vasomotor function appears to be detrimental; 3. Neurohumoral mechanisms of microgravity induced changes in neural function and the regulation of plasma volume and total body water, bone resorption and autonomic neural control of the circulation need further delineation; 4. As performance of work tasks become prolonged, the mechanisms of blood pressure regulation in microgravity needs to be used in the recovery period from prolonged work tasks.
Derived from text
Cardiovascular System; Bed Rest; Plasma Chemistry; Abnormalities; Activity (Biology); Autonomic Nervous System; Bone Demineralization; Heart Function; Heart Rate; Microgravity; Muscular Function

20000020544 Medical Univ. of South Carolina, Gazes Cardiac Research Inst., Charleston, SC USA
Mechanisms for Load Control of Cardiac Mass: Cell Culture Studies in Adult Cardiomyocytes using a 3-D Collagen Matrix
Baicu, C. F., Medical Univ. of South Carolina, USA; Turner, J. H., Medical Univ. of South Carolina, USA; Young, V. D., Medical Univ. of South Carolina, USA; Barnes, M., Medical Univ. of South Carolina, USA; Zile, M. R., Medical Univ. of South Carolina, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 258; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Growth regulation in the adult myocardium is controlled by a complex interaction of mechanical, neurohormonal and growth factors. The purpose of this study was to use in-vitro primary cell culture techniques to isolate hemodynamic and mechanical determinants of cardiac muscle cell growth without making simultaneous changes in other potential factors.
Author
Loads (Forces); Heart; Cells (Biology); Myocardium; Hemodynamic Responses; Research

20000020546 Army Inst. of Surgical Research, Fort Sam Houston, TX USA
Application of Acute Maximal Exercise to Enhance Mechanisms Underlying Blood Pressure Regulation and Orthostatic Tolerance After Exposure to Simulated Microgravity
Convertino, V. A.; Engelke, K. A.; Doerr, D. F.; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 260-262; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Development of orthostatic hypotension and intolerance in astronauts who return to earth following a spaceflight mission represents a significant operational concern to NASA. Reduced plasma volume, vascular resistance, and baroreflex responsiveness following exposure to actual and ground-based analogs of microgravity have been associated with orthostatic instability, suggesting that these mechanisms may contribute alone or in combination to compromise of blood pressure regulation after spaceflight. It therefore seems reasonable that development of procedures designed to reverse or restore the effects of microgravity on regulatory mechanisms of blood volume, vascular resistance and cardiac function should provide some protection against postflight orthostatic intolerance. Several investigations have provided evidence that a single bout of exhaustive dynamic exercise enhances functions of mechanisms responsible for blood pressure stability. Therefore, the purpose of our research project was to conduct a series of experiments using ground-based analogs of reduced gravity (i.e., prolonged restriction to the upright standing posture) in human subjects to investigate the hypothesis that a single bout of dynamic maximal exercise would restore blood volume, vascular resistance and cardiac function and improve blood pressure stability.
Author
Blood Pressure; Cardiovascular System; Heart Function; Microgravity; Orthostatic Tolerance; Plasma Chemistry

20000020547 Presbyterian Hospital of Dallas, Inst. for Exercise and Environmental Medicine, Dallas, TX USA
Potential Mechanism Leading to Impaired Thermoregulation Following Microgravity Exposure
Crandall, C. G., Presbyterian Hospital of Dallas, USA; Etzel, R. A., Presbyterian Hospital of Dallas, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 267-270; In English
Contract(s)/Grant(s): NAGW-3582; NAG9-1033; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Prolonged exposure to microgravity or its analogues impairs thermoregulation in humans evidenced by higher internal temperatures following the exposure during a thermal challenge. Although the mechanism leading to this response has not been clearly delineated, we identified that prolonged head-down tilt (HDT) markedly impairs thermoregulatory reflex control of skin blood flow, as demonstrated by an increased internal temperature threshold for cutaneous vasodilation, and by a reduced slope of the relationship between the elevation in skin blood flow relative to the elevation in internal temperature. Recently, Fortney

et al. identified similar responses in two individuals following 115 days of microgravity exposure. One possible mechanism leading to altered cutaneous vasodilation during a thermal challenge following actual or simulated microgravity exposure may be associated with baroreflex-mediated attenuation in the elevation of skin blood flow. During a heat stress the elevation in skin blood flow is accomplished through a combination of increased cutaneous vascular conductance and cardiac output, both of which result in central venous pressure (CVP) decreasing 2-6 mmHg. Reductions in CVP of this magnitude in normothermia decrease muscle blood flow and skin blood flow presumably through unloading the cardiopulmonary baroreceptors. It is unclear whether the reduction in CVP, and accompanying cardiopulmonary baroreceptor unloading, during passive heating buffers the elevation in skin blood flow. That is, would the elevation in skin blood flow be greater if CVP did not decrease, or decreased to a lesser extent during the heat stress? Conversely, if CVP decreased to a greater extend during a thermal challenge following a perturbation such as prolonged HDT, would the elevation in skin blood flow be attenuated during that thermal challenge? Given that prolonged HDT decreases plasma volume and central venous pressure, such a finding would provide a plausible hypothesis to explain why skin blood flow does not increase to the same extent during a heat stress following simulated or actual microgravity exposure. Thus, the purpose of this project was to identify whether cardiopulmonary baroreceptor unloading coincident with heat stress buffers the elevation in skin blood flow.
Author
Heat Tolerance; Thermoregulation; Microgravity; Physiological Responses; Plasma Chemistry; Heart Function; Cardiovascular System; Analogs

20000020548 Virginia Commonwealth Univ., Medical Coll. of Virginia, Richmond, VA USA
Autonomic Consequences of Microgravity Exposure
Eckberg, Dwain L., Virginia Commonwealth Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 271-273; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Human autonomic stretch and chemical receptors continuously sense changes of body position, arterial pressure, blood volume, blood chemistry, metabolic activity, and exercise, and orchestrate finely tuned changes of efferent sympathetic and vagal nerve traffic to diverse organs. When astronauts enter microgravity, the quality and quantity of receptor inputs change in major ways. Immediately, distension of the heart and arteries in the upper body increases. As exposure to microgravity continues, however, blood volume and distension of the heart and upper body decrease. Upon return to gravity, most astronauts experience difficulty standing: their heart rates increase to levels above those experienced before exposure to microgravity, their arterial pressures may fall, and they may even lose consciousness. My laboratory has longstanding interest in these autonomic changes, and has over many years sought to characterize them before, during, and after space missions. Space studies have been complemented by ground based research in healthy volunteers and patients with orthostatic syncope. This total effort has helped to define basic human physiological mechanisms. In particular, recent efforts have helped to delineate autonomic mechanisms involved with interventions that may lead to hypotension, including major exercise, and standing.
Author
Microgravity; Autonomic Nervous System; Laboratories; Metabolism; Hypotension; Heart Rate; Exposure; Chemical Composition

20000020549 NASA Johnson Space Center, Houston, TX USA
Gender-Related Differences in Cardiovascular Responses to Orthostatic Stress
Fritsch–Yelle, Janice M., NASA Johnson Space Center, USA; DAunno, Dominick S., National Space Biomedical Research Inst., USA; Waters, Wendy W., National Space Biomedical Research Inst., USA; Freeman–Perez, Sondra, Wyle Labs., Inc., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 274-275; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

There is evidence that men and women have different cardiovascular responses to standing, and that women are more susceptible to orthostatic hypotension than men. The present study seeks to determine if decreased orthostatic tolerance in women is caused by diminished vasoconstrictive responses.
Author
Physiological Responses; Cardiovascular System; Hypotension

20000020550 Beth Israel Deaconess Medical Center, Margaret and H. A. Rey Lab. for Nonlinear Dynamics in Medicine, Boston, MA USA
Heart Rate Dynamics During Microgravity: Bedrest and Spaceflight Studies
Goldberger, A. L., Beth Israel Deaconess Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 276-277; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

In collaboration with investigators at NASA and the Russian Space Program, we have been involved with a series of collaborative studies on analysis of heart rate dynamics during both terrestrial bedrest deconditioning studies and long-duration spaceflight aboard Mir. Our objectives are: 1) To compile and analyze digitized databases (preflight, during flight, and postflight) of continuous ECG recordings from de-identified crew members from U.S. Spacelab Life Sciences and Shuttle missions, as well as Russian Mir missions. 2) to test the hypotheses that: (a) loss of complex heart rate variability is a useful new index of cardiac deconditioning and space sickness during space flight, as well as during microgravity simulations with bedrest; and (b) to quantitatively assess the effects of countermeasures such as LBNP and exercise. 3) to analyze electrocardiographic data from spaceflight and microgravity simulations for evidence of potentially serious cardiac electrical instability and its precursors. and 4) to analyze subtle alterations in diurnal cycle dynamics in order to better understand the 46 "restorative" function of sleep.
Author
Heart Rate; Microgravity; Bed Rest; Space Flight; Data Bases; Space Adaptation Syndrome; Motion Sickness; Lower Body Negative Pressure; Electrocardiography

20000020555 Presbyterian Hospital of Dallas, Inst. for Exercise and Environmental Medicine, Dallas, TX USA
The Effect of Cardiac Mechanics on Orthostatic Intolerance Following Bed Rest
Levine, Benjamin D., Presbyterian Hospital of Dallas, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 286-287; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Gravitational and hydrostatic gradients play an essential role in determining the distribution of pressure and volume within the cardiovascular system. When these gradients are removed or minimized, such as during spaceflight or its ground-based simulations (head-down tilt bed rest), a central fluid shift occurs, initiating a neurohumorally mediated reduction in both blood/plasma and ventricular volume. Diastolic wall stress is thereby decreased and the volume load of the left ventricle is reduced compared to the supine position at I G. This adaptation is rapid, and appears to be substantially complete within the first 24-48 hours of microgravity exposure. Compounding these hemodynamic changes is a reduction in physical activity associated with confinement, which minimizes chronotropic and pressure work compared to more freely ambulatory periods. Within a few weeks of real or simulated microgravity, the heart appears to atrophy, presumably in response to reduced myocardial work. This cardiac atrophy results in impaired diastolic function characterized by decreased ventricular distensibility, and possibly by loss of diastolic suction leading to reduced ventricular filling. The combination of atrophy and hypovolemia results in a prominent reduction in stroke volume in the upright position at I G, which is the essential stimulus for microgravity induced orthostatic hypotension. Although the hypovolemia of spaceflight or bed rest appears to plateau after 24-48 hours of real or simulated microgravity, preliminary data obtained by the PI in three subjects who have completed 12 weeks of bed rest has failed to identify a plateau in the loss of cardiac mass measured by MRI. Moreover, 2 additional subjects have been studied through 6 weeks of supine bed rest (total n=5) allowing statistical analysis at this time point.
Derived from text
Cardiovascular System; Bed Rest; Diastole; Heart; Hemodynamic Responses; Microgravity; Myocardium; Physiological Responses; Pressure Distribution; Stroke Volume

20000020556 Yale Univ. School of Medicine, John B. Pierce Lab., New Haven, CT USA
Renal Sodium Handling After Exercise Induced Plasma Volume Expansion
Mack, G. W., Yale Univ. School of Medicine, USA; Kavouras, S. A., Yale Univ. School of Medicine, USA; Nagashima, K., Yale Univ. School of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 288-289; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

It is generally agreed that reduced orthostatic tolerance post space flight in astronauts is due, in part, to a reduction in plasma volume. It is also believed that exercise will be a critical component of any remedy used counter the "maladaptive" response to prolonged space flight. Within this context it is believed that exercise training and its accompanying hypervolemia could be used to offset the reduction on plasma volume associated with space flight. Thus, it is essential that the basic mechanisms responsible for plasma volume expansion be elucidated. Plasma volume expansion during exercise training is essentially isotonic. It has been proposed that increased salt retention could account for the elevation in plasma volume during exercise training yet little direct data supporting this hypothesis exists. The purpose of this investigation was to examine the role of renal sodium handling on exercise induced plasma volume expansion.
Author
Sodium; Physical Exercise; Plasma Chemistry; Hypervolemia

20000020557 Massachusetts Inst. of Tech., Cambridge, MA USA

Cardiovascular System Identification of Alterations in Cardiovascular Regulation During Simulated Space Flight

Mullen, T. J., Massachusetts Inst. of Tech., USA; Ramsdell, C. D., Harvard Medical School, USA; Sundby, G., Harvard Medical School, USA; Williams, G. H., Harvard Medical School, USA; Cohen, R. J., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 290-292; In English; Avail: CASI; A01, Hardcopy; A06, Microfiche

Alterations in cardiovascular regulation and function that occur during and after space flight have been reported. These alterations are manifested, for example, by reduced orthostatic tolerance upon reentry to the earth's gravity from space. However, the precise physiologic mechanisms responsible for these alterations remain to be fully elucidated. Perhaps, as a result, effective countermeasures have yet to be developed. In this study we apply a powerful, new method - cardiovascular system identification (CSI) - for the study of the effects of space flight on the cardiovascular system so that effective countermeasures can be developed. Cardiovascular System Identification (CSI) involves the mathematical analysis of second-to-second fluctuations in non-invasively measured heart rate, arterial blood pressure (ABP), and instantaneous lung volume (ILV - respiratory activity) in order to characterize quantitatively the physiologic mechanisms responsible for the couplings between these signals. Through the characterization of all the physiologic mechanisms coupling these signals, CSI provides a model of the closed-loop cardiovascular regulatory state in an individual subject. The model includes quantitative descriptions of the heart rate baroreflex as well as other important physiologic mechanisms. With an additional non-invasive measurement of stroke volume (SV - ultrasound Doppler method), the model may be extended to also include the characterization of the peripheral resistance baroreflex - which may play a central role in the development of orthostatic intolerance - and measures of systolic and diastolic function. We apply CSI in conjunction with the two general protocols of the human studies core. The first protocol involves ground-based, human bed-rest to simulate microgravity and standing to provide an orthostatic challenge. The second protocol is the same as the first but with the addition of circadian rhythm disruption to determine whether such disruption contributes to cardiovascular alterations. In these studies, we focus on the basic physiologic mechanisms responsible for the alterations in cardiovascular regulation and function during the simulated microgravity in order to formulate hypotheses regarding what countermeasures are likely to be most effective. In future studies, we plan to apply CSI to test the potential countermeasures in conjunction with the same bed-rest model. We also anticipate applying CSI for studying astronauts before and after space flight and ultimately, during space flight. The application of CSI promises to provide information relevant to the development and evaluation of effective countermeasures allowing humans to adapt appropriately upon reentry to the earth's gravity and to live and work for longer periods of time in microgravity.

Author

Space Flight; Simulation; Cardiovascular System; Blood Pressure; Circadian Rhythms; Countermeasures; Feedback Control; Heart Rate; Stroke Volume

20000020558 Massachusetts Inst. of Tech., Cambridge, MA USA

Non-Invasive Assessment of Susceptibility to Ventricular Arrhythmias During Simulated Space Flight

Mullen, T. J., Harvard Medical School, USA; Ramsdell, C. D., Harvard Medical School, USA; Sundby, G., Harvard Medical School, USA; Williams, G. H., Harvard Medical School, USA; Cohen, R. J., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 293-294; In English; Avail: CASI; A01, Hardcopy; A06, Microfiche

There are numerous anecdotal reports that suggest that space flight may increase the incidence of ventricular tachyarrhythmias, including one documented episode of a 14 beat run of ventricular tachycardia during a Mir mission. However, it is not known whether space flight actually does decrease ventricular electrical stability. It is extremely important to assess whether long duration space flight predisposes the heart to life-threatening ventricular arrhythmias - particularly with regard to planning a possible mission to mars. However, experience in clinical medicine on earth has shown that commonly used non-invasively risk stratifiers (e.g. signal averaged electrocardiogram (SAECG), QT dispersion, heart rate variability, baroreceptor sensitivity, left ventricular ejection fraction, and the presence of non-sustained ventricular tachycardia on Holter monitoring) are not very accurate predictors of the occurrence of sudden cardiac death (SCD), sustained ventri!cular tachycardia (VF), or ventricular fibrillation (VF). It is generally believed that invasive electrophysiologic testing (EP) is more accurate, but this procedure is highly invasive and not risk free. Recently, with NASA support, a new technique - the measurement of microvolt level T wave alternans (TWA) - has been developed. In a series of clinical studies in varied patient populations this technique has proven superior to other non-invasive risk stratifiers as a predictor of SCD, VT and VF. TWA has been found in various studies

to be equivalent to or superior to EP. In this project we apply the measurement of TWA, along with other risk stratifiers, to determine whether simulated microgravity increases the risk of ventricular tachyarrhythmias.
Author
Arrhythmia; Simulation; Tachycardia; Synchronism; Stability; Microgravity; Fibrillation

20000020559 Pennsylvania State Univ., Noll Physiological Research Center, University Park, PA USA
Postural Regulation of Muscle Sympathetic Nerve Activity Before and After Simulated and Actual Microgravity Deconditioning
Pawelczyk, J. A., Pennsylvania State Univ., USA; Levine, B. D., Presbyterian Hospital of Dallas, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 295-296; In English
Contract(s)/Grant(s): NAS9-19429; NAS9-19573; NAGW-3582; NAGW-4389; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The etiology of orthostatic intolerance after spaceflight is multifaceted. Morphological adaptations, in particular cardiac atrophy, are likely to magnify the decrease in stroke volume that occurs with reductions in cardiac filling pressure when standing. Neural adaptations may be inferred as well, as reductions in carotid-cardiac baroreflex responsiveness have been reported following bedrest deconditioning and spaceflight. Neural control of vascular resistance has not been studied directly when orthostatic intolerance is florid in the hours following spaceflight. However, the increases in systemic vascular resistance and plasma catecholamines during orthostatic stress are inappropriately low in orthostatically intolerant subjects following spaceflight, suggesting that deficits in the regulation of vascular resistance may be associated with hypoadrenergic function. The studies described in this abstract were designed to test this hypothesis.
Author
Muscular Function; Orthostatic Tolerance; Plasma Chemistry; Neck (Anatomy); Microgravity; Deconditioning; Etiology

20000020560 State Univ. of New York, Buffalo, NY USA
Influence of Gravity on Blood Volume and Flow Distribution
Pendergast, D., State Univ. of New York, USA; Olszowka, A., State Univ. of New York, USA; Bednarczyk, E., State Univ. of New York, USA; Shykoff, B., State Univ. of New York, USA; Farhi, L., State Univ. of New York, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 297-299; In English
Contract(s)/Grant(s): NAS9-16042; NAGW-3937; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

In our previous experiments during NASA Shuttle flights SLS 1 and 2 (9-15 days) and EUROMIR flights (30-90 days) we observed that pulmonary blood flow (cardiac output) was elevated initially, and surprisingly remained elevated for the duration of the flights. Stroke volume increased initially and then decreased, but was still above 1 Gz values. As venous return was constant, the changes in SV were secondary to modulation of heart rate. Mean blood pressure was at or slightly below 1 Gz levels in space, indicating a decrease in total peripheral resistance. It has been suggested that plasma volume is reduced in space, however cardiac output/venous return do not return to 1 Gz levels over the duration of flight. In spite of the increased cardiac output, central venous pressure was not elevated in space. These data suggest that there is a change in the basic relationship between cardiac output and central venous pressure, a persistent "hyperperfusion" and a re-distribution of blood flow and volume during space flight. Increased pulmonary blood flow has been reported to increase diffusing capacity in space, presumably due to the improved homogeneity of ventilation and perfusion. Other studies have suggested that ventilation may be independent of gravity, and perfusion may not be gravity- dependent. No data for the distribution of pulmonary blood volume were available for flight or simulated microgravity. Recent studies have suggested that the pulmonary vascular tree is influenced by sympathetic tone in a manner similar to that of the systemic system. This implies that the pulmonary circulation is dilated during microgravity and that the distribution of blood flow and volume may be influenced more by vascular control than by gravity. The cerebral circulation is influenced by sympathetic tone similarly to that of the systemic and pulmonary circulations; however its effects are modulated by cerebral autoregulation. Thus it is difficult to predict if cerebral perfusion is increased and if there is edema in space. Anecdotal evidence suggests there may be cerebral edema early in flight. Cerebral artery velocity has been shown to be elevated in simulated microgravity. The elevated cerebral artery velocity during simulated microgravity may reflect vasoconstriction of the arteries and not increased cerebral blood flow. The purpose of our investigations was to evaluate the effects of alterations in simulated gravity (+/-), resulting in changes in cardiac output (+/-), and on the blood flow and volume distribution in the lung and brain of human subjects. The first hypothesis of these studies was that blood flow and volume would be affected by gravity, but their distribution in the lung would be independent of gravity and due to vasoactivity changing vascular resistance in lung vessels. The vasodilitation of the lung vasculature (lower resistance) along with increased "compliance" of the heart could account for the absence of

increased central venous pressure in microgravity. Secondly, we postulate that cerebral blood velocity is increased in microgravity due to large artery vasoconstriction, but that cerebral blood flow would be reduced due to autoregulation.
Author
Blood Flow; Blood Volume; Gravitational Effects; Automatic Control; Brain Circulation; Cardiovascular System; Flow Distribution

20000020564 NASA Johnson Space Center, Houston, TX USA
Evaluation of Thermoregulation After Spaceflight
Schneider, S. M., NASA Johnson Space Center, USA; Williams, W. J., Wyle Labs., Inc., USA; Greenleaf, J. E., NASA Ames Research Center, USA; Lee, S. M. C., Wyle Labs., Inc., USA; Gonzalez, R., Army Research Inst. of Environmental Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 308-309; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Altered thermoregulation has been reported following spaceflight simulations such as water immersion and bedrest but it has never been evaluated immediately after actual spaceflight. Impaired thermoregulation may have significant impact during various spaceflight activities such as countermeasure exercise, extravehicular activity (EVA), landing, and egress. It would be manifested as an increased body temperature and heart rate and decreased work capacity and endurance. In this study we evaluated the exercise responses of two crewmembers following a long duration spaceflight and measured their changes in body temperatures, skin blood flow, sweating and heat production during a mild submaximal exercise stress.
Author
Evaluation; Thermoregulation; Simulation; Heart Rate; Extravehicular Activity; Countermeasures; Body Temperature

20000020565 Utah Univ., Biofluid Mechanics Lab., Salt Lake City, UT USA
Hydraulic and Computer Modeling of Cardiovascular Response to Weightlessness
Sharp, M. K., Utah Univ., USA; Pantalos, G. M., Utah Univ., USA; Gillars, K. J., Utah Univ., USA; Peterson, K., Utah Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 310-313; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Hydraulic and computer models of the systemic and pulmonary circulation have been developed for studying the acute effects of gravity on the cardiovascular system, including regional fluid shifting and the influence of hydrostatic pressure within the ventricle on diastolic ventricular filling, cardiac output and vascular pressures.
Author
Cardiovascular System; Computerized Simulation; Weightlessness; Hydraulic Analogies

20000020566 Hershey (Milton S.) Medical Center, Hershey, PA USA
Sympathetic Contributions to Orthostatic Tolerance and Vascular Tone Following Bed Rest
Shoemaker, J. Kevin, Hershey (Milton S.) Medical Center, USA; Sinoway, Lawrence I., Hershey (Milton S.) Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 314-316; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Augmentation of total peripheral resistance is critical for brain blood flow when cerebral perfusion pressure is diminished as one moves from the supine to the upright posture. Under these conditions increased total peripheral resistance is a function of changes in both stroke volume and peripheral vascular tone. In turn, vascular resistance is highly dependent upon a functioning sympathetic nervous system that can produce vasoconstriction in skeletal muscle and abdominal vascular beds. Current evidence suggests that blood vessel regulation may be altered by space flight, and its ground based analog of head-down tilt bed rest (HDBR), possibly contributing to the diminished orthostatic tolerance observed in many individuals following these interventions. We report on two studies that have examined the effects of 14 days HDBR on the relationship between sympathetic outflow and vascular resistance in humans.
Author
Sympathetic Nervous System; Orthostatic Tolerance; Vasoconstriction; Bed Rest; Physiological Responses; Cardiovascular System; Blood Flow

20000020567 Brigham and Women's Hospital, Boston, MA USA
Renal and Cardio-Endocrine Responses in Humans to Simulated Microgravity
Williams, Gordon H., Brigham and Women's Hospital, USA; Mullen, Thomas, Brigham and Women's Hospital, USA; Ramsdell, Craig, Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 317-318; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The volume-regulating systems are integrated to produce an appropriate response to both acute and chronic volume changes. Their responses include changing the levels of the hormones and neural inputs of the involved systems and/or changing the responsiveness of their target tissues. Weightlessness produces a volume challenge which is unfamiliar to the organism. Thus, it is likely that the volume regulatory mechanisms may respond inappropriately, e.g., an inappropriate decrease in total body volume in space and abnormal responses to upright posture and stress on return to earth. A similar "inappropriateness" also can occur in disease states, e.g., congestive heart failure. While it is clear that weightlessness produces profound changes in sodium and volume homeostasis, the mechanisms responsible for these changes are incompletely understood. Confounding this analysis is sleep deprivation, common in space travel, which can also modify volume homeostatic mechanisms. There are two overarching hypotheses: simulated micro-gravity disrupts the renal and cardio-endocrine systems responses to steady state and acute stress, with these disruptions being more profound in the salt-loaded than the salt-depleted state. and sleep deprivation has an additive adverse effect to microgravity on the responsiveness and regulation of the renal and cardio-endocrine homeostatic systems.
Author

Weightlessness; Simulation; Endocrine Systems; Renal Function; Microgravity

20000020568 Baylor Coll. of Medicine, Houston, TX USA

Immunology, Infectious Disease, and Hematology Session Summary

Shearer, William, Baylor Coll. of Medicine, USA; Sonnenfeld, Gerald, Morehouse School of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 320-326; In English; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The presentations of the Immunology, Infectious Disease, and Hematology Scientific Session are divided into four groups of common theme: immune responses in space travel, virus infections in space travel, biological effects of space travel, and health hazards and bacterial containment in space travel. It was clear from the extent of the discussion following each presentation that the general themes of immunology, infection, and toxicity and bacterial containment in long-term space travel have a particularly relevant importance for human survival and quality of life, based upon preliminary evidence of the participating researchers. Each presentation touched upon the possible risks of long-term space travel due to alteration in immune responses, reactivation of previously controlled infections, biological alterations in cell membrane function and gene activation, and toxic chemical and bacterial contamination.
Author

Immunology; Infectious Diseases; Hematology; Viruses; Biological Effects; Health; Hazards

20000020569 Baylor Coll. of Medicine, Houston, TX USA

Neocytolysis: Mechanisms of Monitoring Neocytes

Alfrey, C. P., Baylor Coll. of Medicine, USA; Rice, L., Baylor Coll. of Medicine, USA; Trial, J., Veterans Administration Medical Center, UNited States; Kessler, P. D., Johns Hopkins Medical Institutions, USA; Byrne, B. J., Florida Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 327-328; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

A decrease in red cell mass (RBCM) has been an invariable occurrence following spaceflight that lasts more than 24 hours. Previous studies have indicated this decrease begins within the first day in microgravity because of the elimination of young circulating red cells or neocytolysis. This process of RBCM modulation had not been previously recognized and its exact mechanism has not been thoroughly investigated. Initially, to more clearly define this process, we have developed methods to separate red cells of various ages and have defined suitable markers to monitor the presence, absence or quantitative variation within this population of red cells. This is the first phase of the overall project to study a ground based model of neocytolysis.
Author

Circulation; Erythrocytes; Mass; Monitors

20000020571 Texas Univ., Dental Branch, Houston, TX USA

Regulation of Epidermal Growth Factor by Gravity

Durban, Elisa M., Texas Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 331-333; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Epidermal growth factor (EGF) is synthesized in a variety of tissues as a large membrane-bound precursor protein (approximately 130 kDa) from which mature EGF (6 kDa) and other EGF-like polypeptides are produced by proteolytic cleavage. Measurable levels of EGF are also found in many body fluids including plasma, saliva, urine, prostatic and seminal fluid, sweat, tears, gastric juice, and amniotic fluid. EGF is a principal regulator of proliferation and differentiation in development and throughout life. Documented in vivo functions of EGF include a role in maintaining gastric and oral mucosal integrity and

cytoprotection, stimulating epidermal wound healing and renal tissue repair, regulating local bone formation by stimulating bone resorption, and modulating fluid balance and nervous system functions. Additionally EGF influences reproduction by stimulating the meiotic phase of spermatogenesis, enhancing maturation of oocytes, and participating in pregnancy-induced mammary gland development and lactation. This broad range of physiological functions is induced by binding of EGF to the EGF receptor, an integral membrane glycoprotein (170 kDa) with tyrosine kinase activity that is stimulated by EGF binding. The physiological role of EGF in normal cell function is strengthened by the presence of EGF receptors in virtually every cell in the body. The importance of EGF in human physiology also is highlighted by successful EGF therapy in patients requiring skin grafting, wound management or grastroduodenal ulcer treatment. Conceivably, subtle alterations in the regulation of the EGF biosynthetic/secretory pathway in various tissues could affect a variety of physiological processes, therefore the effects of gravitational changes on EGF production were examined.
Author
Epidermis; Gravitation; Bones; Membranes; Proteins; Regulators; Growth; Nervous System; Physiological Effects; Stimulation

20000020574 Baylor Coll. of Medicine, Houston, TX USA
The Effect of Anti-Orthostatic Suspension on Delayed-Type Hypersensitivity Reactions
Kanwar, Samina, Baylor Coll. of Medicine, USA; Smolen, James E., Baylor Coll. of Medicine, USA; Smith, C. Wayne, Baylor Coll. of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999; 2p; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The anti-orthostatic rodent model is an established ground-based model of simulated space flight. It has been reported that this model induces many physiological changes consistent with those observed in humans and animals during actual space flight. These include changes in stress hormone levels, over-use of upper and under-use of lower extremities and a cephalad fluid shift. To date there is limited evidence to suggest that these physiological changes affect the process of inflammation. Therefore, we propose to systematically study whether anti-orthostatic suspension (AOS) and the associated physiological changes directly influence basic inflammatory mechanisms. We will determine whether AOS induces tissue dysfunction and alters leukocyte infiltration, which is a hallmark feature of inflammation, during acute, non- specific inflammation and/or chronic, antigen-specific inflammation. We anticipate that any changes in leukocyte recruitment induced by AOS will significantly contribute to the development and/or resolution of inflammation.
Author
Orthostatic Tolerance; Models; Physiological Responses; Space Flight; Leukocytes; Infiltration

20000020578 Rochester Univ., NY USA
Health Hazards in Closed Environments: Thermodegradation of Wire Insulation
Oberdoerster, G., Rochester Univ., USA; Finkelstein, J. N., Rochester Univ., USA; Gelein, R., Rochester Univ., USA; Mercer, P., Rochester Univ., USA; Corson, N., Rochester Univ., USA; Johnston, C. J., Rochester Univ., USA; Weiss, B., Rochester Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 343-344; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Thermodegradation events during manned space missions can give rise to fumes originating from overheating of wire insulation. The high toxicity of such fumes is well known from accidental exposures resulting in symptoms summarized under the term "polymer fume fever." We have studied the composition and toxicity of fumes generated by heating of polytetrafluoroethylene (Teflon(R)), which is a frequently used component of insulation material. We have characterized the particulate phase of the fumes as consisting of extremely fine particles with count median diameters of - 1 5-25 nm (ultrafine particles), We hypothesize that these ultrafine particles are the major cause for the extremely high toxicity of PTFE fumes since particles in this range have a very high deposition efficiency throughout the lower respiratory tract, higher than for any other particle size, and they also penetrate rapidly across the epithelium to interstitial and vascular compartments. The objectives of our studies were to determine: (1) the role of the ultrafine Teflon(R) fume particles for causing toxicity; (2) the impact of Teflon(R) fume exposure on work performance; and (3) the effect of repeated exposures.
Author
Health; Hazards; Wire; Toxicity; Polytetrafluoroethylene; Insulation; Exposure

20000020582 NASA Johnson Space Center, Houston, TX USA
Study Design to Test the Hypothesis That Long-Term Space Travel Harms the Human and Animal Immune Systems
Shearer, William T., Baylor Coll. of Medicine, USA; Lugg, Desmond J., Australian Antarctic Div., Australia; Ochs, H. D., Washington Univ., USA; Pierson, Duane L., NASA Johnson Space Center, USA; Reuben, James M., M. D. Anderson Cancer Center, USA; Rosenblatt, Howard M., Baylor Coll. of Medicine, USA; Sams, Clarence, NASA Johnson Space Center, USA;

Smith, C. Wayne, Baylor Coll. of Medicine, USA; Smith, E. Obrian, Baylor Coll. of Medicine, USA; Smolen, James E., Baylor Coll. of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 351-353; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The potential threat of immunosuppression and abnormal inflammatory responses in long-term space travel, leading to unusual predilection for opportunistic infections, malignancy, and death, is of ma or concern to the National Aeronautics and Space Administration (NASA) Program. This application has been devised to seek answers to questions of altered immunity in space travel raised by previous investigations spanning 30-plus years. We propose to do this with the help of knowledge gained by the discovery of the molecular basis of many primary and secondary immunodeficiency diseases and by application of molecular and genetic technology not previously available. Two areas of immunity that previously received little attention in space travel research will be emphasized: specific antibody responses and non-specific inflammation and adhesion. Both of these areas of research will not only add to the growing body of information on the potential effects of space travel on the immune system, but be able to delineate any functional alterations in systems important for antigen presentation, specific immune memory, and cell:cell and cell:endothelium interactions. by more precisely defining molecular dysfunction of components of the immune system, it is hoped that targeted methods of prevention of immune damage in space could be devised.

Author

Design Analysis; Physiological Responses; Infectious Diseases; Immune Systems; Hypotheses; Genetics; Damage

20000020583 Morehouse School of Medicine, Atlanta, GA USA

Update on the Effects of Space Flight on Development of Immune Responses

Sonnenfeld, G., Morehouse School of Medicine, USA; Foster, M., Carolinas Medical Center, USA; Morton, D., Carolinas Medical Center, USA; Bailliard, F., Carolinas Medical Center, USA; Fowler, N. A., Carolinas Medical Center, USA; Hakenwewerth, A. M., Carolinas Medical Center, USA; Bates, R., Texas Technological Univ., USA; Miller, E. S., Carolinas Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 354-355; In English

Contract(s)/Grant(s): NCC2-859; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

This study has been completed, and the following is an update of the results as published. Pregnant rats were flown on the Space Shuttle in the NIH.R I mission for 11 days, and pregnant control rats were maintained in animal enclosure modules in a ground-based chamber under conditions approximating those in flight. Additional controls were in standard housing. The effects of the flight on immunological parameters (including blastogenesis, interferon-gamma production, response to colony stimulating factor and total immunoglobulin levels) of dams, fetuses, and pups was determined.

Author

Immunology; Rats; Physiological Responses; Immunity; Weightlessness

20000020586 NASA Johnson Space Center, Houston, TX USA

Muscle Session Summary

Baldwin, Kenneth, California Univ., USA; Feeback, Daniel, NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 359-362; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Presentations from the assembled group of investigators involved in specific research projeects related to skeletal muscle in space flight can categorized in thematic subtopics: regulation of contractile protein phenotypes, muscle growth and atrophy, muscle structure: injury, recovery,and regeneration, metabolism and fatigue, and motor control and loading factors.

Derived from text

Musculoskeletal System; Proteins; Pharmacology; Nerves; Microgravity; Gravitation

20000020589 California Univ., Los Angeles, CA USA

Effects of Microgravity on the Accuracy of Elbow and Ankle Flexor and Extensor Motor Pools in Maintaining a Target Torque

Edgerton, V. R., California Univ., USA; McCall, G. E., California Univ., USA; Fleischman, K. O., California Univ., USA; Boorman, G. I., California Univ., USA; Goulet, C., California Univ., USA; Roy, R. R., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 369; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The microgravity environment significantly alters proprioceptive inputs to the spinal cord motor pools. However, the means for accommodating those changes so that movements can be controlled in microgravity, and further adapt to this new environment, has received little attention. We hypothesized that the neural control to the motor pools of antigravity (primary extensor) muscles

would be affected more by alterations of sensory systems influenced by gravitational forces than the motor pools of non-antigravity (primary flexor) muscles. to test this hypothesis, the effects of a 17-day spaceflight on the ability to maintain constant torque output at the elbow or ankle joint were studied.
Author
Microgravity; Flexors; Hypotheses; Muscles

20000020590 Baylor Coll. of Medicine, Houston, TX USA
Molecular Signaling in Muscle Plasticity
Epstein, H. F., Baylor Coll. of Medicine, USA; Gordon, S., Texas Univ. Health Science Center, USA; Booth, F. W., Texas Univ. Health Science Center, USA; Rajadurai, H., Baylor Coll. of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 370; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Extended spaceflight under microgravity conditions leads to significant atrophy of weight-bearing muscles. Atrophy and hypertrophy are the extreme outcomes of the high degree of plasticity exhibited by skeletal muscle. Stimuli which control muscle plasticity include neuronal, hormonal, nutritional, and mechanical inputs. The mechanical stimulus for muscle is directly related to the work or exercise against a load performed. Little or no work is performed by weight-bearing muscles under microgravity conditions. A major hypothesis is that focal adhesion kinase (FAK) which is associated with integrin at the adherens junctions and costameres of all skeletal muscles is an integral part of the major mechanism for molecular signaling upon mechanical stimulation in all muscle fibers. Additionally, we propose that myotonic protein kinase (DMPK) and dystrophin (DYSTR) also participate in distinct mechanically-stimulated molecular signaling pathways that are most critical in type I and type II muscle fibers, respectively. to test these hypotheses, we will use the paradigms of hindlimb unloading and overloading in mice as models for microgravity conditions and a potential exercise countermeasure, respectively, in mice. We expect that FAK loss-of-function will impair hypertrophy and enhance atrophy in all skeletal muscle fibers whereas DYSTR and DMPK loss-of-function will have similar but more selective effects on Type II and Type I fibers, respectively. Gene expression will be monitored by muscle-specific creatine kinase M promoter-reporter construct activity and specific MRNA and protein accumulation in the soleus (type I primarily) and plantaris (type II primarily) muscles. With these paradigms and assays, the following Specific Project Aims will be tested in genetically altered mice: 1) identify the roles of DYSTR and its pathway; 2) evaluate the roles of the DMPK and its pathway; 3) characterize the roles of FAK and its pathway and 4) genetically analyze the mechanisms and interactions between the FAK, DYSTR, and DMPK-associated pathways in single and specific combinations of mutants. The identification of potential signaling mechanisms may permit future development of pharmacological countermeasures for amelioration and prevention of the microgravity- induced atrophy in extended spaceflight, and the analysis of both overloading and unloading paradigms may provide further support for development of exercise-based countermeasures. Understanding the basic mechanisms of molecular signaling in muscle plasticity may aid our understanding and treatment of skeletal muscle atrophy not only in spaceflight but in similar problems of the aging population, in prolonged bed rest, and in cachexia associated with chronic disease.
Author
Atrophy; Bed Rest; Countermeasures; Gene Expression; Loads (Forces); Losses; Microgravity; Musculoskeletal System; Neurophysiology; Physical Exercise

20000020591 Marquette Univ., Milwaukee, WI USA
Alterations in Skeletal Muscle Function with Microgravity, and the Protective Effects of High Resistance Isometric and Isotonic Exercise
Fitts, R. H., Marquette Univ., USA; Hurst, J. E., Marquette Univ., USA; Norenberg, K. M., Marquette Univ., USA; Widrick, J. J., Marquette Univ., USA; Riley, D. A., Marquette Univ., USA; Bain, J. L. W., Marquette Univ., USA; Trappe, S. W., Marquette Univ., USA; Trappe, T. A., Marquette Univ., USA; Costill, D. L., Marquette Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 371-373; In English
Contract(s)/Grant(s): NAS9-18768; NAG5-6058; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Exposure to microgravity or models designed to mimic the unloaded condition, such as bed rest in humans and hindlimb unloading (HU) in rats leads to skeletal muscle atrophy, a loss in peak force and power, and an increased susceptibility to fatigue. The posterior compartment muscles of the lower leg (calf muscle group) appear to be particularly susceptible. Following only 1 wk in space or HU, rat soleus muscle showed a 30 to 40% loss in wet weight. After 3 wk of HU, almost all of the atrophied soleus fibers showed a significant increase in maximal shortening velocity (V(sub 0)), while only 25 to 30 % actually transitioned to fast fibers. The increased V(sub 0), was protective in that it reduced the decline in peak power associated with the reduced peak force. When the soleus is stimulated in situ following HU or zero-g one observes an increased rate and extent of fatigue, and in the former the increased fatigue is associated with a more rapid depletion of muscle glycogen and lactate production. Our working hypothesis is that following HU or spaceflight in rats and bed rest or spaceflight in humans limb skeletal muscles during contractile activity

depend more on carbohydrates and less on fatty acids for their substrate supply. Baldwin et al. found 9 days of spaceflight to reduce by 37% the ability of both the high and low oxidative regions of the vastus muscle to oxidize long-chain fatty acids. This decline was not associated with any change in the enzymes of the tricarboxylic acid cycle or oxidation pathway. The purpose of the current research was to establish the extent of functional change in the slow type I and fast type H fibers of the human calf muscle following 17 days of spaceflight, and determine the cellular mechanisms of the observed changes. A second goal was to study the effectiveness of high resistance isotonic and isometric exercise in preventing the deleterious functional changes associated with unloading.

Author

Musculoskeletal System; Microgravity; Physical Exercise; Muscular Function; Losses; Lactates; Isotonicity

20000020592 NASA Johnson Space Center, Houston, TX USA

In Vivo Noninvasive Analysis of Human Forearm Muscle Function and Fatigue: Applications to EVA Operations and Training Maneuvers

Fotedar, L. K., National Academy of Sciences - National Research Council, USA; Marshburn, T., NASA Johnson Space Center, USA; Quast, M. J., Texas Univ., USA; Feeback, D. L., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 374-375; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Forearm muscle fatigue is one of the major limiting factors affecting endurance during performance of deep-space extravehicular activity (EVA) by crew members. Magnetic resonance (MR) provides in vivo noninvasive analysis of tissue level metabolism and fluid exchange dynamics in exercised forearm muscles through the monitoring of proton magnetic resonance imaging (MRI) and phosphorus magnetic resonance spectroscopy (P-31-MRS) parameter variations. Using a space glove box and EVA simulation protocols, we conducted a preliminary MRS/MRI study in a small group of human test subjects during submaximal exercise and recovery and following exhaustive exercise. In assessing simulated EVA-related muscle fatigue and function, this pilot study revealed substantial changes in the MR image longitudinal relaxation times (T2) as an indicator of specific muscle activation and proton flux as well as changes in spectral phosphocreatine-to-phosphate (PCr/Pi) levels as a function of tissue bioenergetic potential.

Author

Magnetic Resonance; Human Beings; Imaging Techniques; Fatigue (Biology); Simulation; Physical Exercise; Muscular Function; Forearm; Exhausting

20000020593 Harvard Medical School, Dept. of Cell Biology, Boston, MA USA

Activation of the Ubiquitin-Proteasome Pathway in Atrophying Muscles and Potential Inhibitors

Goldberg, A. L., Harvard Medical School, USA; Lee, D. H., Harvard Medical School, USA; Solomon, V., Harvard Medical School, USA; Lecker, S., Harvard Medical School, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 376; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Many observations indicate that the rapid loss of muscle mass with denervation atrophy, hind- limb suspension, cancer cachexia, sepsis, and hyperthyroidism is primarily due to enhanced protein breakdown via the ubiquitin-proteasome pathway. This proteolytic system is responsible for most protein degradation in extracts of skeletal muscle. Also, inhibitors of the proteasome, such as MG 132, can selectively reduce the enhanced proteolysis in atrophying muscles during in vitro incubation. While such inhibitors have potential in the prevention of muscle wasting, the "therapeutic window" is narrow, and they can induce apoptosis at high concentrations. Interestingly, our recent studies of the effects of proteasome inhibitors indicate that concentrations that inhibit protein breakdown also cause induction of heat-shock proteins and thus enhance cell resistance to high temperatures and free radical damage. We have also attempted to identify more selective sites in this pathway for inhibition. One property of a protein which leads to its rapid ubiquitination is the presence of a bulky hydrophobic or charged N-terminal residue, but natural substrates of this "N-end rule" pathway have not been identified. Surprisingly, we found that this pathway, which involves E2-14K and E3(x, catalyzes degradation of most soluble proteins in muscle extracts. Moreover, we showed that in many catabolic states, where muscle proteolysis rises, rates of protein ubiquitination increase, due mainly to activation of the "N-end rule" pathway. In extracts of atrophying rat leg muscles from tumor-bearing, hyperthyroid and hind-limb suspended animals, ubiquitin conjugation to soluble proteins increases, and inhibitors of the E3(alpha) suppress most of the enhanced ubiquitination. Furthermore, ubiquitination of lysozyme, a typical "N-end rule" substrate, increases in these atrophying muscles. Thus, overall

rates of ubiquitination vary under different conditions, and activation of the "N-end rule" pathway is a major contributor to the accelerated proteolysis in atrophying muscles.
Author
Musculoskeletal System; Proteins; Lysozyme; Losses; Degradation; Damage; Catabolism; Cancer; Atrophy

20000020595 NASA Ames Research Center, Moffett Field, CA USA
Space Physiology Studies
Hargens, A. R., NASA Ames Research Center, USA; Ballard, R. E., California Univ., USA; Boda, W. L., Sonoma State Univ., USA; Ertl, A. C., Vanderbilt Univ., USA; Schneider, S. M., NASA Johnson Space Center, USA; Hutchinson, K. J., California Univ., USA; Lee, S. M., NASA Johnson Space Center, USA; Murthy, G., California Univ., USA; Putcha, L., NASA Johnson Space Center, USA; Watenpaugh, D. E., University of North Texas, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 378-384; In English; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Calculations suggest that exercise in space to date has lacked sufficient loads to maintain musculoskeletal mass. Lower body negative pressure (LBNP) produces a force at the feet equal to the product of the LBNP and body cross-sectional area at the waist. Supine exercise within 50-60 mm Hg LBNP improves tolerance to LBNP and produces forces similar to those occurring during upright posture on Earth. Thus, exercise within LBNP may help prevent deconditioning of astronauts by stressing tissues of the lower body in a manner similar to gravity and also, may provide a safe and effective alternative to centrifugation in terms of cost, mass, volume, and power usage. We hypothesize that supine treadmill exercise during LBNP at one body weight (50-60 mm Hg LBNP) will provide cardiovascular and musculoskeletal loads similar to those experienced while upright in lg. Also, daily supine treadmill running in a LBNP chamber will maintain aerobic fitness, orthostatic tolerance, and musculoskeletal structure and function during bed rest (simulated microgravity).
Author
Physiological Tests; Aerobes; Cardiovascular System; Deconditioning; Gravitation; Lower Body Negative Pressure; Musculoskeletal System; Physical Exercise

20000020599 NASA Ames Research Center, Moffett Field, CA USA
Muscle Deoxygenation Causes Muscle Fatigue
Murthy, G., California Univ., USA; Hargens, A. R., NASA Ames Research Center, USA; Lehman, S., California Univ., USA; Rempel, D., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 390-392; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Muscle fatigue is a common musculoskeletal disorder in the work place, and may be a harbinger for more disabling cumulative trauma disorders. Although the cause of fatigue is multifactorial, reduced blood flow and muscle oxygenation may be the primary factor in causing muscle fatigue during low intensity muscle exertion. Muscle fatigue is defined as a reduction in muscle force production, and also occurs among astronauts who are subjected to postural constraints while performing lengthy, repetitive tasks. The objectives of this research are to: 1) develop an objective tool to study the role of decreased muscle oxygenation on muscle force production, and 2) to evaluate muscle fatigue during prolonged glovebox work.
Author
Musculoskeletal System; Oxygenation; Fatigue (Biology)

20000020600 Massachusetts General Hospital, Cardiovascular Research Center, Boston, MA USA
E Proteins Control Skeletal Muscle Fiber Type
Neville, Craig, Massachusetts General Hospital, USA; Gonzales, Donald, Massachusetts General Hospital, USA; Purdy, Joy, Massachusetts General Hospital, USA; Zuang, Yuan, Duke Univ., USA; Rosenthal, Nadia, Massachusetts General Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 393-394; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Vertebrate skeletal muscle development involves the fusion of undifferentiated mononucleated myoblasts to form multinucleated myofibers, with a concomitant activation of muscle-specific genes encoding proteins that form the contractile apparatus. The regulatory circuit controlling skeletal muscle gene expression has been well studied in a number of vertebrate animal systems, and has resulted in a rather extensive understanding regarding muscle formation during embryonic development. In contrast, the molecular mechanisms underlying the further specification of muscle cells into different fiber types is poorly understood. We have investigated the role of a family of transcriptional proteins, known as E proteins, as the genetic basis of fiber

specificity. The aims of this project are to define the mechanisms, and the potential importance of E proteins, responsible for the shifts in fiber type under conditions of microgravity.
Author
Proteins; Musculoskeletal System; Fibers; Vertebrates; Cells (Biology)

20000020601 Wisconsin Univ., Dept. of Anatomy, Madison, WI USA
Weightlessness Reduces Skeletal Muscle Growth and Regeneration Potential
Schultz, E., Wisconsin Univ., USA; Mozdziak, P. E., Wisconsin Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 395-396; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Myonuclear increase is required for myofiber enlargement during skeletal muscle growth and is solely dependent upon the proliferation of satellite cells and the fusion of their progeny with the enlarging myofibers. Likewise, regeneration of injured skeletal muscles is dependent upon the proliferation of satellite cells to produce a sufficient supply of myogenic cells for the formation of replacement myofibers and for the subsequent growth of these myofibers.
Author
Weightlessness; Musculoskeletal System; Progeny

20000020604 NASA Ames Research Center, Moffett Field, CA USA
Neurovestibular Session Summary
Oman, Charles, Massachusetts Inst. of Tech., USA; Cohen, Malcolm, NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 403-406; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Oman - The early mission operational problems caused by space motion sickness have been largely resolved in recent years. This has been achieved by appropriate timeline adjustments, voluntary head movement restriction, and judicious use of promethazine. Crew members now simply accept that some symptoms "come with the job," and usually last only a few days. But as more people have flown longer flights, we've seen cases of space sickness and inversion illusion that take several weeks to resolve. Visual reorientation illusions continue throughout long flights, and occasionally cause difficulties. EVA astronauts sometimes suddenly fear they will fall out of the payload bay or off of the RMS or Strella arms. Orientation and navigation in three dimensions in the MIR station reportedly does not come naturally, because modules have different visual verticals. It is clear that the neurovestibular problems of spaceflight have not disappeared. After return to Earth, many crew members are disoriented and ataxic in the first hour after return, and require assistance leaving the vehicle, Flight surgeons say that the longer the mission, the stronger the aftereffects, certain of which last for weeks. We do not yet know how to predict who will be afflicted. Looking ahead to 3-4 month long voyages to Mars, it seems obvious that if cruise is in O-G, the crew may encounter neurovestibular problems on arrival. Artificial G may be broadly effective as a countermeasure for many of the physiological changes of spaceflight, but from the neurovestibular perspective, it is a double-edged sword. We know that the Coriolis stimulus resulting from rotation is potentially disorienting and nauseogenic. But we don't yet know how much artificial G will be enough, nor how successfully people can adapt to a specific angular velocity and hypo G level. Development of countermeasures remains a big challenge for our neurovestibular community. Maintaining an interdisciplinary perspective is important. Three examples were presented at this meeting: 1) Transgenic animal experiments suggest that in addition to the light illumination cycle, vestibular inputs may also serve as an important input to the circadian system. 2) Radiation can cause important CNS effects in animals, including loss of spatial memory. 3) As described in our session, otolith inputs may contribute to cardiovascular regulation of orthostatic tolerance. Over the past three days, we've all enjoyed catching up with old friends, and making many new ones. On behalf of my colleagues, I want to thank Al Coats and the USRA DSLS staff for the great job they did in running this meeting. and keeping the emphasis on fun. and also my Co- Chair, Mal Cohen, who had more stamina than many of us, despite major surgery only three weeks ago. Mal and I have written a few lines describing each of the seventeen papers in our session, to give you a quick over-view, and as a guide to the full abstracts, We have grouped them under five themes: preflight and inflight countermeasurements, postlanding posture and locomotion deficits: assessment and prediction, adaptive processes, relationships among physical simuli, perceptions, and eye movements, vestibular contribution to human autonomic responses, and implications and recommendations.
Author
Angular Velocity; Cardiovascular System; Central Nervous System; Countermeasures; Extravehicular Activity; Head Movement; Oman; Space Adaptation Syndrome

20000020605 Mississippi Univ. Medical Center, Dept. of Surgery (Otolaryngology), Jackson, MS USA
Visually-Induced Adaptation in Gravity-Sensitive Properties of Primate Vestibulo-Ocular Reflex
Angelaki, Dora E., Mississippi Univ. Medical Center, USA; Hess, B. J. M., Zurich Univ., Switzerland; Proceedings of the First

Biennial Space Biomedical Investigators' Workshop; 1999, pp. 407-408; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Most natural head movements, particularly those including pitch and roll movements, involve dynamic changes in the orientation relative to gravity. In addition to the semicircular canals, these head movements also activate the otolith system. Even though the adaptive ability of the semicircular canal-activated aspects of the vestibulo-ocular reflex (VOR) have been repeatedly demonstrated, very little is currently known about the adaptive processes underlying the gravity- related aspects of the VOR. The present studies aimed at addressing this issue.

Author

Vestibules; Head Movement; Otolith Organs; Semicircular Canals; Sensitivity

20000020607 NASA Johnson Space Center, Houston, TX USA

The Effects of Long-Duration Spaceflight on Postflight Terrestrial Locomotion

Bloomberg, J. J., NASA Johnson Space Center, USA; Mulavara, A. P., Wyle Life Sciences, Inc., USA; McDonald, P. V., Wyle Life Sciences, Inc., USA; Layne, C. S., Houston Univ., USA; Merkle, L. A., NASA Johnson Space Center, USA; Cohen, H. S., Baylor Coll. of Medicine, USA; Kozlovskaya, I. B., Institute for Biomedical Problems, Russia; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 411-412; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Locomotion is a complex task requiring the coordinated integration of multiple sensorimotor subsystems. This coordination is exemplified by the precise control of segmental kinematics that allows smooth progression of movement in the face of changing environmental constraints. Exposure to the microgravity environment encountered during space flight induces adaptive modification in the central processing of sensory input to produce motor responses appropriate for the prevailing environment. This inflight adaptive change in sensorimotor function is inappropriate for movement control in 1-g and leads to postflight disturbances in terrestrial locomotor function. We have previously explored the effects of short-duration (7-16 days) space flight on the control of locomotion. The goal of the present set of studies was to investigate the effects of long-duration spaceflight (3-6 months) on the control of locomotion with particular emphasis on understanding how the multiple interacting systems are adaptively modified by prolonged microgravity exposure.

Author

Locomotion; Microgravity; Exposure

20000020608 Brandeis Univ., Ashton Graybiel Spatial Orientation Lab., Waltham, MA USA

Motor Control and Adaptation in a Rotating Artificial Gravity Environment

DiZio, P., Brandeis Univ., USA; Lackner, J. R., Brandeis Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 413-415; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

One obstacle to the idea of rotating a space vehicle to generate artificial gravity is concern about the side effects of rotation on human sensorimotor control. The most conspicuous side effects in a rotating room are the severely disorienting and nauseogenic consequences of head movements at high room speeds. In early experiments, adapting people to tolerate head movements at rotation rates greater than 3 rpm required great effort and resulted in powerful aftereffects upon return to a non-rotating environment. Generating 1 g of artificial gravity at 3 rpm requires a radius of about 100 meters, which is technically and financially unrealistic. Approaches to adapting humans to tolerate higher rates of rotation have focussed on vestibular mechanisms. We have investigated the effects of linear Coriolis forces generated in a rotating environment on voluntary arm and leg movements as well as on head movements and posture. The results indicate that adaptation up to 10 rpm can be achieved if exposure history is appropriately controlled.

Author

Artificial Gravity; Coriolis Effect; Head Movement; Rotating Bodies; Vestibules; Efferent Nervous Systems

20000020609 Mount Sinai School of Medicine, New York, NY USA

Sympathetic Efferent Activity is Driven by Otolith Stimulation

Kaufmann, H., Mount Sinai School of Medicine, USA; Biaggioni, I., Vanderbilt Univ., USA; Voustaniuk, A., Mount Sinai School of Medicine, USA; Diedrich, A., Vanderbilt Univ., USA; Costa, F., Vanderbilt Univ., USA; Clark, R., JFK Neuroscience Inst., USA; Gizzi, M., JFK Neuroscience Inst., USA; Cohen, B., Mount Sinai School of Medicine, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 416-417; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

This study was designed to test the hypothesis that stimulation of vestibular otolith organs in humans activates sympathetic outflow. A vestibular-autonomic reflex triggered by changes in posture or gravity has been postulated. This reflex produces

changes in heart rate and vascular tone that are important in the maintenance of blood flow to the brain, particularly during orthostatic stress. In the vestibular apparatus, semicircular canals sense angular acceleration and otolith organs, sense translation and tilt of the head with regard to gravity, i.e., they are gravireceptors. Thus, otolith organs are the ones likely to trigger a reflex mechanism that maintains cerebral blood flow against gravity during orthostasis. Accordingly, in this study we investigated whether selective stimulation of the otolith organs activates sympathetic efferent.
Author
Sympathetic Nervous System; Efferent Nervous Systems; Otolith Organs; Hypotheses; Vestibules; Brain Circulation

20000020610 NASA Johnson Space Center, Houston, TX USA
Anticipatory Postural Activity During Long-Duration Space Flight
Layne, C. S., Houston Univ., USA; Mulavara, A. P., Wyle Life Sciences, USA; McDonald, P. V., Nascent Technologies, USA; Pruett, C. J., TECMATH, USA; Koslovskaya, B., Institute of Biomedical Problems, USSR; Bloomberg, J. J., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 418-419; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Somatosensory input has been used to modify motor output in many contexts. During space flight, the use of the lower limb musculature is much less than during activities in 1g. Consequently the neuromuscular activity of the legs is also reduced during space flight. This decrease in muscle activity contributes to muscle atrophy. Furthermore, adaptations to weightlessness contribute to posture and locomotion problems upon the return to Earth. Providing techniques to counter the negative effects of weightlessness on the neuromuscular system is an important goal, particularly during a long-duration mission. Previous work by our group has shown that lower limb neuromuscular activation that normally precedes arm movements in 1g is absent or greatly reduced during similar movements made while freefloating. However, preliminary evidence indicates that applying pressure to the feet results in enhanced neuromuscular activation during rapid arm movements performed while freefloating. This finding suggests that sensory input can be used to "drive" the motor system to increase neuromuscular functioning throughout a mission. The purpose of this investigation was to quantify the increase in neuromuscular activation resulting from the application of pressure to the feet.
Author
Weightlessness; Sensory Perception; Muscular Function; Atrophy; Leg (Anatomy)

20000020611 California Univ., Santa Barbara, CA USA
Otolith-Ocular Torsion is Modified in Novel G States
Markham, Charles H., California Univ., USA; Diamond, Shirley G., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 420; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The inner ear otolith system responds to linear acceleration including gravity. Its main motor control function is stabilizing the neck, axial musculature and limbs to maintain posture. It also modulates ocular torsion, giving a window to view the otolith system in ways not possible in viewing the spinal reflexes. Otolith-ocular torsion, when examined binocularly, is especially sensitive to novel changes in G as observed during parabolic flight and in spaceflight. Under these conditions, life-long compensation to possible asymmetries in this bilateral system may become decompensated and at least four unusual responses may be seen: (1) Ocular torsional disconjugacy, increasing over increasing parabolas has allowed prediction of who has or has not had previous motion sickness. Use of this test by NASA could lead to better prophylactic treatment an exclusionary test) since it is known that most of the 60-70% who develop space motion sickness nevertheless perform well after the first 3-4 days of flight. (2) Changes in binocular ocular torsion in the 0 G and 1.8 G portions of parabolic flight reveal in most subjects a systematic reversal of direction. The reversal is consistent within subjects, but not across subjects. We suggest this phenomenon is due to the responsible hair cells being deflected first in one direction and then in the opposite direction. We do not know the location of the critical hair cells but plan appropriate experiments. (3) Parabolic flights in the Hyushin and Caravelle aircraft have 3-5 minutes of level 1 G between each parabola. Binocular torsion in most subjects becomes disconjugate and offset from pre-parabola values in the first parabola and this persists for the remainder of the flight. It is best seen in the intervals between parabolas. We suggest the abrupt G changes experienced in the first parabola causes otoconial displacement or other end organ instability. and (4) In one and six months spaceflights in three cosmonauts, ocular torsion was dis-conjugate and offset by several degrees compared to preflight reference values. On return to earth, torsional disconjugacy and offset persisted for weeks to months. Such long duration changes in the otolith-ocular reflex have unknown impact in humans during and after long-duration spaceflight.
Author
Otolith Organs; Ocular Circulation; Torsion; Cells (Biology); Conjugates; Displacement; Ear; Gravitation; Motion Sickness

20000020612 Nascent Technologies Ltd., Houston, TX USA

A Methodology for Investigating Adaptive Postural Control

McDonald, P. V., Nascent Technologies Ltd., USA; Riccio, G. E., Nascent Technologies Ltd., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 421-424; In English

Contract(s)/Grant(s): RTOP 199-16-11-48; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Our research on postural control and human-environment interactions provides an appropriate scientific foundation for understanding the skill of mass handling by astronauts in weightless conditions (e.g., extravehicular activity or EVA). We conducted an investigation of such skills in NASA's principal mass-handling simulator, the Precision Air-Bearing Floor, at the Johnson Space Center. We have studied skilled movement-body within a multidisciplinary context that draws on concepts and methods from biological and behavioral sciences (e.g., psychology, kinesiology and neurophysiology) as well as bioengineering. Our multidisciplinary research has led to the development of measures, for manual interactions between individuals and the substantial environment, that plausibly are observable by human sensory systems. We consider these methods to be the most important general contribution of our EVA investigation. We describe our perspective as control theoretic because it draws more on fundamental concepts about control systems in engineering than it does on working constructs from the subdisciplines of biomechanics and motor control in the bio-behavioral sciences. At the same time, we have attempted to identify the theoretical underpinnings of control-systems engineering that are most relevant to control by human beings. We believe that these underpinnings are implicit in the assumptions that cut across diverse methods in control-systems engineering, especially the various methods associated with "nonlinear control", "fuzzy control," and "adaptive control" in engineering. Our methods are based on these theoretical foundations rather than on the mathematical formalisms that are associated with particular methods in control-systems engineering. The most important aspects of the human-environment interaction in our investigation of mass handling are the functional consequences that body configuration and stability have for the pick up of information or the achievement of overt goals. It follows that an essential characteristic of postural behavior is the effective maintenance of the orientation and stability of the sensory and motor "platforms" (e.g., head or shoulders) over variations in the human, the environment and the task. This general skill suggests that individuals should be sensitive to the functional consequences of body configuration and stability. In other words, individuals should perceive the relation between configuration, stability, and performance so that they can adaptively control their interaction with the surroundings. Human-environment interactions constitute robust systems in that individuals can maintain the stability of such interactions over uncertainty about and variations in the dynamics of the interaction. Robust interactions allow individuals to adopt orientations and configurations that are not optimal with respect to purely energetic criteria. Individuals can tolerate variation in postural states, and such variation can serve an important function in adaptive systems. Postural variability generates stimulation which is "textured" by the dynamics of the human-environment system. The texture or structure in stimulation provides information about variation in dynamics, and such information can be sufficient to guide adaption in control strategies. Our method were designed to measure informative patterns of movement variability.

Derived from text

Pattern Method (Forecasting); Adaptive Control; Posture; Extravehicular Activity; Multidisciplinary Research; Neurophysiology; Observation; Weightlessness

20000020613 Mount Sinai School of Medicine, New York, NY USA

Low-Frequency Otolith Function in Microgravity: A Re-Evaluation of the Otolith Tilt-Translation Reinterpretation (OTTR) Hypothesis

Moore, Steven T., Mount Sinai School of Medicine, USA; Cohen, Bernard, Mount Sinai School of Medicine, USA; Clement, Gilles, Centre National de la Recherche Scientifique, France; Raphan, Theodore, State Univ. of New York, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 425-428; In English

Contract(s)/Grant(s): NAS9-19441; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

On Earth, the low-frequency afferent signal from the otoliths encodes head tilt with respect to the gravitational vertical, and the higher frequency components reflect both tilt and linear acceleration of the head. In microgravity, static tilt of the head does not influence otolith output, and the relationship between sensory input from the vestibular organs, and the visual, proprioceptive and somatosensory systems, would be disrupted. Several researchers have proposed that in 0-g this conflict may induce a reinterpretation of all otolith signals by the brain to encode only linear translation (otolith tilt-translation reinterpretation or OTTR). Ocular counter-rolling (OCR) is a low-frequency otolith-mediated reflex, which generates compensatory torsional eye movements (rotation about the visual axis) towards the spatial vertical during static roll tilt with a gain of approximately 10%. Transient linear acceleration and off-axis centrifugation at a constant angular velocity can also generate OCR. According to the OTTR hypothesis, OCR should be reduced in microgravity, and immediately upon return from a 0-g environment. Results to date have been inconclusive. OCR was reduced following the 10 day Spacelab-1 mission in response to leftward roll tilts (28-56% in

3 subjects and unchanged in one subject), and sinusoidal linear oscillations at 0.4 and 0.8 Hz. OCR gain declined 70% in four monkeys following a 14 day COSMOS mission. Following a 30 day MIR mission OCR gain decreased in one astronaut, but increased in two others following a 180 day mission. We have studied the affect of microgravity on low-frequency otolith function as part of a larger study of the interaction of vision and the vestibular system. This experiment (E-047) involved off-axis centrifugation of payload crewmembers and flew aboard the recent Neurolab mission (STS 90). Presented below are preliminary results focusing on perception and the OCR response during both centrifugation and static tilt.
Author
Low Frequencies; Otolith Organs; Microgravity; Evaluation; Hypotheses; Vestibules

20000020614 Massachusetts Inst. of Tech., Man Vehicle Lab., Cambridge, MA USA
Human Visual Orientation in Unfamiliar Gravito-Inertial Environments
Oman, C., Massachusetts Inst. of Tech., USA; Howard, I., York Univ., Canada; Shebilske, W., Texas A&M Univ., USA; Taube, J., Dartmouth Coll., USA; Beall, A., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 429-431; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The vestibular, visual, tactile, and proprioceptive senses provide the essential cues necessary for spatial orientation and sensory-motor coordination both on Earth and in weightlessness. Space motion sickness associated with neurovestibular adaptation affects early in-flight performance of astronauts arguably more than any other physiological change. Post-flight neurovestibular problems, including earth sickness, disorientation and locomotor ataxia increase in severity with flight duration. In the fall of 1997, the National Space Biomedical Institute Neurovestibular Adaptation Team initiated three projects to help define the mechanisms, and to develop improved neurovestibular countermeasures for use in NASA's Space Station and future Planetary exploration programs. These include the present multi-investigator, inter-institutional project on human visual orientation, and also two other projects presented at this meeting (Shelhamer, et al's study of context-specific adaptation of gravity-dependent reflex responses; Wall, et al's investigation of locomotor ataxia, spatial orientation, and gaze stability). The objective of the Visual Orientation project is to better understand the process of spatial orientation and navigation in unfamiliar gravito-inertial environments, and to use this information to develop effective countermeasures against the orientation and navigation problems experienced by astronauts.
Derived from text
Visual Stimuli; Orientation; Adaptation; Astronauts; Coordination; Countermeasures; Gravitational Effects; Weightlessness; Vestibules

20000020615 NASA Johnson Space Center, Houston, TX USA
Mechanisms of Sensorimotor Adaptation to Centrifugation
Paloski, W. H., NASA Johnson Space Center, USA; Wood, S. J., National Space Biomedical Research Inst., USA; Kaufman, G. D., National Academy of Sciences - National Research Council, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 432-434; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We postulate that centripetal acceleration induced by centrifugation can be used as an inflight sensorimotor countermeasure to retain and/or promote appropriate crewmember responses to sustained changes in gravito-inertial force conditions. Active voluntary motion is required to promote vestibular system conditioning, and both visual and graviceptor sensory feedback are critical for evaluating internal representations of spatial orientation. The goal of our investigation is to use centrifugation to develop an analog to the conflicting visual/gravito-inertial force environment experienced during space flight, and to use voluntary head movements during centrifugation to study mechanisms of adaptation to altered gravity environments. We address the following two hypotheses: (1) Discordant canal-otolith feedback during head movements in a hypergravity tilted environment will cause a reorganization of the spatial processing required for multisensory integration and motor control, resulting in decreased postural stability upon return to normal gravity environment. (2) Adaptation to this "gravito-inertial tilt distortion" will result in a negative after-effect, and readaptation will be expressed by return of postural stability to baseline conditions. During the third year of our grant we concentrated on examining changes in balance control following 90-180 min of centrifugation at 1.4 9. We also began a control study in which we exposed subjects to 90 min of sustained roll tilt in a static (non-rotating) chair. This allowed us to examine adaptation to roll tilt without the hypergravity induced by centrifugation. To these ends, we addressed the question: Is gravity an internal calibration reference for postural control? The remainder of this report is limited to presenting preliminary findings from this study.
Author
Adaptation; Centrifuging; Countermeasures; Feedback; Gravireceptors; Head Movement; Otolith Organs; Sensory Feedback; Vestibules

20000020619 Massachusetts General Hospital, Biomotion Lab., Boston, MA USA

Application of Floquet Stability Analysis to Repeated Stepping in LD and Normal Subjects

Wall, Conrad, III, Massachusetts General Hospital, USA; Krebs, David E., Massachusetts General Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 447-448; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

One aim of this work is to characterize the dynamics of locomotion stability in response to perturbations of the Body Segment Variables. This report concerns the application of Floquet multipliers to analyze the stability of normal and labyrinthine deficient (LD) subjects. At the Massachusetts General Hospital Biomotion Laboratory, a preliminary analysis of a stair stepping experiments done on 24 subjects.

Author

Locomotion; Dynamic Characteristics; Stability Tests; Experimentation

20000020620 NASA Ames Research Center, Moffett Field, CA USA

Vision and Visual-Motor Coordination in Pitched Visual Environments

Welch, Robert B., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 449-450; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The everyday perception of one's bodily orientation is determined by two classes of sensory cues: Vision and gravity. Because these cues typically agree, as when one is standing in a lighted room, it is difficult if not impossible to determine the degree to which each contributes to spatial perception. Therefore, in order to make this judgment it is necessary to introduce a conflict between vision and gravity and note the resulting perceptual experience. One simple way to do this is to expose the observer to a visual framework that has been rolled or pitched relative to the gravitational vector. The underlying assumption is that the separate contributions of vision and gravity to the perception of bodily orientation that are measured in such a situation of intersensory conflict are the same as those that operate under normal (i.e., non-conflicting) circumstances.

Derived from text

Visual Perception; Orientation; Cues; Motion

20000020622 Texas Univ., Medical Branch, Galveston, TX USA

The Combined Effects of Inactivity and Cortisol on Muscle Protein Metabolism

Ferrando, Arny A., Texas Univ., USA; Stuart, Charles S., Texas Univ., USA; Wolfe, Robert R., Texas Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 455; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We have previously noted that inactivity results in a loss of lean body mass (LBM) due to reduced protein synthesis. We have also shown that severely burned patients lose lean body mass due to an increase in net protein breakdown. Severe burn injury is also associated with an increased cortisol secretion, whereas inactivity does not alter this hormonal profile. Thus, we tested the hypothesis that inactivity exacerbates the catabolic effects of cortisol on skeletal muscle protein.

Author

Cortisone; Catabolism; Protein Metabolism; Muscles

20000020623 Wake Forest Univ., Dept. of Urology, Winston-Salem, NC USA

Dietary Oxalate and its Influence on Urinary Oxalate Excretion

Holmes, Ross P., Wake Forest Univ., USA; Assimos, Dean G., Wake Forest Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 456-458; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

One in eight white Caucasian males will form a calcium oxalate kidney stone at some point in their lifetime and up to one in three may be genetically susceptible to forming one. As physiological changes during space flight increase stone risk factors the formation of a kidney stone during extended space flight becomes a distinct possibility. Effective countermeasures are required to offset this stone risk. We have investigated the contribution of dietary oxalate to stone risk as gauged by changes in urinary oxalate excretion as this risk factor has the potential to be modified.

Author

Oxalates; Diets; Urology; Excretion; Calcium

20000020626 NASA Johnson Space Center, Houston, TX USA

Salivary Pharmacodynamics and Bioavailability of Promethazine in Human Subjects

Putcha, Lakshmi, NASA Johnson Space Center, USA; Harm, Deborah L., NASA Johnson Space Center, USA; Nimmagudda,

Ram, Wyle Labs., Inc., USA; Berens, Kurt L., Wyle Labs., Inc., USA; Bourne, David W. A., Oklahoma Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 462-463; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The acute effects of exposure to microgravity include the development of space motion sickness which usually requires therapeutic intervention. The current drug of choice, promethazine (PMZ), has side effects which include nausea, drowsiness, dizziness, sedation and impaired psychomotor performance. In a ground-based study with commercial airline pilots and shuttle simulator trainers, we measured sleep and psychomotor performance variables, and physiological variables such as blood pressure and heart rate, as a function of circulating drug concentrations in the body. We evaluated a non-invasive sampling method (saliva) as a means of assessing pharmacodynamics following a single intramuscular (IM) dose of PMZ.

Author

Saliva; Pharmacology; Promethazine; Microgravity; Exposure; Physiological Effects; Psychomotor Performance

20000020627 Wisconsin Univ., Dept. of Nutritional Sciences, Madison, WI USA

Measurement of Body Compostion for Nutritional Assessment in Space Flight

Schoeller, Dale A., Wisconsin Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 464-465; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Long term space flight increases the risk of reduced human performance due to the loss of body cell mass from the combined effects of weightlessness and energy imbalance. Loss of body mass can now be measured during space flight, but this cannot be assumed to equal body cell mass as loss in mass can also result from decreases in body water or loss of body fat. In order to determine whether the loss of body mass results from loss of body cell mass or other components of body mass, it is necessary to measure body composition. At this time, no methods have been validated for the measurement of body composition during space flight. to address this limitation, we will validate the use of bioelectrical impedance analysis to measure the change in body composition in simulated microgravity.

Author

Bioelectricity; Body Fluids; Losses; Microgravity; Water Loss; Weightlessness; Cells (Biology)

20000020628 NASA Johnson Space Center, Houston, TX USA

Calcium Kinetics During Space Flight

Smith, Scott M., NASA Johnson Space Center, USA; Wastney, Meryl E., Georgetown Univ. Medical Center, USA; OBrien, Kimberly O., Johns Hopkins Univ., USA; Lane, Helen W., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 466; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Bone loss is one of the most detrimental effects of space flight, threatening to limit the duration of human space missions. The ability to understand and counteract this loss will be critical for crew health and safety during and after extended-duration missions. The hypotheses to be tested in this project are that space flight alters calcium homeostasis and bone mineral metabolism, and that calcium homeostasis and bone mineral metabolism will return to baseline within days to weeks of return to Earth. These hypotheses will be evidenced by elevated rates of bone mineral resorption and decreased bone mineral deposition, decreased absorption of dietary calcium, altered calcitropic endocrine profiles, elevated excretion of calcium in urine and feces, and elevated excretion of markers of bone resorption. The second hypothesis will be evidenced by return of indices of calcium homeostasis and bone metabolism to preflight levels within days to weeks of return to Earth. Studies will be conducted on International Space Station astronauts before, during, and after extended-duration flights. Measurements of calcium kinetics, bone mass, and endocrine/biochemical markers of bone and calcium homeostasis will be conducted. Kinetic studies utilizing dual isotope tracer kinetic studies and mathematical modeling techniques will allow for determination of bone calcium deposition, bone calcium resorption, dietary calcium absorption and calcium excretion (both urinary and endogenous fecal excretion). These studies will build upon preliminary work conducted on the Russian Mir space station. The results from this project will be critical for clarifying how microgravity affects bone and calcium homeostasis, and will provide an important control point for assessment of countermeasure efficacy. These results are expected to aid in developing countermeasures for bone loss, both for space crews and for individuals on Earth who have metabolic bone diseases.

Author

Calcium Metabolism; Countermeasures; Biochemistry; Bone Demineralization; Homeostasis; Kinetics; Losses; Metabolic Diseases; Mineral Metabolism

20000020629 Medicine and Dentistry Univ. of New Jersey, Dept. of Surgery Science Center, Stratford, NJ USA
Protein-Energy Relationships During Space Flight
Stein, T. P., Medicine and Dentistry Univ. of New Jersey, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 467; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Protein metabolism has been investigated on five missions, three short term (Shuttle missions SLS 1, SLS2 and D2) and two long term missions (Skylab and NASA/MIR). Measurements made have included nitrogen balance (four missions), whole body protein kinetics with 15N glycine as the tracer (four missions) and 3-methyl histidine (four missions). Also available for comparison are bed rest studies with and without exercise. The following conclusions can be drawn: (i) No two missions are alike, (ii) Entry into orbit is associated with a metabolic stress response. (iii) Comparison of energy intake (5 missions) and energy balance (four missions) suggests that for at least three of the missions an energy deficit was a major factor in the protein loss. (iv) Serious energy deficits occur on mission with high mandatory exercise requirements. (v) Fidelity with the bed rest models is poor. Author

Protein Metabolism; Physiological Responses; Nitrogen; Methyl Compounds; Kinetics; Energy Budgets

20000020630 Michigan Univ., Coll. of Pharmacy, Ann Arbor, MI USA
A Noninvasive Test for Gastric Emptying and Intestinal Absorption
Welage, Lynda S., Michigan Univ., USA; Amidon, Gordon L., Michigan Univ., USA; Rhie, Julie, National Cancer Inst., USA; Neudeck, Brien L., Michigan Univ., USA; Choe, Sally, Michigan Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 468-469; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Gastric emptying depends on the size and densities of ingested particles including nondigestible food. In the low gravity environment in space, gastric emptying is expected to be altered due to the low gravitational force constant. Thus, gastrointestinal adaptation may occur in a microgravity environment. We have developed a pellet gastric emptying test composed of enteric coated particles of caffeine and acetaminophen of 0.7 and 3.6 mm in diameter. The enteric coat prevents dissolution in the stomach but allows for rapid dissolution in the small intestinal environment. In a gravity environment, it is expected that the large particles will empty slower than the small particles and will appear at a later time in the plasma, while particles of the same size would be expected to empty at the same rate.
Author

Gastrointestinal System; Intestines; Microgravity; Emptying

20000020631 California Univ., Lawrence Berkeley Lab., Life Sciences Div., Berkeley, CA USA
Radiation Session Summary
Kronenberg, Amy, California Univ., Lawrence Berkeley Lab., USA; Miller, Jack, California Univ., Lawrence Berkeley Lab., USA; Huso, David L., Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 471-476; In English; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The National Academy of Sciences (NAS) has identified radiation hazards as one of the potential "show stoppers" for long term human exploration of space. NASA supports a multi-disciplinary research effort encompassing diverse fields including radiation physics and transport, basic research in radiation carcinogenesis and research on behavioral effects. to supplement the current research effort, the National Council on Radiation Protection and Measurements (NCRP) has assembled Scientific Committee 1-7 (SC 1-7) to provide recommendations on further information that is required to develop radiation protection guidelines for manned missions beyond low earth orbit. Townsend presented an update on the recent activities of NCRP SC 1-7, and reviewed the knowledge base that will be required to accurately assess the risks to humans from exposure to the radiation environment of space. The presentations in the Radiation Session addressed the critical research needs identified by the NAS and the NCRP. These included: (1) characterization of the space radiation environment, (2) modeling and ground-based measurement of the fragmentation properties of heavy charged particles as they interact with shielding and tissue equivalent materials, (3) biodosimetry in astronauts, (4) ground- and flight-based studies to elucidate the mechanisms of biological response to space radiation (and potential interactions with microgravity), and (5) ground-based studies to quantify the risks of carcinogenesis and other damage to normal tissues that may ensue after exposure to different components of the space radiation environment.
Author

Biological Effects; Carcinogens; Damage; Exposure; Extraterrestrial Radiation; Physiological Responses; Radiation Dosage; Radiation Hazards

20000020632 NASA Johnson Space Center, Houston, TX USA

Radiation Measurements on the Russian MIR Orbital Station

Badhwar, Gautam D., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 477; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The Russian Mir orbital station was launched into an orbit with a 51.65 deg inclination in March 1986. It has operated continuously in the altitude range of 380 to 460 km. Almost immediately, cosmonauts began to carry out missions to the station. to date, there have been some 25 Russian missions. As part of the NASA Mir Program, a comprehensive set of radiation measurements were made to map the radiation in all of the Mir module. Numerous radiation measurements have been made on the Mir station throughout its lifetime. However, the comparison of these measurements have been difficult because of different sensitivities of detectors, some active and some passive, differing self shielding and in most cases unknown location shielding. In spite of these complications, very significant progress in the knowledge of the radiation environment onboard the Mir station has been made. These results are directly applicable to expected radiation environment on the International Space Station. In this paper, we describe the combined results from all seven NASA Mir missions. We show: (1) the absorbed dose rate from trapped particles is well correlated with the atmospheric density computed nearly 400 days earlier than the time of observation, (2) developed a relationship between the absorbed dose rate from galactic cosmic rays to the deceleration potential derived using the Climax neutron monitor rate, giving a tool to predict GCR dose rates to +/- 15% nearly 90 days prior to observations, (3) describe the drift of the South Atlantic Anomaly (SAA) with time, (4) compare the predictions of the dose rates as a function of time from the November 6-8, 1998 solar particle event with observations, (5) compare measurements made with NASA Tissue Equivalent Proportional Counter (TEPC) with the ESA DOSTEL device, the Hungarian Pille system, and the Russian R-16 dosimeter. Implications of these measurements for the ISS will be discussed.

Author

Deceleration; Anomalies; Dosage; Mir Space Station; Neutron Counters; Solar Corpuscular Radiation; Solar Flares

20000020633 Maryland Univ., Dept. of Radiation Oncology, Baltimore, MD USA

Characterization of Treefoil Peptide Genes in Iron-Ion or X-Irradiated Human Cells

Balcer–Kubiczek, E. K., Maryland Univ., USA; Harrison, G. H., Maryland Univ., USA; Xu, J. F., Maryland Univ., USA; Zhou, X. F., Maryland Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 478-479; In English

Contract(s)/Grant(s): NAGW-4392; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The gastrointestinal (GI) tract is especially sensitive to ionizing radiation, probably because of its high rate of cell turn over. Most of the data in the literature concerns the histological/anatomical description of damage rather than functional studies. In fact, previous reports in humans have shown that, at doses of 2 Gy or more, functional abnormalities appear indicating that in radiation sensitive tissues the effects of radiation are not limited to cell death. GI functions are controlled in particular by GI peptides. One hypothesis is that ionizing radiation may modulate the synthesis and release of these peptides and consequently may contribute largely to abnormalities in GI function. However, no previous studies have been concerned with GI-specific gene expression in irradiated GI tissues. The family of human trefoil peptides comprises three members thus far, all of which are expressed in specific regions of the GI tract. In addition, two trefoil peptides, pS2 (TFFI) and HITF (TFF2) are expressed in breast tissue. Their exact function in GI and breast tissues is unclear but mucosal integrity, repair, mucin secretion and responsiveness to hormones have been shown. We recently isolated and characterized pS2 as a novel p53- and estrogen receptor-independent gene whose MRNA expression in several cells lines was found to be delayed 4 to 7 days after irradiation with X-rays, fission neutrons or 1 GeV/n Fe-ions. The aim of the present study was to determine whether pS2 and HITF have a similar induction kinetics in irradiated gastric and breast cell lines, and whether they have the phorbol ester (TPA) responsive element (TRE).

Author

Peptides; Gene Expression; Iron; Ions; X Rays; Cells (Biology); Gastrointestinal System; Ionizing Radiation

20000020635 San Francisco Univ., Physics Dept., CA USA

Radiation Dosimetry on Manned Space Missions and at Ground-Based Accelerators

Benton, E. V.; Benton, E. R., San Francisco Univ., USA; Frank, A. L., Eril Research, Inc., USA; Moyers, M. M., San Francisco Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 483; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Exposure to ionizing radiation of space crews engaged in long-term space missions such as on space stations, Lunar bases and trips to Mars, poses a set of complex scientific and technological problems which are being resolved on the road toward achieving adequate radiation protection. At the same time, both space and ground-based radiobiological experiments, and

radiation sensitive biomedical experiments require adequate dosimetric support. In both areas, passive radiation detectors have in the past and are now playing an important role. Recently we have been conducting two separate but related experiments involving environmental radiation measurements aboard the Russian Mir Space Station and ground-based accelerators aimed at clarifying the role of proton-induced target fragmentation.
Author
Radiation Detectors; Ionizing Radiation; Sensitivity; Radiobiology; Radiation Protection

20000020638 California Univ., Lawrence Berkeley Lab., Life Sciences Div., Berkeley, CA USA
Simulation of Clusters of DNA Damage Induced by Ionizing Radiation Encountered in Spaceflight
Chatterjee, A., California Univ., Lawrence Berkeley Lab., USA; Holley, W. R., California Univ., Lawrence Berkeley Lab., USA; Mian, I. S., California Univ., Lawrence Berkeley Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 488-489; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Energetic Protons and Heavy Charged particles are present in the Galactic Cosmic Rays (GCR). Thus, an assessment of their possible harmful health effects to astronauts in long duration space flights above the earth's magnetic field is of high priority in NASA supported research. The research presented here is from our efforts in the NASA Specialized Center of Research and Training related to Radiation Health. Theoretical modeling of radiobiological effects of charged particles found in the GCR can provide very useful information which may not be obtainable through experiments alone. One such example is the production of clusters of damage by tracks of charged particles interacting with cellular DNA. Based on our general theory of radiation damage to DNA, it has been demonstrated that several damaged sites (base damage, single strand breaks and double strand breaks) can be produced in close proximity, generally within twenty base pairs. The severity of the clustering can vary greatly based on the quality of radiation. One recurring theme in our studies and a feature which distinguishes radiation damage from most other types of insult to DNA is the strong spatial correlations in the damage. The next obvious question is what are the biological consequences of such clustering? Furthermore, since clustering of damaged sites cannot be measured directly, is it possible to correlate theoretical estimates of the frequencies with which certain types of clusters are generated by particle tracks with selected biological end points? In this presentation, we demonstrate our initial efforts in correlating clusters of damage with experimentally measured unrejoined double strand breaks.
Author
Radiation Damage; Simulation; Radiobiology; Mathematical Models; Ionizing Radiation; Health; Estimates; Damage

20000020640 California Univ., Lawrence Berkeley Lab., Life Sciences Div., Berkeley, CA USA
Genetic Regulation of Charged Particle Mutagenesis in Human Cells
Kronenberg, Amy, California Univ., Lawrence Berkeley Lab., USA; Gauny, S., California Univ., Lawrence Berkeley Lab., USA; Cherbonnel–Lasserre, C., Commissariat a l'Energie Atomique, France; Liu, W., California Univ., Lawrence Berkeley Lab., USA; Wiese, C., California Univ., Lawrence Berkeley Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 493-496; In English
Contract(s)/Grant(s): NASA Order T-864-W; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Our studies use a series of syngeneic, and where possible, isogenic human B-lymphoblastoid cell lines to assess the genetic factors that modulate susceptibility apoptosis and their impact on the mutagenic risks of low fluence exposures to 1 GeV Fe ions and 55 MeV protons. These ions are representative of the types of charged particle radiation that are of particular significance for human health in the space radiation environment. The model system employs cell lines derived from the male donor WIL-2. These cells have a single X chromosome and they are hemizygous for one mutation marker, hypoxanthine phosphoribosyltransferase (HPRT). TK6 and WTK1 cells were each derived from descendants of WIL-2 and were each selected as heterozygotes for a second mutation marker, the thymidine kinase (TK) gene located on chromosome 17q. The HPRT and TK loci can detect many different types of mutations, from single basepair substitutions up to large scale loss of heterozygosity (LOH). The single expressing copy of TK in the TK6 and WTKI cell lines is found on the same copy of chromosome 17, and this allele can be identified by a restriction fragment length polymorphism (RFLP) identified when high molecular weight DNA is digested by the SacI restriction endonuclease and hybridized against the cDNA probe for TK. A large series of polymorphic linked markers has been identified that span more than 60 cM of DNA (approx. 60 megabasepairs) and distinguish the copy of chromosome 17 bearing the initially active TK allele from the copy of chromosome 17 bearing the silent TK allele in both TK6 and WTKI cells. TK6 cells express normal p53 protein while WTKI cells express homozygous mutant p53. Expression of mutant p53 can increase susceptibility to x-ray-induced mutations. It's been suggested that the increased mutagenesis in p53 mutant cells might be due to reduced apoptosis.
Author
Mutagens; Mutations; Deoxyribonucleic Acid; Extraterrestrial Radiation; Genetics; Health; Polymorphism

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Mutagenic Effects of Fe-56 Radiation on Cultured Mammalian Cells

Lenarczyk, M., Colorado State Univ., USA; Ueno, A., Colorado State Univ., USA; Vannais, D., Colorado State Univ., USA; Warters, R., Utah Univ., USA; Roberts, J., Utah Univ., USA; Kronenberg, Amy, California Univ., Lawrence Berkeley Lab., USA; Hei, T., Columbia Univ., USA; Waldren, C., Colorado State Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 497-499; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Travelers in space will almost certainly be exposed to various kinds of ionizing radiation especially high linear energy transfer (LET) particles such as HZE Fe. Such exposures can cause mutations in somatic cells that can increase the risk of developing such genetic diseases as cancer. We have, therefore, measured the mutagenic potency of HZE Fe in culture mammalian cells and begun experiments to determine if mutagenicity can be reduced by radioprotective chemicals like WR-1065 and RibCys, a prodrug of L-cysteine.

Author

Radiation Effects; Radiation Protection; Cells (Biology); Exposure; Ionizing Radiation

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DNA Repair-Protein Relocalization After Heavy Ion Exposure

Metting, N. F., Pacific Northwest National Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 503-506; In English

Contract(s)/Grant(s): DE-AC06-76RL-01830; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Ionizing radiation is good at making DNA double strand breaks, and high linear energy transfer (LET) radiations such as heavy ion particles are particularly efficient. For this reason, the proteins belonging to repair systems that deal with double strand breaks are of particular interest. One such protein is Ku, a component in the non-homologous recombination repair system. The Ku protein is an abundant, heterodimeric DNA end-binding complex, composed of one 70 and one 86 kDa subunit. Ku protein binds to DNA ends, nicks, gaps, and regions of transition between single and double-stranded structure. These binding properties suggest an important role in DNA repair. The Ku antigen is important in this study because it is present in relatively large copy numbers and it is part of a double-strand-break repair system. More importantly, we consistently measure an apparent upregulation in situ that is not verified by whole-cell-lysate immunoblot measurements. This apparent upregulation is triggered by very low doses of radiation, thus showing a potentially useful high sensitivity. However, elucidation of the mechanism underlying this phenomenon is still to be done.

Author

Deoxyribonucleic Acid; Exposure; Proteins; Maintenance; Ionizing Radiation; Dosage

20000020643 California Univ., Lawrence Berkeley Lab., Berkeley, CA USA

Accelerator-Based Studies of Heavy Ion Interactions Relevant to Space Biomedicine

Miller, J., California Univ., Lawrence Berkeley Lab., USA; Heilbronn, L., California Univ., Lawrence Berkeley Lab., USA; Zeitlin, C., California Univ., Lawrence Berkeley Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 507-510; In English

Contract(s)/Grant(s): NASA Order L-14230-C; DE-AC03-76SF-00098; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Evaluation of the effects of space radiation on the crews of long duration space missions must take into account the interactions of high energy atomic nuclei in spacecraft and planetary habitat shielding and in the bodies of the astronauts. These heavy ions (i.e. heavier than hydrogen), while relatively small in number compared to the total galactic cosmic ray (GCR) charged particle flux, can produce disproportionately large effects by virtue of their high local energy deposition: a single traversal by a heavy charged particle can kill or, what may be worse, severely damage a cell. Research into the pertinent physics and biology of heavy ion interactions has consequently been assigned a high priority in a recent report by a task group of the National Research Council. Fragmentation of the incident heavy ions in shielding or in the human body will modify an initially well known radiation field and thereby complicate both spacecraft shielding design and the evaluation of potential radiation hazards. Since it is impractical to empirically test the radiation transport properties of each possible shielding material and configuration, a great deal of effort is going into the development of models of charged particle fragmentation and transport. Accurate nuclear fragmentation cross sections (probabilities), either in the form of measurements with thin targets or theoretical calculations, are needed for input to the transport models, and fluence measurements (numbers of fragments produced by interactions in thick targets) are needed both to validate the models and to test specific shielding materials and designs. Fluence data are also needed to characterize the incident radiation field in accelerator radiobiology experiments. For a number of years, nuclear fragmentation measurements at GCR-like energies have been carried out at heavy ion accelerators including the LBL Bevalac, Saturne (France), the

Synchrophasotron and Nuklotron (Dubna, Russia), SIS-18 (GSI, Germany), the Alternating Gradient Synchrotron at Brookhaven National Laboratory (BNL AGS) and the Heavy Ion Medical Accelerator (HIMAC) in Chiba, Japan. Until fairly recently most of these experiments were done to investigate fundamental problems in nuclear physics, but with the increasing interest in heavy charged particles on the part of the space flight, radiobiology and radiotherapy communities, an increasing number of experiments are being directed at these areas. Some of these measurements are discussed in references therein. Over the past several years, our group has taken cross section and fluence data at the AGS and HIMAC for several incident beams with nuclear charge, Z, between 6 and 26 at energies between 290 and 1050 MeV/nucleon. Iron (Z = 26) has been studied most extensively, since it is the heaviest ion present in significant numbers in the GCR. Targets have included tissue-equivalent and proposed shielding materials, as well as a variety of elemental targets for cross section measurements. Most of the data were taken along the beam axis, but measurements have been made off-axis, as well. Here we present selected data and briefly discuss some implications for spacecraft and planetary habitat design.
Author
Heavy Ions; Research; Biomedical Data; Damage; Human Body; Incident Radiation; Ion Accelerators; Spacecraft Design; Spacecraft Shielding

20000020644 Colorado State Univ., Dept. of Radiological Health Sciences, Fort Collins, CO USA
Molecular and Chromosomal Damage and MIS-Repair in Human X Chromosomes
Muhlmann–Diaz, M. C., Colorado State Univ., USA; Loebrich, M., California Univ., Lawrence Berkeley Lab., USA; Rydberg, B., California Univ., Lawrence Berkeley Lab., USA; Cooper, P. K., California Univ., Lawrence Berkeley Lab., USA; Bedford, J. S., Colorado State Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 511-512; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The structure and/or activity of chromatin is known to influence substantially the damage and damage processing in cells after exposure to both ionizing and non-ionizing radiations as well as other genotoxic agents. There is virtually no information, however, on the comparison of ionizing radiation damage and its processing at the DNA and chromosome levels in relation to the influence of chromatin structure/activity. to study this question, we compared initial ionizing radiation damage in terms of DNA double strand breaks and breaks in prematurely condensed chromatin as well as the end product of mis-repair in DNA and the development of chromosomal aberrations in human X chromosomes of cells from normal males, females with an active and an inactive X, and individuals with supernumerary X chromosomes which are particularly inactive. The object was to determine whether the total initial and mis-repaired damage per cell simply increased in proportion to the number of X chromosomes, or whether one or the other (or both) damage end-points varied depending (presumably) on the known differences in structure/activity of the X chromosomes in these cells.
Author
Chromosomes; Molecules; Radiation Damage; Maintenance

20000020645 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Modulation of Radiogenic Damage by Microgravity: Results From STS-76
Nelson, Gregory, Loma Linda Univ., USA; Kazarians, Gayane, Loma Linda Univ., USA; Schubert, Wayne, Jet Propulsion Lab., California Inst. of Tech., USA; Kern, Roger, Jet Propulsion Lab., California Inst. of Tech., USA; Schranck, David, Jet Propulsion Lab., California Inst. of Tech., USA; Hartman, Philip, Texas Christian Univ., USA; Hlavacek, Anthony, Texas Christian Univ., USA; Wilde, Honor, Texas Christian Univ., USA; Lewicki, Dan, Texas Christian Univ., USA; Benton, Eugene, San Francisco Univ., USA; Benton, Eric, San Francisco Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 515-516; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The STS-76 (Shuttle-Mir 3) spaceflight provided an opportunity to test two questions about radiation responses in C. elegans. First, does the absence of gravity modify the dose-response relation for mutation and chromosome aberration and second, what are the features of the mutation spectrum resulting from exposure to cosmic rays? These questions were put to the test in space using the ESA "Biorack" facility which was housed in the Spacehab module aboard shuttle Atlantis. The mission flew in March, 1996 and was a shuttle rendezvous with the Russian space station Mir.
Author
Damage; Chromosomes; Mutations; Gravitation; Radiation Dosage

20000020646 Maryland Univ. Baltimore County, Dept. of Psychology, Catonsville, MD USA
Some Behavioral Effects of Exposure to Low Doses of Fe-56 Particles
Rabin, Bernard M., Maryland Univ. Baltimore County, USA; Joseph, James A., Tufts Univ., USA; Shukitt–Hale, Barbara, Tufts Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 517-519; In English

Contract(s)/Grant(s): NAGW-4394; NAG5-6093; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Future missions in space (such as a mission to Mars) will involve long-term travel beyond the magnetic field of the Earth. As a result, astronauts will be exposed to radiation qualities and doses that differ from those experienced in low earth orbit, including exposure to heavy particles, such as Fe-56, which are a component of cosmic rays. Although the hazards of exposure to heavy particles are often minimized, they can affect neural functioning, and as a consequence, behavior. Unless the effects of exposure to cosmic rays can somehow be reduced, their effects on the brain throughout long duration flights could be disastrous. In the extreme case, it is possible that the effects of cosmic rays on space travelers could result in symptomatology resembling that of Alzheimer's or Parkinson's diseases or of advancing age, including significant cognitive and/or motor impairments. Because successful operations in space depend in part on the performance capabilities of astronauts, such impairments could jeopardize their ability to satisfy mission requirements, as well as have long-term consequences on the health of astronauts. As such, understanding the nature and extent of this risk may be vital to the effective performance and possibly the survival of astronauts during future missions in space.

Author

Iron Isotopes; Heavy Ions; Cosmic Rays; Dosage; Exposure; Hazards; Health

20000020647 California Univ., Lawrence Berkeley Lab., Life Sciences Div., Berkeley, CA USA

Non-Rejoined DNA Double-Strand Breaks in Human Cells. A Shift in RBE versus LET for HZE Iron Particles in Comparison with Low Energy Helium Particles

Rydberg, B., California Univ., Lawrence Berkeley Lab., USA; Cooper, P. K., California Univ., Lawrence Berkeley Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 520; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

DNA double-strand breaks (dsbs) are likeley to be the most important lesions produced by ionizing radiation. Among the dsbs, those that are either misrejoined or remain unrejoined a long time after induction are probably the most relevant for a variety of biological endpoints. We present here results of unrejoined dsbs in human fibroblasts 16 hrs after irradiation with Energy Heavy Ions (HZE) Fe particles with LETs of 190 and 150 keV/micron and compare this with similar results with He particles in the Linear Energy Transfer (LET) range of 65-160 keV/micron.

Author

Deoxyribonucleic Acid; Linear Energy Transfer (LET); Cells (Biology); Relative Biological Effectiveness (RBE); Particle Energy; Ionizing Radiation

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Quantitation of Radiation Induced Deletion and Recombination Events Associated with Repeated DNA Sequences

Sinden, Richard R., Texas A&M Univ., USA; Ford, John R., Texas A&M Univ., USA; Braby, Leslie A., Texas A&M Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 521-523; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Manned exploration of space exposes the explorers to a complex and novel radiation environment. The galactic cosmic ray component of this environment is relatively constant, and the variations with the solar cycle are well understood and predictable. However, a significant fraction of the dose may be delivered by solar particle events which vary dramatically in dose rate and incident particle spectrum. When these radiations interact with spacecraft materials and added shielding they produce a spectrum of secondary particles which depends on the spectrum of the incident particles as well as the shielding material. The different particle types and energies result in different patterns of energy deposition at the molecular and cellular level. Differences in these energy deposition patterns significantly alter the ability of cellular systems to repair the resulting damage. It is likely that these differences also effect the spatial distribution of damage within the DNA of the interphase cell nucleus and produce corresponding differences in endpoints related to health effects. Nearly one-third of the human genome is composed of DNA repeats, which include simple mono-, di-, tri-, and tetranucleotide repeats; widely separated small and large repeats; and inverted repeats. Mutations associated with repetitive DNA are a source of many genetic diseases and cancer. In fact, the vast majority of mutations leading to human disease likely result from replication errors involving misalignment between repeated DNAs. Therefore, understanding how the various kinds of repeats contribute to the disease burden and understanding the impact of DNA damage on repeat-associated genomic instability is important for human health. DNA damage from ionizing radiation induces DNA structures and DNA repair events that can promote errors associated with repeated DNA sequences. Such repeated DNA sequences are likely to be very prone to mutation following exposure to high-Z high-energy (HZE) particles during space flight. Cells in the direct line of the HZE particle sustain a high dose of energy while cells surrounding the primary tract sustain a lower dose of energy from the energetic delta rays (electrons) produced by HZE particles. Therefore, the nature and pattern DNA damage

to cells in tissue upon irradiation with HZE particles is particularly complex. It is important to understand the types of mutational changes induced by both the HZE particles as well as the delta rays.
Author
Quantitative Analysis; Irradiation; Deoxyribonucleic Acid; Damage; Deletion; Dosage; Energy Transfer; Genetics; Ionizing Radiation

20000020649 Tennessee Univ., Dept. of Nuclear Engineering, Knoxville, TN USA
Information Needed to Make Radiation Protection Recommendations for Travel Beyond Low-Earth Orbit
Townsend, Lawrence W., Tennessee Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 524; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Scientific Committee 1-7 (SC 1-7) of the National Council on Radiation Protection and Measurements (NCRP) has been assembled for the purpose of providing recommendations to NASA concerning the information needed to make radiation protection guidelines for manned space missions beyond low-Earth orbit. Current space radiation limits pertain only to missions in low-Earth orbit and are not considered relevant for future deep space missions. SC 1-7 has met numerous times over the past three years to review the current status of scientific knowledge relevant to this task. The committee is currently formulating a set of recommendations for additional research needed to provide the data necessary to establish astronaut radiation limits for exomagnetospheric missions, such as a Lunar base or mission to Mars. In this presentation, the procedures followed by the NCRP for making recommendations are briefly discussed. The composition of SC 1-7 and the scope of its efforts and activities are presented. Brief overviews of the current status and shortcomings of scientific knowledge of the space radiation environment, radiation physics and transport, radiation biology, dosimetry and radiation risk are presented. However, formal recommendations of research necessary to establish radiation limits for deep space missions will not be presented since they have not been developed by the committee or approved by the Council.
Author
Extraterrestrial Radiation; Formulations; Low Earth Orbits; Manned Space Flight; Radiation Protection

20000020650 ANSER Corp., Arlington, VA USA
Risk Management Strategies During Solar Events
Turner, Ron, ANSER Corp., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 525; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The natural radiation from galactic cosmic rays (GCR) and solar particle events (SPEs) will pose a serious health risk to humans during missions to Mars or the Moon. The opportunities and limitations of astronauts on these missions will be constrained by the radiation environment and NASA's response to it. NASA recognizes both an ethical and legal responsibility to minimize the acute and long-term risks to astronauts during space flight. There is an extensive program underway to collect statistically meaningful data to understand the fundamental biological impacts of the radiation environment. These data can be directly related to the well-characterized incident, slowly varying, galactic cosmic ray flux. There is greater uncertainty in predicting and characterizing the rapidly changing solar particle radiation which, over time periods of hours to days, can produce particle fluences comparable to mission-long GCR fluence. Work by this investigator in an earlier grant (NAGW-4166) systematically identified the types of solar particle events (SPEs), the stages of a human Lunar or Mars mission when the events may occur, and the methods used to detect and forecast these events. Alternative scenarios were identified that represented the range of architectures that could be employed to mitigate SPE risk. The advantages and disadvantages of each scenario were discussed. Based on the earlier results, we initiated a program to continue this research through a sequence of additional phases that will progressively add to NASA's ability to develop a comprehensive SPE risk management strategy. These subsequent phases examine in more detail the science, engineering, and operational requirements. The focus in each phase is to identify the key issues and general approaches to address these issues, rather than to attempt to specify a particular solution. This presentation will include a short review of the physics of SPEs and the current ability to forecast SPEs. It will then cover techniques to observe SPEs and the solar precursers to SPEs.
Author
Galactic Cosmic Rays; Solar Storms; Data Acquisition; Health; Legal Liability; Solar Flares

20000020651 Utah Univ., Health Sciences Center, Salt Lake City, UT USA
Aminothiol Induced Modulation of p53 Protein Activity in Human Cells
Warters, Raymond L., Utah Univ., USA; Thai, David K., Utah Univ., USA; Roberts, Jeanette C., Utah Univ., USA; Gaffney, David K., Utah Univ., USA; Cress, Anne E., Arizona Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 526-527; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The aminothiols (S-2-(3-aminopropylamino)ethylphosphorothioic acid (WR1065) and the thiazolidine prodrug Ribose Cysteine (RibCys) have been reported to be antimutagenic in mammalian cells when present either during irradiation, or more significantly when present only after irradiation. The antimutagenesis effect mediated by these agents when present during irradiation may be attributable to their ability to reduce radiation-induced DNA damage. The antimutagenesis effect observed when these agents are added well after irradiation must be due to some modification of the cell's response to DNA damage. In an attempt to better understand this modulation of the cellular response to radiation, we are investigating the intracellular changes in cells exposed either to ionizing radiation or aminothiols.
Author
Amino Radical; Cells (Biology); Radiation Damage; Ionizing Radiation

20000020653 NASA Langley Research Center, Hampton, VA USA
Impact of Track Structure Effects on Shielding and Dosimetry
Wilson, J. W., NASA Langley Research Center, USA; Cucinotta, F. A., NASA Johnson Space Center, USA; Schimmerling, W., NASA, USA; Kim, M. Y., NASA Langley Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 529-532; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Galactic cosmic rays (GCR) consisting of nuclei of all the known elements with kinetic energies extending from tens to millions of MeV pose a significant health hazard to future deep space operations. Even half of the radiation exposures expected in ISS will result from GCR components. The biological actions of these radiations are known to depend on the details of the energy deposition (not just linear energy transfer, LET, but the lateral dispersion of energy deposition about the particle track). Energy deposits in tissues are dominated by the transfer of tens to hundreds of eV to the tissue's atomic electrons. In the case of low LET radiations, the collisions are separated by large dimensions compared to the size of important biomolecular structures. If such events are also separated in time, then the radiation adds little to the background of radicals occurring from ordinary metabolic processes and causes little or no biological injury. Hence, dose rate is a strong determinant of the action of low LET exposures. The GCR exposures are dominated by ions of high charge and energy (HZE) characterized by many collisions with atomic electrons over biomolecular dimensions, resulting in high radical- density events associated with a few isolated ion paths through the cell and minimal dose rate dependence at ordinary exposure levels. The HZE energy deposit declines quickly laterally and merges with the background radical density in the track periphery for which the exact lateral distribution of the energy deposit is the determinant of the biological injury. Although little data exists on human exposures from HZE radiations, limited studies in mice and mammalian cell cultures allow evaluation of the effects of track structure on shield attenuation properties and evaluation of implications for dosimetry. The most complete mammalian cell HZE exposure data sets have been modeled including the C3H10T1/2 survival and transformation data of Yang et al., the V79 survival and mutation data of various groups, and the Harderian gland tumor data of Alpen et al. Model results for the Harderian gland tumor data in comparison with data from Alpen et al. The Harderian target cell initiation cross section compares closely with the transformation cross section found for the C3H10T1/2 cell transformation data of Yang et al. The most notable feature of the cross sections are the multivalued cross sections for a given LET which implies the corresponding relative biological effectiveness (RBE) is dependent not only on the LET but also the ion type. This fact is at variance with the latest ICRP recommended quality factor which is a defined function of only the LET.
Author
Galactic Cosmic Rays; Dosimeters; Energy Transfer; Exposure; Hazards; Mutations; Radiation Dosage; Relative Biological Effectiveness (RBE)

20000020654 NASA Johnson Space Center, Houston, TX USA
Analysis of Incomplete Chromosomal Exchanges Using Fluorescence In Situ Hybridization with Telomere Probes
Wu, H., NASA Johnson Space Center, USA; George, K., NASA Johnson Space Center, USA; Yang, T. C., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 533; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

To determine the frequency of true incomplete exchanges induced by both low- and high-LET radiation.
Author
Linear Energy Transfer (LET); Chromosomes; Research

20000020655 Baylor Coll. of Medicine, Houston, TX USA
Sleep/Circadian Rhythm Session Summary
Dinges, David F., Baylor Coll. of Medicine, USA; Czeisler, Charles A., Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 535-537; In English; No Copyright; Avail: CASI; A01,

Hardcopy; A06, Microfiche

Sleep and circadian rhythm systems are fundamental regulatory processes of the nervous system, and the most ubiquitous endogenous controls of human biobehavioral functions - everyone is internally programmed to sleep every night. The need for sleep is a homeostatic drive that occurs regardless of time of day, but it is also modulated by the endogenous circadian pacemaker. Conversely, the endogenous circadian pacemaker oscillates regardless of the need for sleep, although its promotion of wakefulness can be overwhelmed by elevated homeostatic sleep drive. These two powerful neurobiological systems interact continuously to control brain state (i.e., waking vs. sleep) and the intensity of state (e.g., alert vs. sleepy). Sleep and circadian rhythmicity also temporally modulate a wide range of physiological functions (e.g., body temperature, cardiovascular activity, respiration, immune responses), hormonal functions (e.g., growth hormone, melatonin, cortisol, thyroid hormones), behavioral functions (e.g., movement, posture, reaction time), and cognitive functions (e.g., fatigue, alertness, vigilance, memory, cognitive throughput). No astronaut-no matter how much training, preparation, nutrition, psychosocial support, or environmental protection is provided -is immune from the daily control of physiology and performance by the homeostatic drive for sleep and the endogenous circadian timing system. Failure to take these two interactive neurobiological imperatives into account when planning human activities in space will have catastrophic consequences. The need for sleep and the circadian pacemaker have a sustained influence over many biomedical systems essential for maintaining astronaut physical condition, mental health, and performance capability. Dysfunction of sleep and circadian systems can adversely affect an organism's ability to respond to environmental challenges and has been linked to physiological and psychological disorders. This area therefore has a high degree of relevance to a number of other space life science technical areas including research on muscle and bone loss, cardiovascular and immune changes, neurovestibular alterations and nutritional needs, and behavioral and psychological health in space flight.

Author

Alertness; Body Temperature; Bone Demineralization; Cardiovascular System; Circadian Rhythms; Mental Health; Nervous System; Physiological Responses; Sleep; Wakefulness

20000020657 Massachusetts General Hospital, Statistics Research Lab., Boston, MA USA

Dynamic Assessment of Circadian Phase and Amplitude Under the Simulated Lighting Conditions of Long-Duration Space Missions

Brown, E. N., Massachusetts General Hospital, USA; Luithardt, H. H., Massachusetts General Hospital, USA; Wright, K. P., Jr., Brigham and Women's Hospital, USA; Czeisler, Charles A., Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 541-542; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Maintenance of physiologic and neurobehavioral homeostasis during long-duration space missions is crucial for ensuring optimal crew performance. Alterations in the circadian system will occur due to loss of contact with the normal geophysical light-dark cycles. Assessing the status of the circadian system is an especially challenging task because this normally requires special protocols such as the constant routine, free-run and forced desynchrony. We are developing statistical methods to make dynamic assessments of circadian phase and amplitude from core-temperature measurements collected under the simulated lighting conditions of long- duration space missions.

Author

Statistical Analysis; Dynamic Characteristics; Circadian Rhythms; Physiology; Long Duration Space Flight; Human Performance; Homeostasis

20000020658 Massachusetts Inst. of Tech., Man-Vehicle Lab., Cambridge, MA USA

Effectiveness of an Expert System for Astronaut Assistance on a Sleep Experiment

Callini, G., Massachusetts Inst. of Tech., USA; Essig, S. M., Massachusetts Inst. of Tech., USA; Heher, D., Caelum Research Corp., USA; Young, L. R., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 543; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Principal Investigator-in-a-Box ([PI]) is an expert system designed to train and assist astronauts with the performance of an experiment outside their field of expertise, particularly when contact with the Principal Investigators on the ground is limited or impossible. In the current case, [PI] was designed to assist with the calibration and troubleshooting procedures of the Neurolab Sleep and Respiration Experiment during the pre-sleep period of no ground contact. It displays physiological signals in real time during the pre-sleep instrumentation period, and alerts the astronauts when a poor signal quality is detected.

Author

Effectiveness; Expert Systems; Respiration; Sleep; Experimentation

20000020659 NASA Ames Research Center, Moffett Field, CA USA

Ambient Light Intensity, Actigraphy, Sleep and Respiration, Circadian Temperature and Melatonin Rhythms and Daytime Performance of Crew Members During Space Flight on STS-90 and STS-95 Missions

Czeisler, Charles A., Brigham and Women's Hospital, USA; Dijk, D.–J., Brigham and Women's Hospital, USA; Neri, D. F., California Univ., USA; Hughes, R. J., Brigham and Women's Hospital, USA; Ronda, J. M., Brigham and Women's Hospital, USA; Wyatt, J. K., Brigham and Women's Hospital, USA; West, J. B., California Univ., USA; Prisk, G. K., California Univ., USA; Elliott, A. R., California Univ., USA; Young, L. R., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 544-546; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Sleep disruption and associated waking sleepiness and fatigue are common during space flight. A survey of 58 crew members from nine space shuttle missions revealed that most suffered from sleep disruption, and reportedly slept an average of only 6.1 hours per day of flight as compared to an average of 7.9 hours per day on the ground. Nineteen percent of crewmembers on single shift missions and 50 percent of the crewmembers in dual shift operations reported sleeping pill usage (benzodiazepines) during their missions. Benzodiazepines are effective as hypnotics, however, not without adverse side effects including carryover sedation and performance impairment, anterograde amnesia, and alterations in sleep EEG. Our preliminary ground-based data suggest that pre-sleep administration of 0.3 mg of the pineal hormone melatonin may have the acute hypnotic properties needed for treating the sleep disruption of space flight without producing the adverse side effects associated with benzodiazepines. We hypothesize that pre-sleep administration of melatonin will result in decreased sleep latency, reduced nocturnal sleep disruption, improved sleep efficiency, and enhanced next-day alertness and cognitive performance both in ground-based simulations and during the space shuttle missions. Specifically, we have carried out experiments in which: (1) ambient light intensity aboard the space shuttle is assessed during flight; (2) the impact of space flight on sleep (assessed polysomnographically and actigraphically), respiration during sleep, circadian temperature and melatonin rhythms, waking neurobehavioral alertness and performance is assessed in crew members of the Neurolab and STS-95 missions; (3) the effectiveness of melatonin as a hypnotic is assessed independently of its effects on the phase of the endogenous circadian pacemaker in ground-based studies, using a powerful experimental model of the dyssomnia of space flight; (4) the effectiveness of melatonin as a hypnotic is assessed during the STS-90 (Neurolab) and STS-95 missions in a double-blind placebo-controlled trial. In both flight-based experiments, the effects of melatonin on sleep stages and spectral composition of the EEG during sleep will be determined as well as its effects on daytime alertness and performance; (5) the impact of space flight on sleep and waking neurobehavioral alertness and performance in 30-45-year-old astronauts is compared with its impact in a 77-year-old astronaut. This case study is the first to assess the effects of space flight on an older individual. Because the investigators are still blind to the treatment in this double-blind, placebo-controlled trial, preliminary results will be presented independent of the drug condition.

Author

Luminous Intensity; Alertness; Circadian Rhythms; Disorders; Electroencephalography; Mental Performance; Simulation; Surveys

20000020660 Brigham and Women's Hospital, Boston, MA USA

Electroencephalographic and Ocular Correlates of Neurobehavioral Performance Decrements

Dijk, Derk–Jan, Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 547-550; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Neurobehavioral performance of astronauts during long duration space flight may be compromised by sleep loss, non-24 h rest-activity cycles, desynchrony of the sleep-wake cycle and endogenous circadian rhythms as well as micro-gravity itself. Ground-based research has demonstrated that all of these factors contribute significantly to neurobehavioral performance decrements and interact in a complex non-additive manner. In particular, it has been shown that prolonged partial sleep loss, i.e., loss of 3-4 hours of sleep per night, results in a progressive deterioration of neurobehavioral performance. Furthermore, it has been demonstrated that stable levels of alertness and cognitive throughput during a 16-18 h wake episode are critically dependent on the maintenance of an appropriate phase relationship between the sleep-wake cycle and the circadian timing system. When this appropriate phase relationship is not maintained neurobehavioral performance deteriorates even within an episode of wakefulness of 16 h in duration. Finally, posture has been shown to interact with the effects of the hormone melatonin on subjective alertness as well as the spectral composition of the electroencephalogram (EEG), such that it appears that humans are more susceptible to the effects of melatonin when in a supine position. Previous research has indicated that sleep loss and circadian phase affect the EEG during sleep as well as during wakefulness. EEG and ocular (EOG) parameters recorded during wakefulness are associated with neurobehavioral performance decrements in the laboratory as well as in real life situations. However, this association of EEG and EOG parameters with neurobehavioral performance has not been investigated under conditions in which a wide variety of combinations of sleep pressure (i.e., wake duration) and circadian phase has been realized. Furthermore, the interaction between

these independent variables and posture has not been investigated in detail. The aim of the present research is to investigate the robustness of the associations between EEG/EOG parameters and neurobehavioral performance and to identify new associations under conditions in which circadian phase, circadian amplitude, sleep pressure and posture are manipulated. Identification of EEG and EOG parameters that are highly correlated with neurobehavioral performance under these conditions could lead to the development of algorithms and devices that allow on-line and non-invasive monitoring, as well as prediction, of neurobehavioral performance during long duration space flight.
Author
Electroencephalography; Performance Prediction; Neuromuscular Transmission; Alertness; Circadian Rhythms; Losses; Sleep; Wakefulness

20000020661 Baylor Coll. of Medicine, Houston, TX USA
Countermeasures to Neurobehavioral Deficits from Cumulative Partial Sleep Deprivation During Space Flight
Dinges, David F., Baylor Coll. of Medicine, USA; VanDongen, H. P. A.; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 551-553; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The performance capability of astronauts during extended-duration space flight depends heavily on achieving recovery through adequate sleep. Even with appropriate circadian alignment, sleep loss will erode fundamental elements of human neurobehavioral performance capability including vigilance, cognitive speed and accuracy, working memory, reaction time, and physiological alertness. Our preliminary experiments have revealed that these deficits occur reliably when sleep is limited to 6 hr per day. Such chronic sleep restriction has been a common experience during manned space flight, occurring in response to endogenous disturbances of sleep (motion sickness, stress, circadian rhythms), environmental disruptions of sleep (noise, temperature, light), and curtailment of sleep due to the work demands that accompany extended space flight operations. In order to prevent cumulative waking deficits resulting from sleep restriction, research suggests that the sleep drive must be met through increased duration of the major (anchor) sleep period, and/or through the strategic use of a single pre-planned (preemptive) nap each day. The implementation of a brief nap may be an important way in which cumulative sleep loss and waking performance deficits could be reversed or prevented. However, nap strategies have not been systematically tested as countermeasures to performance impairment from cumulative anchor sleep restriction. Thus, there is a critical deficiency in knowledge of which combinations of anchor sleep and nap durations yield the most efficient return of performance per unit time invested in sleep. The primary aim of this project is to meet this critical deficiency through utilization of a response surface model design, testing in a dose-response manner varying combinations of anchor sleep and nap sleep durations for the purpose of establishing how to most effectively and efficiently limit the cumulative effects of chronic sleep restriction in space operations. A search algorithm involving two-stage regression analyses is being used to test the hypothesis that the addition of a relatively brief preemptive nap to restricted sleep each day markedly attenuates the cumulative performance deficits developing across days. This approach is also being used to explore the possibility that the addition of a nap to anchor sleeps increases sleep-related secretion of growth hormone, which may be a countermeasure for the effects of microgravity on muscle and loss in prolonged space flight.
Author
Countermeasures; Neuromuscular Transmission; Sleep; Alertness; Circadian Rhythms; Human Performance; Muscles

20000020662 California Univ., Section of NPB, Davis, CA USA
The Effects of Gravity on the Circadian Timing System
Fuller, Charles A., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 554; In English
Contract(s)/Grant(s): NAG2-840; NAG5-4320; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

All vertebrates have a physiological control system that regulates the timing of the rhythms of their daily life. Dysfunction of this system, the circadian timing system (CTS), adversely affects an organism's ability to respond to environmental challenges and has been linked to physiological and psychological disorders. Exposure to altered gravitational environments (the microgravity of space and hyperdynamic environments produced via centrifugation) produces changes in both the functioning of the CTS and the rhythmic variables it controls. The earliest record of primate rhythms in a spaceflight environment come from Biosatellite III. The subject, a pig-tailed macaque, showed a loss of synchronization of the body temperature rhythm and a fragmented sleep-wake cycle. Alterations in the rhythm of body temperature were also seen in rhesus macaques flown on COSMOS 1514. Squirrel monkeys exposed to chronic centrifugation showed an initial decrease in the amplitude and mean of their body temperature and activity rhythms. In a microgravity environment, Squirrel monkeys on Spacelab-3 showed a reduction in the mean and amplitude of their feeding rhythms. Since 1992 we have had the opportunity to participate on three US/Russian sponsored biosatellite missions on which a total of six juvenile male rhesus macaques were flown. These animals uniformly

exhibited delays in the phasing of their temperature rhythms, but not their heart rate or activity rhythms during spaceflight. There was also a tendency for changes in waveform mean and amplitude. These data suggest that the spaceflight environment may have a differential effect on the different oscillators controlling different rhythmic variables. Ongoing studies are examining the effects of +G on the CTS. The long-term presence of humans in space highlights the need for effective countermeasures to gravitational effects on the CTS.
Author
Animals; Gravitational Effects; Circadian Rhythms; Countermeasures; Losses; Microgravity; Vertebrates

20000020663 Brigham and Women's Hospital, Boston, MA USA
Melatonin as a Countermeasure for Entrainment to the Sleep/Wake Schedules Required During Shuttle Missions
Khalsa, Sat Bir S., Brigham and Women's Hospital, USA; Dijk, Derk–Jan, Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 555-558; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Most if not all physiologic and behavioral variables in humans exhibit endogenous circadian rhythms with a period of about 24.2 hours. On earth, a stable phase relation between circadian rhythms and the 24-hr day is maintained by a process called entrainment, in which the daily alternation of light and darkness is the most important periodic environmental agent. Although bright light has been shown to be effective in synchronizing and resetting the human circadian pacemaker, the effects of dim levels of light have limited effectiveness in maintaining synchronization, especially when the imposed light/dark cycle is shifted with respect to the habitual sleep/wake cycle. This is the case for shuttle astronauts who are typically exposed to recurrent "sleep cycle shifting" due to mission-dependent orbital mechanics and mission duration requirements and is equivalent to imposition of a shorter-than-24 hour day. Power requirements on the shuttle necessitate a restricted level of ambient lighting. Together, these conditions are likely to result in misalignment of the endogenous circadian timing system with respect to the desired sleep/wake cycle, even among crew members who begin the mission with their sleep- wake cycle well adapted to mission elapsed time on the day of launch.
Author
Countermeasures; Sleep; Wakes; Misalignment; Physiology; Darkness; Circadian Rhythms

20000020664 Pittsburgh Univ., Sleep and Chronobiology Center, Pittsburgh, PA USA
Sleep and Circadian Rhythms in Four Orbiting Astronauts
Monk, Timothy H., Pittsburgh Univ., USA; Buysse, Daniel J., Pittsburgh Univ., USA; Billy, Bart D., Pittsburgh Univ., USA; Kennedy, Kathy S., Pittsburgh Univ., USA; Willrich, Linda M., Pittsburgh Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 559-560; In English
Contract(s)/Grant(s): NAS9-18404; NAS9-19407; NIH-MH-01235; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

INTRODUCTION The study of human sleep and circadian rhythms in space has both operational and scientific significance. Operationally, U.S. Spaceflight is moving away from brief missions with durations of less than one week. Most space shuttle missions now last two weeks or more, and future plans involving space stations, lunar bases and interplanetary missions all presume that people will be living away from the gravity and time cues of earth for months at a time. Thus, missions are moving away from situations where astronauts can "tough it out" for comparatively brief durations, to situations where sleep and circadian disruptions are likely to become chronic, and thus resistant to short term pharmacological or behavioral manipulations. As well as the operational significance, there is a strong theoretical imperative for studying the sleep and circadian rhythms of people who are removed from the gravity and time cues of earth. Like other animals, in humans, the Circadian Timekeeping System (CTS) is entrained to the correct period (24h) and temporal orientation by various time cues ("zeitgebers"), the most powerful of which is the alternation of daylight and darkness. In leaving Earth, astronauts are removing themselves from the prime zeitgeber of their circadian system -- the 24h alternation of daylight and darkness.
Author
Circadian Rhythms; Sleep; Astronauts; Darkness; Daytime; Gravitation; Space Flight

20000020665 Beth Israel Deaconess Medical Center, Boston, MA USA
Neuroendocrine and Neuroimmune Modulation by Sleep Deprivation
Mullington, J., Beth Israel Deaconess Medical Center, USA; Carlin, M., Pennsylvania Univ., USA; Kapoor, S., Pennsylvania Univ., USA; Price, N., Pennsylvania Univ., USA; Szuba, M., Pennsylvania Univ., USA; Schwartz, R., Baylor Coll. of Medicine, USA; Shearer, W., Baylor Coll. of Medicine, USA; Butel, J., Baylor Coll. of Medicine, USA; Dinges, D. F., Pennsylvania Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 561-562; In English; No Copyright;

Avail: CASI; A01, Hardcopy; A06, Microfiche

Animal studies have shown that sleep deprivation impairs prognostic outcome during infectious disease in rabbits. We are analyzing blood sampled from subjects participating in a number of sleep deprivation conditions. We will present results of ongoing studies on the effects of total (TSD) and partial sleep deprivation (PSD) on neuroendocrine and neuroimmune parameters in humans.

Author

Neurophysiology; Endocrine Systems; Immune Systems; Sleep Deprivation; Data Acquisition

20000020666 California Univ., Section of NPB, Davis, CA USA

BRN 3.1 Knockouts Affect the Vestibular, Autonomic, and Circadian Rhythm Responses to 2G Exposure

Murakami, D. M., California Univ., USA; Erkman, L., California Univ., USA; Rosenfeld, M. G., California Univ., USA; Fuller, C. A., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 563-564; In English

Contract(s)/Grant(s): NAGW-4552; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Our previous studies have demonstrated that 2G exposure via centrifugation significantly attenuated the daily mean and circadian rhythm amplitude of rat body temperature (Tb), heart rate, and activity (Act). In addition, 2G exposure activates neural responses in several vestibular, autonomic, and circadian nuclei. Although we have characterized the effect of 2G on an animal's physiological, neuronal, and behavioral responses, it will be important to understand the underlying neural and physiological mechanisms that mediate those responses. For example, the vestibular responses, proprioceptive feedback, or fluid shifts may be the critical factors that mediate the responses to 2G. As a first step to understand the relative importance of these different response pathways to altered gravitational fields, this study examined the contribution of the vestibular system by utilizing an animal model from molecular biology. Brain 3.1 (Bm 3.1) is a POU domain homeobox gene involved in the normal development of the vestibular and auditory system. Brn 3.1 deletion results in a loss of hair cells in the otoliths, semicircular canals, and cochlea. As a result mice with a Brn 3.1 deletion do not have a functioning vestibular or auditory system. The BRN 3.1 knockout mouse could be a very useful animal model for isolating the role of the vestibular system in mediating the physiological responses to 2G exposure. Therefore, this study compared the effect of 2G exposure via centrifugation between Brn 3.1 knockout (KO) versus Wildtype (W) mice.

Author

Vestibules; Autonomic Nervous System; Circadian Rhythms; Exposure; Cells (Biology); Gravitational Fields; Losses; Physiological Responses; Semicircular Canals

20000020667 University of North Texas Health Science Center, Dept. of Integrative Physiology, Forth Worth, TX USA

Sleep Restriction Effects on Cardiovascular Regulation

Smith, M. L., University of North Texas Health Science Center, USA; Watenpaugh, D. E., University of North Texas Health Science Center, USA; Muenter, N., University of North Texas Health Science Center, USA; Wasmund, S. L., University of North Texas Health Science Center, USA; Wasmund, W. L., University of North Texas Health Science Center, USA; Carter, R., III, University of North Texas Health Science Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 565-566; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Our previous studies have demonstrated that 2G exposure via centrifugation significantly attenuated the daily mean and circadian rhythm amplitude of rat body temperature (Th), heart rate, and activity (Act). In addition, 2G exposure activates neural responses in several vestibular, autonomic, and circadian nuclei. Although we have characterized the effect of 2G on an animal's physiological, neuronal, and behavioral responses, it will be important to understand the underlying neural and physiological mechanisms that mediate those responses. For example, the vestibular responses, proprioceptive feedback, or fluid shifts may be the critical factors that mediate the responses to 2G. As a first step to understand the relative importance of these different response pathways to altered gravitational fields, this study examined the contribution of the vestibular system by utilizing an animal model from molecular biology. Brain 3.1 (Bm 3. 1) is a POU domain homeobox gene involved in the normal development of the vestibular and auditory system. Brn 3.1 deletion results in a loss of hair cells in the otoliths, semicircular canals, and cochlea. As a result mice with a Brn 3.1 deletion do not have a functioning vestibular or auditory system. The BRN 3.1 knockout mouse could be a very useful animal model for isolating the role of the vestibular system in mediating the physiological responses to 2G exposure. Therefore, this study compared the effect of 2G exposure via centrifugation between Bm 3.1 knockout (KO) versus Wildtype (W) mice.

Author

Sleep; Cardiovascular System; Autonomic Nervous System; Cells (Biology); Centrifuging; Circadian Rhythms; Gravitational Fields; Physiological Responses; Semicircular Canals; Vestibules

20000020668 Brigham and Women's Hospital, Circadian, Neuroendocrine and Sleep Disorders Section, Boston, MA USA
Circadian Entrainment, Sleep-Wake Regulation and Neurobehavioral Performance Under the Simulated Lighting Conditions of Long-Duration Space Missions
Wright, K. P., Jr., Brigham and Women's Hospital, USA; Jewett, M. E., Brigham and Women's Hospital, USA; Klerman, E. B., Brigham and Women's Hospital, USA; Kronauer, R. E., Brigham and Women's Hospital, USA; Czeisler, C. A., Brigham and Women's Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 567-568; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Sustaining high levels of performance throughout extended duration space missions requires: 1) circadian entrainment of the intrinsic longer-than-24-hour period of the human circadian pacemaker to the 24-hour day; 2) maintenance of an appropriate phase relation of the human circadian pacemaker to the sleep-wake schedule. During space exploration, astronauts are likely to be exposed to light-dark cycles that are characterized by either an abnormal period different from the 24.0-hour duration of an Earth day, i.e., the 1.5-hour period of the light-dark cycle during earth orbit and the 24.6-hour period of the light-dark cycle on Mars, or by a light-dark cycle of reduced intensity, i.e., less than 50 lux in the angle of gaze, when the space craft is illuminated artificially and under power constraints. Such light-dark cycles maybe inadequate to maintain the appropriate phase-relation between the scheduled sleep-wake cycle and the circadian system, resulting in circadian misalignment. Such circadian misalignment can result in sleep disturbances, reduced growth hormone secretion, reduced attention, gastrointestinal disorders and impaired daytime alertness. We have undertaken nine 55-day inpatient studies to evaluate: 1) whether entrainment of the human circadian pacemaker will be disturbed in humans when the strength of the environmental light-dark cycle is reduced, resulting in poor sleep and impaired daytime performance; and 2) whether abnormal entrainment to either the 24.0-hour Earth day or the 24.6 hour Mars day will result in disturbed sleep, impaired daytime performance, reduced growth hormone secretion during sleep and inappropriate secretion of the sleep-promoting hormone melatonin during the waking day. to do so, we have used a strict light-dark cycle comparable to that used in entrainment studies of plants and animals. The present report discusses preliminary results from these studies.
Author
Circadian Rhythms; Sleep; Wakes; Neuromuscular Transmission; Astronaut Performance; Cycles; Daytime; Gastrointestinal System; Illuminating; Long Duration Space Flight

20000020669 Massachusetts Inst. of Tech., Cambridge, MA USA
User Friendly Instrumentation for Non-Invasive Assessment of Alterations of Cardiovascular Regulation Associated With Space Flight
Cohen, R. J., Massachusetts Inst. of Tech., USA; Iyengar, N., Massachusetts Inst. of Tech., USA; Mullen, T. J., Harvard Medical School, USA; Ramsdell, C. D., Harvard Medical School, USA; Sundby, G., Massachusetts Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 570-572; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

It is critically important to be able to assess alterations in cardiovascular regulation during and after space flight. We are presently developing an instrument for the non-invasive assessment of such alterations that can be used on the ground and potentially during space flight. This instrumentation will be used by the Cardiovascular Alterations Team at multiple sites for the study of the effects of space flight on the cardiovascular system and the evaluation of countermeasures. In particular, the Cardiovascular Alterations Team will use this instrumentation in conjunction with ground-based human bed-rest studies and during application of acute stressors (e.g., tilt, exercise) as well as in animal studies. In future studies, the Cardiovascular Alterations Team anticipates using this instrumentation to study astronauts before and after space flight and ultimately, during space flight. The instrumentation may also be used by the Bone Demineralization/Calcium Metabolism Team, the Neurovestibular Team and the Human Performance Factors, Sleep and Chronobiology Team to measure changes in autonomic nervous function. The instrumentation is based on a powerful new technology - cardiovascular system identification (CSI) - which has been developed in our laboratory. CSI provides a non-invasive approach for the study of alterations in cardiovascular regulation. This approach involves the analysis of second-to-second fluctuations in physiologic signals such as heart rate and non- invasively measured arterial blood pressure in order to characterize quantitatively the physiologic mechanisms responsible for the couplings between these signals. Through the characterization of multiple physiologic mechanisms, CSI provides a closed-loop model of the cardiovascular regulatory state in an individual subject. The application of CSI currently requires off-line computerized analysis of recorded physiologic signals by an expert user. The user operates in an iterative manner with the computer to preprocess the data, select data segments for analysis, run the CSI analyses, and to evaluate and interpret the results. Thus, the availability of this technology is currently limited to highly expert users located in Professor Cohen's laboratory. In this project, we are developing integrated instrumentation capable of acquiring the physiologic signals, performing the CSI analysis in a fully automated fashion, and displaying the results on-line. The design of this instrumentation will be such that users with minimal

training (including astronauts and other NSBRI investigators) can perform CSI onsite, conveniently and effectively. The availability of this instrumentation is essential for effectively studying the cardiovascular effects of space flight and for the subsequent development and evaluation of appropriate countermeasures. The development of such instrumentation may also have significant clinical impact on earth in the diagnosis and treatment of patients with a variety of cardiovascular and neurologic disorders.
Author
Cardiovascular System; Autonomic Nervous System; Procedures; Human Performance; On-Line Systems; Sleep; Rhythm (Biology); Physical Exercise; Diagnosis; Countermeasures; Computer Techniques

20000020672 NASA Ames Research Center, Moffett Field, CA USA
Physiological Signal Conditioner
Friedericks, C., NASA Ames Research Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 577; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Sensors 2000! is developing a Physiological Signal Conditioner (PSC) for monitoring of astronauts in the ISS Human Research Facility. The PSC is battery powered and worn by the crew. The Engineering Development Unit (PSC EDU) and the form-and-fit PSC Tooling Model will be displayed along with associated graphics and text explanations. Results of a recent advanced PSC-2 feasibility study will be presented. The presentation will stimulate discussion of the functional capabilities of a wireless, crew worn Physiological Signal Conditioner. Application of advanced technology to meet the conflicting demands of size, power, and functional capability will be of interest.
Author
Product Development; Feasibility; Wireless Communication; Bioinstrumentation

20000020679 Harvard-MIT Div. of Health Sciences and Technology, Cambridge, MA USA
New Techniques for the Non-Invasive Imaging of Tissue Perfusion
Sherman, D. A., Harvard-MIT Div. of Health Sciences and Technology, USA; Rubin, R. H., Harvard-MIT Div. of Health Sciences and Technology, USA; Cohen, R. J., Harvard-MIT Div. of Health Sciences and Technology, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 585; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Non-invasively imaging and quantitative perfusion of tissue by blood is important for both space and civilian medicine. Changes in muscle perfusion may lead to atrophy and subsequent tissue loss. Changes in cerebral perfusion may be linked to motion sickness and altered brain function. Similarly, reduced perfusion of other organs may similarly compromise their function. Little is known about alterations in regional perfusion resulting from space flight because traditional methods for measuring perfusion have relied upon contrast agents injected into the blood stream. Because these agents have a limited half-life, they are not ideal for monitoring long-term changes in tissue perfusion. Alterations in perfusion may be more pronounced in older astronauts and astronauts with pre-existing disease. The development of non-invasive means of assessing regional tissue perfusion would also be of great benefit to diagnosing and treating patients on earth; it would be of particular value in managing patients in the intensive care unit.
Author
Procedures; Imaging Techniques; Tissues (Biology); Muscles; Cerebrum; Motion Sickness; Diffusion

20000020685 NASA Johnson Space Center, Houston, TX USA
Context-Specific Adaptation of Gravity-Dependent Vestibular Reflex Responses (NSBRI Neurovestibular Project 1)
Shelhamer, Mark, Johns Hopkins Univ., USA; Goldberg, Jefim, Baylor Coll. of Medicine, USA; Minor, Lloyd B., Johns Hopkins Univ., USA; Paloski, William H., NASA Johnson Space Center, USA; Young, Laurence R., Massachusetts Inst. of Tech., USA; Zee, David S., Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 443-446; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Impairment of gaze and head stabilization reflexes can lead to disorientation and reduced performance in sensorimotor tasks such as piloting of spacecraft. Transitions between different gravitoinertial force (gif) environments - as during different phases of space flight - provide an extreme test of the adaptive capabilities of these mechanisms. We wish to determine to what extent the sensorimotor skills acquired in one gravity environment will transfer to others, and to what extent gravity serves as a context cue for inhibiting such transfer. We use the general approach of adapting a response (saccades, vestibuloocular reflex: VOR, or vestibulocollic reflex: VCR) to a particular change in gain or phase in one gif condition, adapting to a different gain or phase in a second gif condition, and then seeing if gif itself - the context cue - can recall the previously-learned adapted responses. Previous

evidence indicates that unless there is specific training to induce context-specificity, reflex adaptation is sequential rather than simultaneous. Various experiments in this project investigate the behavioral properties, neurophysiological basis, and anatomical substrate of context-specific learning, using otolith (gravity) signals as a context cue. In the following, we outline the methods for all experiments in this project, and provide details and results on selected experiments.
Author
Adaptation; Vestibular Tests; Sensorimotor Performance; Reflexes; Otolith Organs; Gravitational Effects; Cues

20000020688 Loma Linda Univ., Radiobiology Program, CA USA
Cooperative Research in Proton Space Radiation
Nelson, G. A., Loma Linda Univ., USA; Slater, J. M., Loma Linda Univ., USA; Archambeau, J. O., Loma Linda Univ., USA; Green, L. M., Loma Linda Univ., USA; Gridley, D. S., Loma Linda Univ., USA; Abell, G. A., Loma Linda Univ., USA; Moyers, M. M., Loma Linda Medical Center, USA; Coutrakon, G. A., Loma Linda Medical Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 513-514; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Loma Linda University and NASA Code UL are participating in a cooperative research agreement whose focus is on the effects of proton radiation on biological systems. Principal elements of this agreement are: 1) development of physics and biology facilities for controlled irradiation of subjects with protons in the energy and dose ranges found in space, 2) facility and personnel support for visiting investigators, and 3) conduct of radiobiology and physics research emphasizing the unique properties of protons. Loma Linda has upgraded its Proton Treatment Center by designing and installing a dedicated beam line that can provide high energy protons for biological investigations. Supporting biological laboratories have been outfitted for investigations with sub.ects ranging from microorganisms and cultured cells to rodents. A visitors' laboratory is maintained exclusively for visiting scientists and radiobiological investigations with protons are now underway.
Author
Research; Bioassay; Extraterrestrial Radiation; Proton Energy; Radiobiology

20000020915 Naval Health Research Center, San Diego, CA USA
Body Composition and Physical Performance: Estimation of Lifting and Carrying from Fat-Free Mass *Final Report, 1 Jun. - 30 Sep. 1998*
Hodgdon, J. A.; Beckett, M. B.; Oct. 30, 1998; 22p; In English
Report No.(s): AD-A370123; NHRC-98-37; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Services, have, for 16 years, used body composition as the basis for weight control policy. There is a familiarity with the concepts and notions of the nature of body composition within the Services. Body composition variables, specifically fat-free mass and fat mass have been shown to be related to materials handling performances. It is the purpose of this report to determine these relationships, and suggest ways in which they might be used for safe, field deployable methods for estimation of materials handling performance. It appears that fat-free mass can be used to estimate ability to perform manual materials handling tasks. In the case of lifting, logistic models can be used to determine acceptable levels of fat-free mass for specific tasks: lifting heights and weights. In the case of carrying tasks, simplifying principles need to be developed before predictive models can be developed. DTIC
Aerospace Medicine; Human Body; Physical Fitness; Fats; Body Composition (Biology); Human Performance

20000021105 Washington Univ., Grant and Contract Services, Seattle, WA USA
Telemedical Portable Ultrasound *Final Report, 1 Jul. 1997-30 Sep. 1999*
Carter, Stephen J.; Stewart, Brent K.; Oct. 1999; 161p; In English
Contract(s)/Grant(s): DAMD17-97-1-7258
Report No.(s): AD-A371318; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The purpose of this project has been to develop a small hand-held self-contained battery powered diagnostic ultrasound (US) unit that would be highly transportable and relatively easy to use in the context of combat casualty care. The primary goal is to decrease the incidence of exsanguination on the battlefield secondary to intra-abdominal bleeding (hemoperitoneum) from blunt abdominal trauma (BAT). The scope includes telemedicine capability allowing remote diagnosis and direction as needed by a medic in the field using a variety of transmission modes (satellite to Internet). This has resulted in the development of a DARPA prototype unit, and a commercially available hand-held self- contained diagnostic ultrasound unit (SonoSite 180) weighing about 5 lb. and having telemedicine capability. Evaluations by experts have rated the unit to have good diagnostic image quality similar to a mid-range clinical diagnostic unit. The ability to get a good quality sophisticated portable US unit to the soldier/patient in

a remote setting regardless of location, and to be able to transmit the image to an expert for remote diagnosis as needed, is of major significance in triage evaluation.
DTIC
Medical Services; Telemedicine; Portable Equipment; Clinical Medicine; Hemorrhages; Image Resolution

20000021161 American Coll. of Sports Medicine, Indianapolis, IN USA
Conference Support: Physical Activity in the Prevention and Treatment of Obesity and its Co-Morbidities *Final Report, 15 Jun. 1999-14 Nov. 1999*
Kuiper, Sandra; Nov. 1999; 182p; In English
Contract(s)/Grant(s): DAMD17-99-1-9476
Report No.(s): AD-A371316; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

Partial Contents: Physical Activity and Obesity: American College of Sports Medicine Consensus Conference, Introductory comments to the consensus on physical activity and obesity, Physical activity in the prevention and treatment of obesity and its co-morbidities: evidence report of independent panel to assess the role of physical activity in the treatment of obesity and its co-morbidities, The obesity epidemic in children and adults: current evidence and research issues, Overview of the determinants of overweight and obesity: current evidence and research issues, Assessment of physical activity level in relation to obesity: current evidence and research issues, Levels of physical activity and inactivity in children and adults in the USA: current evidence an research issues, Contribution of a sedentary lifestyle and inactivity to the etiology of overweight and obesity: current evil research issues, Physical activity in the prevention of obesity: current evidence and research issues.
DTIC
Obesity; Etiology; Human Beings; Physical Exercise

20000021201 Colorado Univ., Health Science Center, Denver, CO USA
Women at Altitude: Effects of Menstrual Cycle Phase and Alpha-Adrenergic Blockade on High Altitude Acclimatization *Final Report, 22 Sep. 1995 - 21 Sep. 1999*
Moore, Loma G.; Oct. 1999; 71p; In English
Contract(s)/Grant(s): DAMD17-95-C-5110
Report No.(s): AD-A371312; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Three field studies were conducted under the award. The purpose of the first year's studies was to examine the effect of the menstrual cycle on acclimatization to high altitude (4300 m) in healthy, normally menstruating women. Twenty women were studied in the follicular and luteal phases of the menstrual cycle while residing at sea level and again in either the follicular or the luteal phase during the course of a sojourn in the US Army Research institute of Environmental Medicine (USARIEM) laboratory on the summit of Pikes Peak, CO (4300 m). The second year's studies were conducted at USARIEM to determine the role of alpha-I adrenergic activity and its interaction with menstrual cycle phase in early altitude acclimatization. Fifteen women were exposed to an effective altitude of 4300 m in a hypobaric chamber for 52 hr on two occasions, once while being treated with an alpha -1 blocker (prazosin) and once while taking a placebo. Cycle phase was the same (follicular or luteal) during the blocked and unblocked studies for each subject. Sea level studies were performed prior to the altitude exposure. In year three, the purpose of the study was to determine the role of alpha-I adrenergic activity and its interaction with cycle phase during altitude acclimatization. Sixteen women were divided into two groups, half treated with an alpha-I blocker (prazosin) and the remaining half with placebo.
DTIC
Aerospace Medicine; Menstruation; Altitude Acclimatization; Antiadrenergics; Sympathetic Nervous System

20000021213 Institute of Space Medico-Engineering, Beijing China
Space Medicine and Medical Engineering (Hangtian Yixue yu Yixue Gongcheng), Volume 12, No. 4, August 1999
Wei, J.; Aug. 1999; 88p; In Mixed
Report No.(s): PB2000-102517; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Partial Contents: Biochemical Changes of Plasma in Paratroops after Parachuting: A Preliminary Investigation; Ultrastructural Changes of Arterial Wall from Different Body Parts of Rats during Simulated Weightlessness; Computer Simulation of Cardiovascular Response to Lower Body Negative Pressure; Effects of Acute Mild and Moderate Hypoxia on Human Short Memory; Development of a Multi-channel Physiological Telemetry System; Thermodynamic Analysis of Saturation Degree of O2 in Myoglobin and Hemoglobin; Telemedicine--Technology, Application, Evaluation and Prospect.
NTIS
Aerospace Medicine; Telemedicine; Biotelemetry

20000021240 Old Dominion Univ., Dept. of Mechanical Engineering, Norfolk, VA USA
Thermodynamic Modeling and Analysis of Human Stress Response *Final Report, period ending 21 Oct. 1999*
Boregowda, S. C., Old Dominion Univ., USA; Tiwari, S. N., Old Dominion Univ., USA; February 2000; 204p; In English
Contract(s)/Grant(s): NCC1-254; NAG1-363
Report No.(s): ODURF-163621; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

A novel approach based on the second law of thermodynamics is developed to investigate the psychophysiology and quantify human stress level. Two types of stresses (thermal and mental) are examined. A Unified Stress Response Theory (USRT) is developed under the new proposed field of study called Engineering Psychophysiology. The USRT is used to investigate both thermal and mental stresses from a holistic (human body as a whole) and thermodynamic viewpoint. The original concepts and definitions are established as postulates which form the basis for thermodynamic approach to quantify human stress level. An Objective Thermal Stress Index (OTSI) is developed by applying the second law of thermodynamics to the human thermal system to quantify thermal stress or dis- comfort in the human body. The human thermal model based on finite element method is implemented. It is utilized as a "Computational Environmental Chamber" to conduct series of simulations to examine the human thermal stress responses under different environmental conditions. An innovative hybrid technique is developed to analyze human thermal behavior based on series of human-environment interaction simulations. Continuous monitoring of thermal stress is demonstrated with the help of OTSI. It is well established that the human thermal system obeys the second law of thermodynamics. Further, the OTSI is validated against the experimental data. Regarding mental stress, an Objective Mental Stress Index (OMSI) is developed by applying the Maxwell relations of thermodynamics to the combined thermal and cardiovascular system in the human body. The OMSI is utilized to demonstrate the technique of monitoring mental stress continuously and is validated with the help of series of experimental studies. Although the OMSI indicates the level of mental stress, it provides a strong thermodynamic and mathematical relationship between activities of thermal and cardiovascular systems of the human body.
Author
Thermal Stresses; Models; Stress Analysis; Stress (Psychology); Stress (Physiology); Human Behavior; Environment Simulation

20000021264 Academy of Sciences of the Ukraine, Cybermetycy Center, Kiev, Ukraine
Development of a Hemodynamics Computer Model of Human Tolerance to +Gz Accelerations
Grygoryan, R. D., Academy of Sciences of the Ukraine, Ukraine; Oct. 21, 1999; 64p; In English
Contract(s)/Grant(s): F61708-97-W-0253
Report No.(s): AD-A370016; SPC-97-4058; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

The work presented in this report related to the last class of models. The exclusive side of this development is that in fact it is the first attempt in World practice when was aimed to create both a special problem-oriented mathematical model complex and a special software oriented to physiologist-researcher to solve by theoretically way practically all of problems which might be arise during development and test of new methods of human protection under rapid and gradual accelerations. This report describes developed original mathematical models and also gives the information necessary for user (physiologist) to let him to be able to do computer simulation experiments. As to inside structure of computational algorithms and software, they are not described here because of such an information was not required in contract by customers of development.
Derived from text
Hemodynamics; Blood Circulation; Computerized Simulation; Algorithms; Computer Programs; Mathematical Models; Human Tolerances

20000021272 Naval Health Research Center, Human Performance Dept., San Diego, CA USA
Organizational Influences on Gender Differences in Stress and Strain Aboard US Navy Ships *Final Report, Dec. 1994 - Dec. 1997*
Vickers, Ross R., Jr., Naval Health Research Center, USA; Martin, James A., Bryn Mawr Coll., USA; November 1998; 46p; In English
Report No.(s): AD-A370130; Rept-98-33; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Previous research has shown that women assigned to shipboard duty in the U.S. Navy generally report only slightly higher psychological stress and strain than their male shipmates. However, average trends might mask substantial gender differences between selected groups of and women. The present study investigated whether ship assignment, Navy rating, or previous deployment experience was related to the magnitude of gender differences in stress.
Author
Stress (Psychology); Females; Males; Navy

20000021278 Pennsylvania State Univ., University Park, PA USA
Strategies for Optimizing Strength, Power, and Muscle Hypertrophy in Women: Contribution of Upper Body Resistance Training *Final Report, 21 Aug. 1995-1 Oct. 1999*
Kraemer, William J.; Nov. 1999; 184p; In English
Contract(s)/Grant(s): DAMD17-95-C-5069
Report No.(s): AD-A371349; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

To determine the performance and physiological effects of various physical conditioning programs in women, total body, upper-body resistance training groups, field training and aerobic training groups (n = 11 to 21) were examined over 6 months. A normative group of men (n=100) were also tested. Adaptations in muscular strength, size, endocrine function, and immune cell changes can be seen in three months of training. Training responses are very specific to the type of program used, the movements trained, and the way exercises are performed in the training session (e.g., slow versus explosive). It appears that a periodized resistance training program using loads from is less than or equal to8 RM and performs explosive exercises is the most effective in eliciting gains in all fitness and military task tests. An aggressive field training program utilizing explosive plyometrics and partner exercises would be effective maintenance program in the field. Load carriage capabilities in resistance trained women equaled the men's. Aerobic training alone is not effective in making gains in any of the military performance tasks. A total training program is effective to enhance physical performance in military tasks without any direct practice of the task (e.g., box lift, ruck sack carriage) reducing risk of injury.
DTIC
Physiological Effects; Physical Fitness; Muscular Strength; Endocrinology; Human Beings

20000021306 Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Zeist, Netherlands
Literature Study on the Influence of Exhaustive Exercise on Gastrointestinal Symptoms and Immune Response *Final Report Literatuuronderzoek Naar de Invloed van Zware Inspanning op Maagdarmklachten en Immuunstatus*
Welten, D. C., Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Netherlands; November 1999; 19p; In Dutch
Contract(s)/Grant(s): A97/D/148; DO-13504; TNO Proj. 20240.01.01
Report No.(s): TD99-0417; TNO-V99.1005; Copyright; Avail: Issuing Activity, Hardcopy

An orientating literature search was carried out to study the influence of exhaustive exercise on gastrointestinal symptoms and immuno-suppression. Besides, the influence of nutrition on gastrointestinal problems and increased risk of infection was examined, as well as the effect of duration and intensity of the exercise on these physiological problems. In addition, based on existing literature, it was studied whether military personnel of the Royal Land Force conduct the same type of activities regarding duration and intensity.
Author
Gastrointestinal System; Immunity; Infectious Diseases; Physiological Responses; Literature; Bibliographies

20000021322 Army Research Inst. of Environmental Medicine, Military Nutrition and Biochemistry Div., Natick, MA USA
Artificial Human Skin: Cytokine, Prostaglandin, Hsp70 and Histological Responses to Heat Exposure
Bowers, Wilbert, Army Research Inst. of Environmental Medicine, USA; Blaha, Michael, Army Research Inst. of Environmental Medicine, USA; Alkhyyat, Ahmad, Army Research Inst. of Environmental Medicine, USA; Sankovich, James, Army Research Inst. of Environmental Medicine, USA; Kohl, John, Army Research Inst. of Environmental Medicine, USA; Wong, Geraldine, StressGen Biotechnologies Corp., Canada; Patterson, Donna, Army Research Inst. of Environmental Medicine, USA; Journal of Dermatological Science; 1999; ISSN 0923-1811; Volume 20, pp. 172-182; In English
Report No.(s): AD-A366226; Copyright; Avail: Issuing Activity, Microfiche, Hardcopy

Artificial human skin, Skin (keratinocytes and fibroblasts) and EpiDerm (keratinocytes), was used to determine heat-induced release/accumulation of mediators of injury and repair. Skin was exposed to 37 or 41-45 C for 90 min, followed by 37 C for 22.5 h. Media were analyzed for interluekin-1alpha (IL-1alpha), prostaglandin-E2 (PGE2), thromboxane-B2 (TXB2) and nuclear matrix apparatus protein (NMAP, viability). Specimens were taken for microscopy. Media and lysates from Skin and EpiDerm (37 and 45 C) were analyzed for IL-1alpha, its soluble receptor (sIL-1RII), receptor antagonist (IL-1Ra), interleukin-6 (IL-6) and heat shock protein-70A (lysates only). Significant release of IL-1alpha and PGE2 was detected only above 43 C, where viability deteriorated and histological damage (especially to keratinocytes) was observed. With both skin products, sIL-1RII release was heat-depressed. IL-1alpha and IL-1Ra were elevated in media and IL-1Ra appeared to lower the bioactivity of IL-1alpha Heat depressed IL-6 release from Skin fibroblasts. IL-6 production and release were negligible with EpiDerm. Heat increased Hsp-70A in both products. We conclude keratinocytes and fibroblasts are not primary cytokine and prostaglandin sources in heatstroke (

is less than 44 C) but could be in evaporative cooling failure. focal hot spots, or systemic responses. Levels of IL-1Ra, PGE2 and Hsp70A may be important markers of cell status.
Author
Epidermis; Fibroblasts; Tissues (Biology); Temperature Effects; Thermal Shock

20000021354 Aeromedical Inst., Soesterberg, Netherlands
Ear Pulse Waveform Parameters during the Gradual Onset Centrifuge Training Profile *Interim Report*
Holewijn, M., Aeromedical Inst., Netherlands; vanderBurgt, J., Aeromedical Inst., Netherlands; Kuijper, A., Aeromedical Inst., Netherlands; June 1999; 34p; In English
Contract(s)/Grant(s): A98/KLu/03
Report No.(s): TD99-0418; AMI-1999-K2; Copyright; Avail: Issuing Activity

During regular centrifuge training at the Aeromedical Institute the ear photoplethysmogram and the ECG of 15 (candidate) pilots were measured. The main goal of present study was to evaluate the use of the ear pulse waveform (ear pulse) as a potential feedback parameter of a pilot's head level blood pressure during accelerations. From the ear pulse waveform, the amplitude of the pulse and the pulse transit time (FM of each pulse were determined. The results showed clearly that the amplitude of the ear pulse waveform decreased and the PTT increased with increasing acceleration level during a centrifuge run. On basis of the results of this study it is concluded that the ear pulse can be implemented as a feedback parameter for PLL onset. In order to implement the ear pulse waveform as a standard feedback signal during centrifuge training the reliability of the signal must be evaluated under different G-onset rates and with pilots performing an anti-G straining maneuver. Specially, the delay between the changes in the ear pulse waveform and changes in head level blood pressure must investigated under higher G-onset rates. So, the ear pulse wave form changes will have to be correlated with continuously measured blood pressure.
Author
Antigravity; Ear; Feedback; Pressure Heads; Transit Time; Pulse Duration; Waveforms

20000021359 Institute for Human Factors TNO, Soesterberg, Netherlands
The Influence of Inspiration Resistance on Performance during Graded Exercise Tests *Final Report De Invloed van (In)Ademweerstand op de Preststie Tijdens Maximale Inspanningstests*
Heus, R., Institute for Human Factors TNO, Netherlands; denHartog, E. A., Institute for Human Factors TNO, Netherlands; Kistemaker, J. A., Institute for Human Factors TNO, Netherlands; vanDijk, W. J., Institute for Human Factors TNO, Netherlands; Aug. 26, 1999; 24p; In English
Contract(s)/Grant(s): A98/KL/335; TNO Proj. 789.2
Report No.(s): TD99-0336; TM-99-A058; Copyright; Avail: Issuing Activity

Due to more stringent requirements to protect military personnel against hazardous gases, the inspiration resistance of the present generation of gas masks tends to increase. A former study with a new type of industrial canister proved that these canisters do not give problems during short-term heavy exercise and not during long-term moderate exercise. However the question remains how much the inspiration resistance may increase without giving problems during military operations. That is why a study has been carried out to test the effects of three levels (0, 24; 1,4 en 8,3 kPa.s /l) of inspiration resistance. Subjects performed a graded exercise test with and without these three levels of inspiration resistance on a cycle ergometer. Measured were e.g. oxygen consumption, heart rate, time to exhaustion and external power. The results of these experiments showed that inspiration resistance led to a reduction of time to exhaustion (TTE): without inspiration resistance the mean TTE was 11.9 min, the three levels of resistance gave the following mean TTE's (10.7, 7.8 and 2.7 min). Time to exhaustion can be predicted very well when physical fitness (V(sub O(sub 2))-max) of the subject and inspiration resistance are known parameters. Energy expenditure was higher with breathing resistance, but that there was no difference between the three selected resistance levels. Other breathing parameters as ventilation, tidal volume, expiration time and breathing frequency showed no er minor significant differences due to inspiration resistance. Some of the results are not in agreement with the literature. Ventilation has been reported to decrease while wearing respiratory protection. However the protocols of most of these studies are not comparable to this study. The most important conclusions of these experiments are that workload increases when respiratory protection devices are worn, leading to an increase in inspiration resistance. An increased inspiratory resistance led to significant shorter times to exhaustion.
Author
Inspiration; Mental Performance; Respiration; Expiration; Ventilation; Masks

20000021401 Prins Maurits Lab. TNO, Rijswijk, Netherlands
Development of a Method for Biological Dosimetry of Radiation Injury in Blood Samples Collected More Than One Hour After Exposure *Final Report Ontwikkeling van een Methode voor Biologische Dosimetrie van Stralingsschade in*

Bloedmonsters Die Meer Dan Eeen Uur Na De Blootstelling Zijn Afgenomen
vanderSchans, G. P., Prins Maurits Lab. TNO, Netherlands; Timmerman, A. J., Prins Maurits Lab. TNO, Netherlands; vanDijk–Knijnenburg, W. C. M., Prins Maurits Lab. TNO, Netherlands; Bruijnzeel, P. L. B., Prins Maurits Lab. TNO, Netherlands; August 1999; 60p; In English
Contract(s)/Grant(s): A96/M/429; TNO Proj. 215496155
Report No.(s): TD99-0132; PML-1999-A37; Copyright; Avail: Issuing Activity

In this report the results are described of the development of immunochemical assays for the detection of persistent base damage induced by ionizing radiation and attempts to develop a method for detection of damage on the single-cell level by quantitative immunofluorescence microscopy. It appeared that radiation-induced base damage can be detected in human blood lymphocytes in a dose range of 1 - 20 Gy . During the first 4 h no significant repair was observed both with Micrococcus luteus extract as well as endonuclease III. Damage induced by UV-C is only recognized by the Micrococcus luteus extract. In conclusion, this makes base damage detection a very promising biological indicator for radiation injury at perPiods between 1 h and longer (at least 4 h) after exposure. Together with the earlier developed biological radiation dosimeter, methods are available to detect radiation injury in blood samples collected from radiation casualties which can be applied in the time-frame immediately after radiation exposure up to possibly one day. These methods are therefore complementary to other methods which can be applied or are producing data at a later stage.
Author
Radiation Injuries; Blood; Lymphocytes; Dosimeters; Radiation Dosage; Radiation Damage; Ionizing Radiation; Exposure

20000021428 National Aeromedical Center, Soesterberg, Netherlands
Ear Pulse Waveform Parameters During the Gradual Onset Centrifuge Training Profile *Interim Report*
Holewijn, M.; van der Burgt, J.; Kuijper, A.; Jun. 1999; 34p; In English
Contract(s)/Grant(s): A08/KLu/03
Report No.(s): AD-A372680; AMI-1999-K2; TDCK-TD-99-0418; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

During regular centrifuge training at the Aeromedical Institute the ear photoplethysmogram and the ECG of 15 (candidate) pilots were measured. The main goal of present study was to evaluate the use of the ear pulse waveform (ear pulse) as a potential feedback parameter of a pilot's head level blood pressure during accelerations. From the ear pulse waveform, the amplitude of the pulse and the pulse transit time (HT) of each pulse were determined. The results showed clearly that the amplitude of the ear pulse waveform decreased and the FIT increased with increasing acceleration level during a centrifuge run. On basis of the results of this study it is concluded that the ear pulse can be implemented as a feedback parameter for PLL onset. In order to implement the ear pulse waveform as a standard feedback signal during centrifuge training the reliability of the signal must be evaluated under different G-onset rates and with pilots performing an anti-G straining maneuver. Specially, the delay between the changes in the ear pulse waveform and changes in head level blood pressure must investigated under higher G-onset rates. So, the ear pulse wave form changes will have to be correlated with continuously measured blood pressure.
DTIC
Acceleration Tolerance; Aerospace Medicine; Ear; Gravitational Effects; Centrifuging Stress

20000021460 Institute for Human Factors TNO, Soesterberg, Netherlands
Maximum Oxygen Uptake Measured During a Graded Exercise Test at Sea and Ashore *Final Report Maximale Zuurstofopname Tijdens een Maximaaltest Gemeten op zee en aan Land*
Wetheim, A. H., Institute for Human Factors TNO, Netherlands; Heus, R., Institute for Human Factors TNO, Netherlands; denHartog, E. A., Institute for Human Factors TNO, Netherlands; Nov. 08, 1999; 23p; In English
Contract(s)/Grant(s): A98/KM/332; TNO Proj. 789.3
Report No.(s): TD99-0361; TM-99-A072; Copyright; Avail: Issuing Activity

Time to Exhaustion (TTE) - the total amount of time a person is able to carry out a particular physical task - can be used as an index of fatigue associated with that task. The TTE fatigue index is calculated from relative workload, which is defined as: oxygen uptake (VO2) during physical work, expressed as percentage of the maximum oxygen uptake (VO(2-max)) measured during a Graded Exercise Test (GXT) in standard circumstances (i.e. in a separate session). In past experiments we calculated TTE during work in a ship motion simulator in which the VO2 measurement took place. We calculated the extra fatigue caused by this motion (Motion Induced Fatigue, MIF). However, the obvious tiredness of subjects after experimentation suggested that with this TTE fatigue index MIF is underestimated. It was proposed that to calculate TTE we should not use VO(2-max), but VO(2-peak), which is maximum oxygen uptake during a GXT carried out in the same (moving) environment as in which VO2 is measured. In two follow up experiments VO(2-peak) appeared indeed to be lower than VO(2-max) measured in standard (stationary)

conditions. Consequently TTE doubled. However, performance on the GXT was not significantly reduced in the moving simulator (which would have implied reduced muscle activity). Thus an explanation for the difference between VO(2-max) and VO(2.peak) was lacking. The present study, aboard a ship at sea, was designed to see if the difference was somehow an artefact of the simulator, and if not, to find out if its magnitude corresponds to the magnitude of the environmental motions. The results replicate the earlier findings: at sea VO(2-peak) was less than VO(2-max) measured ashore. Although the ship movements were much stronger than the simulator movements, the effect was only slightly, and not significantly, larger than in the earlier two studies. Thus there was no evidence that VO(2-peak) depends on the magnitude of environmental movements. At sea performance on the GXT was again not significantly reduced, but the reduction became significant when the data from all three studies were pooled. It seems the three separate studies had too few subjects each for this effect to reach significance. However, this lower level of maximum performance may, at best, explain only a very small part of the reduced level of maximum oxygen uptake in a moving environment.
Author
Gas Exchange; Oxygen Production; Oxygen Consumption; Oxygen; Ships; Seas

20000021576 Defence and Civil Inst. of Environmental Medicine, Downsview, Ontario Canada
Efficacy of 1 and 5 mg Doses of Melatonin on Heat Tolerance While Wearing NBC Protective Clothing
McLellan, T. M.; Oct. 1999; 20p; In English
Report No.(s): AD-A372446; DCIEM-TR-1999-108; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report summarises the findings from 2 studies which examined whether the reported hypothermic effect of melatonin ingestion increased tolerance to the heat stress of wearing NBC protective clothing. In the first study, trials were conducted either in the morning or afternoon, 2 each in the morning (0930 h) and afternoon (1330 h) following the double-blind ingestion of either two placebo or two 1 mg capsules of melatonin. The heat stress test consisted of intermittent walking and seated rest at 40 deg C and 30% relative humidity while wearing NBC protective clothing. In the second study, subjects performed 4 trials which involved 2h of rest in combat clothing at either 23 C or 40 C followed by exercise at 40 C while wearing the NBC ensemble. A single 5 mg dose of melatonin was ingested following 30-min of rest. In the first study, rectal temperature (T(re)) was not affected by melatonin ingestion but T(re) was increased during the afternoon trials by 0.3 C compared with the morning exposures and these differences remained throughout the heat stress such that final T(re) was also increased for the afternoon (39.2 C) versus the morning (39.0 C) trials. Since the rate of heat storage was similar, tolerance times (108, 111, 110, and 107 min for the morning melatonin and placebo trials, and the afternoon melatonin and placebo trials, respectively) were not different among the trials. During the second study, T(re) during rest at 23 C decreased significantly from 36.8 C to 36.7 C following the ingestion of the drug, whereas values during the placebo trial did not change. The lower T(re) response during the melatonin trial at rest remained during the exercise in the heat while wearing the NBC protective clothing. However, since the T(re) tolerated at exhaustion also was significantly lower for the melatonin (39.0 C) compared with the placebo (39.1 C) trial, tolerance times approximated 95 min in both conditions.
DTIC
Protective Clothing; Heat Tolerance; Exhaustion; Stress (Physiology)

20000024832 Institute of Space Medico-Engineering, Beijing, China
Effect of 7 d Head Down Tilt on Cardiopulmonary Circulation During Orthostasis
Wang, De–Sheng, Institute of Space Medico-Engineering, China; Xiang, Qiu–Lu, Institute of Space Medico-Engineering, China; Shen, Xian–Yun, Institute of Space Medico-Engineering, China; Meng, Jing–Rui, Institute of Space Medico-Engineering, China; Dong, Qi, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Apr. 1999; ISSN 1002-0837; Volume 12, No. 2, pp. 125-129; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective of this study was to accumulate data for further studies on the mechanisms of the decrease of cardiovascular function after weightlessness. Cardiopulmonary circulatory function was monitored using a XXH- 2000 lesser (pulmonary) circulation and cardiac function instrument for 6 healthy adults who aged 19 to 21 who were under supine position and head up tilting (HUT) for 20 minutes before and after exposure to 7 day 6 degree head down tilt (HDT). Result The 7 day HDT resulted in orthostatic intolerance of the subjects; the reduction of RVET - (j-z) and the elevation of RPEP[RVET (Q - j)/(j - z)] indicated a decrease of the right heart function. An obvious decrease of the right heart reserves was also observed under HUT after HDT. The hc and hc/hz measurements were demonstrated to be useful parameters to evaluate orthostatic tolerance or to forecast orthostatic syncope. The lesser (pulmonary) circulation and cardiac function testing methods are valuable in evaluating the cardiopulmonary circulatory function during HUT.
Author
Cardiovascular System; Head Down Tilt; Heart; Heart Function; Orthostatic Tolerance; Pulmonary Circulation; Aerospace

Medicine; Bioastronautics; Physiological Effects; Blood Pressure

20000024833 Institute of Space Medico-Engineering, Beijing, China
Variations of EGG in Subjects Under Vestibular Stimulation
Liu, Zhi–Qiang, Institute of Space Medico-Engineering, China; Pei, Jing–Chen, Institute of Space Medico-Engineering, China; Sun, Ruo–Liang, Institute of Space Medico-Engineering, China; Chang, Lei, Institute of Space Medico-Engineering, China; Zhang, Hua, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Apr. 1999; ISSN 1002-0837; Volume 12, No. 2, pp. 134-137; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective of this study was to investigate the patterns of electrogastrogragm(EGG) before, during and after vestibular stimulation. Twenty five subjects were stimulated by Coriolis acceleration and 28 by Coriolis stimulation. Dysrhythmia of EGG and increase of tachygastria were recorded in all subjects during the stimulation. The period dominant frequency(PDF) of EGG shifted from 2.40 to about 3.70 cpm to 3.70; to about 10. 00 cpm during Coriolis stimulus in subjects with nausea. This study suggests that PDF could be a parameter in reflecting the level of motion sickness.
Author
Coriolis Effect; Motion Sickness; Nausea; Vestibular Tests; Acceleration Stresses (Physiology); Aerospace Medicine

20000024834 Institute of Space Medico-Engineering, Beijing, China
Comparison Between Two Anti-Motion Sickness Drugs
Wang, Jing, Institute of Space Medico-Engineering, China; Qian, Jin–Kang, Institute of Space Medico-Engineering, China; Wang, Bao–Zhen, Institute of Space Medico-Engineering, China; Gao, Jian–Yi, Institute of Space Medico-Engineering, China; Shi, Hong–Zhi, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Apr. 1999; ISSN 1002-0837; Volume 12, No. 2, pp. 138-140; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective of this study was to test the validity of an animal model in selecting anti-motion sickness drugs, and compare the effects of two drugs. Anti-motion sickness effects of two drugs (Cyclizine and Scopolamin-d-amphetamin compound) were observed in rats with motion sickness (MS) induced by rotatory stimulation and the amount of Kaolin ate by rats was taken as an evaluation criterion. The consumption of Kaolin by the rats decreased significantly after administration of both drugs, and the effect of Scopolamin-d-amphetamin compound was better than those of Cyclizine under the same condition. This study suggests that the rat model of motion sickness is practical and useful in studying anti-motion sickness drugs.
Author
Antiemetics and Antinauseants; Motion Sickness; Motion Sickness Drugs; Pharmacology; Aerospace Medicine

20000024835 Beijing Medical Univ., Occupational Dept., Beijing, China
A Method of Detecting Respiratory Rate with a High-Sensitivity Capacitance Transducer
Ge, Wei–Qing, Beijing Medical Univ., China; Wang, Sheng, Beijing Medical Univ., China; Liu, Shi–Jie, Beijing Medical Univ., China; Luo, Zhi–Cheng, Beijing Medical Univ., China; Space Medicine and Medical Engineering; Apr. 1999; ISSN 1002-0837; Volume 12, No. 2, pp. 141-143; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective of this study was to introduce a simple and low cost respiratory rate detection method. A high-sensitivity capacitance transducer and corresponding detecting system were used in the system. Satisfactory signals were obtained at the upper portion of the right thorax with the method. This mechanism could be used widely, to comprise the respiratory module in multi-parameter patient monitoring, or be used alone to detect respiratory rate.
Author
Capacitance; Detection; Respiratory Rate; Transducers; Respiratory Physiology

20000024894 Tsinghua Univ., Dept. of Electrical Engineering, Bejing, China
HRV Analysis System Based on Windows 95 and Its Preliminary Application
Shen, Yong–Lin, Tsinghua Univ., China; Chen, Wen–Hui, Tsinghua Univ., China; Jiang, Ke, Tsinghua Univ., China; Liang, Yu–Hou, Tsinghua Univ., China; Space Medicine and Medical Engineering; Apr. 1999; ISSN 1002-0837; Volume 12, No. 2, pp. 111-115; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective of this study was to provide a real useful application system for the Heart Rate Variability (HRV) research. The acquisition, detection and analysis system of HRV signal was set up using Windows 95. The system analyzes the HRV signal with

statistical methods in the time domain and the power spectrum in the frequency domain. The power spectrum array was also introduced into the analysis. HRV signals of some healthy persons and some patients were detected and analyzed. The HRV characteristic is much more obvious in the diabetics patients. The system is useful in HRV signal analysis and cardiovascular research.
Author
Cardiovascular System; Heart Rate; Variability; Windows (Computer Programs)

20000024896 Institute of Space Medico-Engineering, Beijing, China
Star Figure in Medical Monitoring During Lower Body Negative Pressure Test
Zhao, Guo–Xuan, Institute of Space Medico-Engineering, China; Yang, Jing–Sheng, Institute of Space Medico-Engineering, China; Zhong, Chong–Fa, Institute of Space Medico-Engineering, China; Lu, Li–Li, Institute of Space Medico-Engineering, China; Hu, Zhi–Hong, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Apr. 1999; ISSN 1002-0837; Volume 12, No. 2, pp. 101-105; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective of this study was to find a real - time, quick and audio - visual method to evaluate the subject's physiological function condition and possible development. The Star figure technique was adopted to analyse multiple physiological indices during lower body negative pressure test(LBNP). Based on the character and stability of the stars figure, the steadiness of the subjects physiological function can be judged. Physiological function can be accurately assessed only when the model of stress response of an individual is formed. The changes of star figure can indicate the possible development of the physiological function stage.
Author
Lower Body Negative Pressure; Physiology; Stability; Stress (Physiology)

20000024897 Fourth Military Medical Univ., Dept. of Aerospace Medicine, Xi'an, China
Countermeasuring Effect of Lower Body Negative Pressure Against Orthostatic Intolerance Induced by 21 d - 6 Deg Head Down Tilt in Humans
Yao, Yong–Jie, Fourth Military Medical Univ., China; Wu, Xing–Yu, Fourth Military Medical Univ., China; Sun, Xi–Qing, Fourth Military Medical Univ., China; Hao, Wei–Ya, Fourth Military Medical Univ., China; Qiao, Zong–Lin, Fourth Military Medical Univ., China; Jiang, Shi–Zhong, Fourth Military Medical Univ., China; Space Medicine and Medical Engineering; Apr. 1999; Volume 12, No. 2, pp. 97-100; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective of this study was to investigate whether Lower Body Negative Pressure (LBNP) during 21 days of 6 degree head-down tilt(HDT) would modify orthostatic tolerance. Twelve healthy males, age 23.7 +/- 5.0, were exposed to - 6 degree HDT for 21 days 6 of them received - 4.0 kPa LBNP sessions for l hour/day from the 15th day to the 21st day of HDT. The other 6 served as control. Head-up Tilt (HUT) +75 degree, for 20 minutes of orthostatic tolerance test were done before, on day 10 and on day 21 of HDT. During HUT +75 degree, 20 min orthostatic tolerance test on day 10 of HDT, 5 subjects of the control group and 4 of the LBNP group presented presyncopal or syncopal signs and symptoms, the average standing time of both groups were shorter than those of the pre-HDT (P is less than 0.05) . During HUT +75 degree, 20 min orthostatic tolerance test on day 21 of HDT, 5 subjects of the control group and one subject of the LBNP group presented presyncopal or syncopal signs and symptoms, the average standing time of control group reduced significantly as compared with those of pre-HDT (P is less than 0.05), also significantly shorter than those of LBNP group (P is less than 0.05). The present study clearly shows that the use of LBNP could alleviate the bed rest-induced orthostatic intolerance.
Author
Head Down Tilt; Lower Body Negative Pressure; Orthostatic Tolerance; Aerospace Medicine; Bioastronautics; Blood Pressure; Weightlessness Simulation

20000024935 Institute of Space Medico-Engineering, Beijing, China
The Effect of Weightlessness and Simulated Weightlessness on the Expression of Genes
Li, Ying–Xian, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Apr. 1999; ISSN 1002-0837; Volume 12, No. 2, pp. 154-156; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The research results of the relationship between gene expression and weightlessness or simulated weightlessness were studied. The influence of weight on the expression of genes in central nervous system were summarized in three aspects. It can

be concluded that the expression of genes in central nervous system were precisely regulated by weight. It was important to study the effects of microweight on central nervous system in the molecular level.
Author
Central Nervous System; Gene Expression; Weightlessness; Weightlessness Simulation; Molecular Biology; Bioastronautics

20000025083 Civil Aeromedical Inst., Oklahoma City, OK USA
The FAA Health Awareness Program: Results of the 1998 Customer Service Assessment Survey *Final Report*
Hilton, Thomas F., Civil Aeromedical Inst., USA; Hart, I. Sam, Federal Aviation Administration, USA; Farmer, William L., Civil Aeromedical Inst., USA; Thompson, Jennifer J., Oklahoma Univ. Health Sciences Center, USA; Behn, Lydia D., Environmental Protection Agency, USA; February 2000; 46p; In English
Contract(s)/Grant(s): AAM-A-98-HRR-500
Report No.(s): DOT/FAA/AM-00/3; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report presents the results of an agency-wide survey of employee health and wellness to determine workforce involvement in and satisfaction with the Federal Aviation Administration's Health Awareness Program (HAP). Surveys were received from 3,262 employees, representing a 45% response rate. Results indicated that about half the workforce had heard about HAP and that about half the workforce had participated in one or more HAP events (even if they did not realize that the event was HAP-sponsored). In terms of attendance, the most popular HAP information programs were health fairs, health awareness lectures, and stress management awareness programs. Likewise, annual flu shots, cholesterol screening, blood chemistry screening, and blood pressure screening were the most popular HAP service programs. Analyses found a consistent relationship between HAP participation and employee exercise rates, involvement in healthy lifestyle behaviors, and overall wellness. These findings may have been influenced to some extent by respondent characteristics, which were somewhat disproportionately over age 45, female, and managerial. However, the respondents' backgrounds matched previous study results, indicating that Federal Aviation Administration respondents accurately represent the HAP customer base -- that segment of the workforce most interested in health and wellness.
Author
Health; Personnel; Surveys

20000025505 NASA Johnson Space Center, Houston, TX USA
Microwave Treatment for Cardiac Arrhythmias
Arndt, G. Dickey, Inventor, NASA Johnson Space Center, USA; Carl, James R., Inventor, NASA Johnson Space Center, USA; Raffoul, George W., Inventor, NASA Johnson Space Center, USA; Pacifico, Antonio, Inventor, NASA Johnson Space Center, USA; May 18, 1999; In English
Patent Info.: Filed 17 Apr. 1996; NASA-Case-MSC-22483-1; US-Patent-5,904,709; US-Patent-Appl-SN-641045; No Copyright; Avail: US Patent and Trademark Office, Hardcopy

Method and apparatus are provided for propagating microwave energy into heart tissues to produce a desired temperature profile therein at tissue depths sufficient for thermally ablating arrhythmogenic cardiac tissue to treat ventricular tachycardia and other arrhythmias while preventing excessive heating of surrounding tissues, organs, and blood. A wide bandwidth double-disk antenna is effective for this purpose over a bandwidth of about six gigahertz. A computer simulation provides initial screening capabilities for an antenna such as antenna, frequency, power level, and power application duration. The simulation also allows optimization of techniques for specific patients or conditions. In operation, microwave energy between about 1 Gigahertz and 12 Gigahertz is applied to monopole microwave radiator having a surface wave limiter. A test setup provides physical testing of microwave radiators to determine the temperature profile created in actual heart tissue or ersatz heart tissue. Saline solution pumped over the heart tissue with a peristaltic pump simulates blood flow. Optical temperature sensors disposed at various tissue depths within the heart tissue detect the temperature profile without creating any electromagnetic interference. The method may be used to produce a desired temperature profile in other body tissues reachable by catheter such as tumors and the like.
Official Gazette of the U.S. Patent and Trademark Office
Arrhythmia; Heart; Heating; Medical Equipment; Microwaves

20000025539 Swedish Water and Air Pollution Research Lab., Stockholm, Sweden
Working Environment-LCA: Development of a Quantitative Method *Arbetsmiljoe-LCA: Vidareutveckling av en Kvantitativ Metod*
Antonsson, A. B.; Nilsson, M.; Jan. 1999; 58p; In Swedish
Report No.(s): PB2000-102749; IVL-B-1320; No Copyright; Avail: National Technical Information Service (NTIS)

A method has previously been developed within IVL, to integrate working environment in the methodology for life cycle assessments, LCA. The case is a comparison of two alternatives, diesel and ethanol as fuel for bus driving. Data for the life cycle from a traditional LCA previously done for this case was used. The method developed is based on the collection of data for four impact categories, deaths due to work related accidents, workdays lost due to work related accidents and disease, hearing damages, and allergies and eczemas. The amount of work related accidents and diseases in the four impact categories in different parts of the life cycle has been calculated based on the amount of material/transports etc in each part of the life cycle in relation to the total amount produced in the branch. to control if the amount of injuries and diseases in any part of the life cycle deviates from a value calculated from average statistics on injuries and diseases in Sweden, a normalisation has been made for each of the four impact categories. In addition, a sensitivity analysis has been made to control how sensitive the result is to uncertainties in the statistics. NTIS

Quantitative Analysis; Occupation; Aerospace Medicine

20000025559 Institute of Space Medico-Engineering, Beijing, China

Ocular Counterrolling as an Indicator of Vestibular Otolith Function

Wang, Lin–Jie, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 231-234; In Chinese

Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Space Motion Sickness (SMS) occurred in the first few days of space flight correlated with the vestibular function. As the main influence of weightlessness in space focused on the otolith receptors. The test of otolith function is of great importance. Although there are a lot of methods to test otolith function, at present ocular counterrolling is the only relative pure indicator of otolith function. It provides a valid method for predicting SMS susceptibility, it has great application prospect in the research of the SMS mechanism and the readaptability of vestibular function after space flight, it also provides great reference in the clinical diagnosis of vestibular problems.

Author

Aerospace Medicine; Ocular Circulation; Vestibules; Otolith Organs; Function Space

20000025560 Institute of Space Medico-Engineering, Beijing, China

Developments of the Theory of Skeletal Adaptation to Mechanical Loading

Xie, Li–Qin, Institute of Space Medico-Engineering, China; Liu, Cheng–Lin, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 226-230; In Chinese

Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The primary mechanical function of bone is to provide rigid levers for limbs to act against mechanical loading and gravity, and to remain as light as possible to allow efficient locomotion. There are increasing evidence that mechanical loading is an important, if not the most important, factor influences bone mass and architecture. Many bones are exposed to thousands of repetitive loads every day, which always cause strains. Unusual strain distributions, high strains, and high strain rates seem to be particularly osteogenic. Bone modeling can increase bone strength and mass, bone remodeling can conserve or reduce them, and each can be turned ON or OFF in response to its own threshold range of bone strains. During growth and development, the skeleton optimizes its architecture and strength by (re)modeling to adapt to the largest voluntary loads on bones. The loads come from muscles, not body weight. A new standard of defining osteoporosis might relate bone strength to muscle strength that concerns the osteopenias pathogenesis and its severity, and it would be useful for prevention and cure of osteoporosis.

Author

Adaptation; Loads (Forces); Aerospace Medicine; Bones

20000025561 Academy of Military Science, Inst. of Hygiene and Environment Science, Tianjin, China

The Relationship Between Optimum Carriage Load and Slope at High Altitude of 3700 m

Yin, Zhao–Yun, Academy of Military Science, China; Zan, Jun–Bing, Academy of Military Science, China; Sun, Xing–Bin, Academy of Military Science, China; Ma, Zhi, Academy of Military Science, China; Nan, Wen–Kao, Academy of Military Science, China; Wang, He–Xin, Academy of Military Science, China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 223-225; In Chinese

Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

To observe the relationship between optimum carriage load and slope at high altitude. Optimum carriage load was investigated in twelve healthy young men at an altitude of 3700 m. The subjects marched on a treadmill for 10 min at walking speed of 4.0 km/h with different slopes (0 deg, 5 deg, 10 deg, 15 deg) and carriage loads (0, 7, 14, 21 and 28% body weight). Ventilation (V(E)), heart rate (HR) and energy expenditure (E) during marching were measured. The optimum carriage load was

estimated by finding the break point of the systematic increase in V(E), HR and E. Optimum carriage load at walking slope of 0 deg, 5 deg, 10 deg and 15 deg were 20.5, 13.8, 7.0 and 0.4 kg, respectively. The relationship between the reduction in optimum carriage load and slope has been estimated to be on the order of about 7 kg for every slope of 5 deg at high altitude of 3700 m. Author

Carriages; Loads (Forces); Aerospace Medicine; Slopes

20000025565 Southeast Univ., Dept. of Biomedical Engineering, Nanjing, China

An Experimental Study on 3-D Human Body Virtual Endoscope

Li, Nai–Hong, Southeast Univ., China; Yu, Wen–Xue, Southeast Univ., China; Luo, Li–Min, Southeast Univ., China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 209-213; In Chinese

Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

To make experimental study on 3-D human body virtual endoscope systematically using 3-D image data of a human body. The geometrical model and locating of a virtual endoscope were built. by the model, we can view a virtual human body in different directions and resolutions. Then, method of ray tracing for surface detection and tri-linear interpolation for surface rendering were applied to visualize the result of virtual endoscope. A virtual endoscope system based on PC that uses the method were given and a few virtual endoscope images of 3-D human body image data were also presented. Virtual endoscope is one of the most hopeful methods for virtual diagnosis, virtual therapy and virtual teaching.

Author

Aerospace Medicine; Endoscopes; Human Body

20000025566 Xian Jiaotong Univ., Biomedical Engineering Inst., China

Detection of Spikes in Epileptic Electroencephalography by using Wavelet Series

Huan, Fei, Xian Jiaotong Univ., China; Zheng, Chong–Xun, Xian Jiaotong Univ., China; Huang, Yuan–Gui, Xian Jiaotong Univ., China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 200-203; In Chinese

Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

To study automatic detection of the spikes in the epileptic EEG signals. Based on wavelet series decomposition of EEG signals, the mean amplitude between two cross-zeros of the detail signals at every scale was utilized to obtain quantitative values for the transient waves, and the abnormal spikes were distinguished from normal background EEG activities by the local maximum of the mean amplitudes of the different scales. The analysis of 6 patients' EEG data showed that the correctness ratio was 79.66% in detecting the spikes. The epileptiform spikes in the abnormal EEG can be accurately detected with this method. Author

Electroencephalography; Detection; Epilepsy; Spike Potentials; Aerospace Medicine

20000025567 Institute of Space Medico-Engineering, Beijing, China

Counteracting Effect of Chinese Herbs on "Insufficiency of Spleen Qi" Induced by Simulated Weightlessness

Shi, Hong–Zhi, Institute of Space Medico-Engineering, China; Wang, Bao–Zhen, Institute of Space Medico-Engineering, China; Gao, Jian–Yi, Institute of Space Medico-Engineering, China; Qian, Jin–Kang, Institute of Space Medico-Engineering, China; Fan, Quan–Chun, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 197-199; In Chinese

Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

To observe the counteracting effect of a Chinese herb-compound on "insufficiency of spleen qi" induced by simulated weightlessness, animal and human experiment were carried out to the Chinese herb-compound (Dangshen, Baizhu, Fuling etc). The result is that this compound protected the tail suspended rats from atrophy of spleen, thymus, soleus and gastrocnemius muscles, prevented excessive decrease of body weight effectively; at the same time it relieved the symptoms of the subjects greatly. It demonstrated that the compound decreased the "insufficiency of spleen qi" of both animals and human subjects. Author

Weightlessness Simulation; Aerospace Medicine; Spleen

20000025568 Institute of Space Medico-Engineering, Beijing, China

Bifurcation and Chaos of Heart Cell Pacing Rhythm Evoked by Changing [Ca(++)](sub o) in Body Fluid

Gu, Hua–Guang, Institute of Space Medico-Engineering, China; Ren, Wei, Institute of Space Medico-Engineering, China; Jiang, Shi–Zhong, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 188-192; In Chinese

Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective is to study the effect of changes of electrolyte concentration on heart cell pacing rhythm. The minimal model of gating mechanism for ionic channels of exciting cells was used in this study. ISI (interspike interval) is regarded as the key parameter. ISI appears period, chaos, period adding bifurcation and period doubling bifurcation when V(c), a parameter related to [Ca(++)](sub o), was adjusted. The results reveal that changes of [Ca(++)](sub o) may evoke changes of rhythm of heart pacemaker cells. This implies that changes of [Ca(++)](sub o) of body fluid are a cause influencing pacing rhythm of pacemaker cells and cardiac arrhythmia besides the neuro-humoral regulation, which should not be ignored.
Author
Aerospace Medicine; Chaos; Heart Rate; Body Fluids; Electrolytic Cells; Rhythm (Biology); Bifurcation (Biology)

20000025569 Institute of Space Medico-Engineering, Beijing, China
Counteracting Effect of Chinese Herbs-Compounds on "Blood Stasis" Induced by Bed Rest
Wang, Bao–Zhen, Institute of Space Medico-Engineering, China; Shi, Hong–Zhi, Institute of Space Medico-Engineering, China; Gao, Jian–Yi, Institute of Space Medico-Engineering, China; Fan, Quan–Cun, Institute of Space Medico-Engineering, China; Xu, Zhi–Ming, Institute of Space Medico-Engineering, China; Qian, Jin–Kang, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 193-196; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective is to observe the improved effect of syndromes of blood stasis by taking Chinese medicine during bed-rest simulated weightlessness. Ten subjects were randomly divided into two groups: Chinese medicine group and control group. Both of them were exposed to HDBR-6 deg for a week. The Chinese medicine group took Chinese medicine during the bed rest, and the control group took sugar water. Syndromes of blood stasis of Chinese medicine group had a significant relief and some physiological parameters, such as blood pressure, pulse graph, and amount of urine, maintained the level of pre-bed rest. While the control group was more severe than the Chinese medicine group in syndromes of blood stasis. Chinese medicine can be a measure in preventing the effect of weightlessness.
Author
Aerospace Medicine; Blood; Bed Rest

20000025570 Institute of Space Medico-Engineering, Beijing, China
The Preliminary Nonlinear Dynamical Analysis of Surface Electromyogram
Yang, Jian–Qun, Institute of Space Medico-Engineering, China; Liu, Bing–Zheng, Institute of Space Medico-Engineering, China; Peng, Jian–Hua, Institute of Space Medico-Engineering, China; Ma, Zhi–Jia, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 185-187; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective is to study the nonlinear characteristics of the surface electromyogram(EMG). Method EMG was studied with physical quantities (i.e. complexity, correlation time, correlation dimension, Lyapunov exponent and entropy) which are commonly used in nonlinear dynamics. Pairs of contracted and relaxed muscles were analyzed. The results show that EMG is more stochastic in the contracted state and more regular in the relaxed state. Except for the amplitude of EMG used in conventional method, quantities used in nonlinear dynamics such as complexity, correlation time Lyapunov exponent etc, are also helpful in defining the characteristics of EMG.
Author
Electromyography; Aerospace Medicine

20000025571 Institute of Space Medico-Engineering, Beijing, China
Physiological Analysis of a Mathematical Model for Predicting Somatic Eigenstates Under Combined Stresses
Yu, Xue–Jun, Institute of Space Medico-Engineering, China; Jia, Si–Guang, Institute of Space Medico-Engineering, China; Chen, Jing–Shan, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 181-184; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective is to put a mathematical model for predicting human Somatic eigenstates (HS) into practical engineering design of countermeasures against combined stresses (hypoxia, heat, noise and vibration) in an aircraft cabin, and confirm the model from the human physiological viewpoint. Published works on these 4 stresses were employed to verify the main and interactive effects which had been previously proved mathematically. The main effects of 4 stresses and the significant interactive effects of 2 from

4 stresses agreed with the published experiments in single or in the same combination of these stresses. The model is reasonable in human physiological consideration and has been adopted in engineering design.
Author
Aerospace Medicine; Mathematical Models; Eigenvectors; Combined Stress; Physiology

20000025573 Fourth Military Medical Univ., Dept. of Aerospace Biodynamics, Xi'an, China
Characteristics of Dynamic Loading and the Cushioning Effect of Tempormadibular Joints during Impact on Chins in Goat and Man
Hao, Wei–Ya, Fourth Military Medical Univ., China; Wang, Mei–Qing, Fourth Military Medical Univ., China; He, Yang–Ju, Fourth Military Medical Univ., China; Yuan, Fang, Fourth Military Medical Univ., China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 173-176; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective is to investigate the dynamic load characteristics of mandible-tempormadibular joints (TMJ) -skull during blunt impact on the chin. Twelve goat heads were randomly divided into two groups, and were employed in a cross-control trial. Group 1 was first impacted by a blunt mass with a velocity (v(1) = 1.1 ms) for three times, and then with another velocity (V(2) = 1.6 m/s) for three times; group 2 was impacted with V(2) and then v(1) for similar times too. Two fresh human heads were experimented in the same way as goat heads in group 1. The same impact mass was used in all the experiments. The impact was exerted along the chin and vertically to the junctional line of both sides of TMJs. The results are: (1)The cross-control trial of goat heads showed that repeated impact didn't make any difference (P is greater than 0.05) in the results of our experiment. (2) The impact time (t) in v(1) of human heads (44.14 +/- 3.33 ms) was longer than that of V(2) (39.23 +/- 1.60 ms) but without any statistical difference (P is greater than 0.05), while the peak values of impact forces (F(p)) and slide forces of v(1) (169.20 +/- 23.58 N, 105.37 +/- 20.96 N) were both significantly lower than those in v(2) (319.42 +/- 35.7 N, 155.67 +/- 25.67 N) P is less than 0.0 1). (3) With the same impact velocities, the human groups had longer t (P is less than 0.01), but lower F(p)(P is less than 0.01) as compared with the goat heads; furthermore, their force-time curves were different. We conclude that (1) The dynamic load curves of human heads during impact on chins were obtained. (2) The anatomy structure of human TMjs enable it to well cushion the impact forces. (3) The impact forces rise significantly with the increase of impact velocity with which the impact time decrease.
Author
Chin; Aerospace Medicine; Dynamic Loads; Cushions; Skull

20000025575 Institute of Space Medico-Engineering, Beijing, China
Effect of Extremely Low Frequency Magnetic Field on Brain Response to Selective Mental Arithmetic Under Simulated Weightlessness
Zhao, Lun, Institute of Space Medico-Engineering, China; Wei, Jin–He, Institute of Space Medico-Engineering, China; Yan, Gong–Dong, Institute of Space Medico-Engineering, China; Chen, Wen–Juan, Institute of Space Medico-Engineering, China; Duan, Ran, Institute of Space Medico-Engineering, China; Ren, Wei, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 161-164; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective is to study effects of extremely low frequency magnetic field (ELMF) on brain function state during weightlessness. The brain event-related potentials (ERPs) during a selective mental arithmetic task were compared in 40 normal subjects (20-25 yrs) before and after ELMF (5 Hz) stimulation during simulated weightlessness(head down tilt - 10 deg, HDT). The amplitude of slow positive potentials which were supposed to be related to the mental arithmetic activity decreased significantly especially in 100 min after HDT, but it did not decrease significantly after ELMF stimulation. ELMF stimulation may improve the brain function state during simulated weightlessness.
Author
Aerospace Medicine; Magnetic Fields; Brain; Physiological Responses; Mental Performance; Magnetic Effects

20000025576 Institute of Space Medico-Engineering, Beijing, China
Study on Testing Method of Susceptibility to Decompression Sickness in Aerospace
Zhang, Jing–Xue, Institute of Space Medico-Engineering, China; Peng, Yuan–Kai, Institute of Space Medico-Engineering, China; Zhang, Bao–Lan, Institute of Space Medico-Engineering, China; Wang, Cheng–Min, Institute of Space Medico-Engineering, China; Fu, Hong–Wei, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Jun. 1999; ISSN 1002-0837; Volume 12, No. 3, pp. 157-160; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective is to provide related parameters for astronauts. A study of susceptibility to decompression sickness was carried out in 43 subjects in a hypobaric chamber. Incidence of altitude decompression sickness under rest condition was closely related to age, time of oxygen prebreathing, gas bubble formation rates in the venous blood flow returned to heart and some other physiological indexes. Incidence of decompression sickness was significantly higher in subjects aged 30 - 36 years than in those aged 19 - 20 years under the same experimental conditions. In the older subjects body-fat, blood cholesterol and noradrenaline in urine during experiment were significantly higher than those in the younger subjects. It also showed that among persons of the same ages, when prebreathing time was longer, the incidence of decompression sickness was significantly lower under the same experimental conditions. It is desirable that the susceptibility to decompression in astronaut be tested with 1 h oxygen prebreathing before exposure to the altitude of 10000 m for 30 min.
Author
Aerospace Medicine; Decompression Sickness; Magnetic Permeability; Altitude Sickness

20000025956 Norwegian Defence Research Establishment, Kjeller, Norway
Immuno- and Neurotoxic Effects of Ortho-Substituted Polychlorinated Biphenyls (PCBs)
Voie, Oyvind Albert, Norwegian Defence Research Establishment, Norway; Nov. 08, 1999; 136p; In English
Contract(s)/Grant(s): FFIBM Proj. 293001
Report No.(s): FFI/PUBLICATION-99/05502; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
The present study shows that polychlorinated and polybrominated biphenyls elevate intracellular free [Ca2+] and activate respiratory burst in human granulocytes. The mechanism of intracellular [Ca2+] elevation appears to occur by activation of phospholipase C, which leads to the production of inositol 1,4,5-triphosphate. This will release Ca2+ from intracellular stores and subsequently activation of Ca2+ release activated Ca2+ channel (CRAC) in the plasma membrane. The mechanism activating respiratory burst by PCBs appears to involve activation of phospholipase D or phospholipase C, tyrosine kinase and protein kinase C prior to the activation of NADPH oxidase. This could in part account for the effects of PCB on the immune system. The structure-activity relationship studies reveal that dichloro biphenyls up to hexachloro biphenyls are active. At least 1 chlorine in ortho position is needed to activate respiratory burst. Ortho-substituted PCB congeners with large total surface area are not active. Congeners with a very specific 2,4,6-substitution on one biphenyl ring are optimal activators. All three factors, size, rotation, and electronic properties, which are not independent of each other,are important for the activity of the PCBs. Polychlorinated biphenyls also increase the production of reactive oxygen species (ROS) in rat brain synaptosomes by a mechanism that appear to involve phospholipase C or D and tyrosine kinase. This effect may contribute to the many neurobehavioral and neurotoxicological effects observed after PCB exposure. Ortho-substituted PCB congeners are active, but also a dimeta-substituted congener is found to be active. A tetra ortho-substituted congener is not active. This indicates that multiple structural requirements are involved in PCB activity in vitro.
Author
Polychlorinated Biphenyls; Immunology; Neurology; Substitutes; Cells (Biology); Toxicology

20000026304 Cleveland Clinic Foundation, Cleveland, OH USA
Lower Limb Response to Impact Loads in 1G and Micro-G
Davis, Brian, Cleveland Clinic Foundation, USA; Kambic, Helen E., Cleveland Clinic Foundation, USA; Grabiner, Mark D., Cleveland Clinic Foundation, USA; Sferra, James, Cleveland Clinic Foundation, USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 3-6; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche
The overall goals of this study are 1) to demonstrate that jumping exercises may be more effective and efficient than current exercises performed in zero-gravity with respect maintaining bone density and muscle strength; 2) to validate the zero-gravity simulator as an appropriate substitute for true zero-gravity experiments during development of an optimum exercise regime; and 3) to quantify relationships between external loading profiles and internal bone strains.
Author
Impact Loads; Physical Exercise; Weightlessness; Bone Demineralization; Osteoporosis; Musculoskeletal System; Biological Effects; Physiological Effects; Microgravity; Atrophy; Bioastronautics

20000026306 NASA Ames Research Center, Moffett Field, CA USA
Physiologic Pressure and Flow Changes During Parabolic Flight (Pilot Study)
Pantalos, George, Utah Univ., USA; Sharp, M. Keith, Utah Univ., USA; Mathias, John R., Texas Univ., USA; Hargens, Alan R., NASA Ames Research Center, USA; Watenpaugh, Donald E., University of North Texas, USA; Buckey, Jay C., NASA Johnson Space Center, USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 11-13; In English; See also 20000026303;

Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The objective of this study was to obtain measurement of cutaneous tissue perfusion central and peripheral venous pressure, and esophageal and abdominal pressure in human test subjects during parabolic flight. Hemodynamic data recorded during SLS-I and SLS-2 missions have resulted in the paradoxical finding of increased cardiac stroke volume in the presence of a decreased central venous pressure (CVP) following entry in weightlessness. The investigators have proposed that in the absence of gravity, acceleration-induced peripheral vascular compression is relieved, increasing peripheral vascular capacity and flow while reducing central and peripheral venous pressure, This pilot study seeks to measure blood pressure and flow in human test subjects during parabolic flight for different postures.

Author

Blood Pressure; Heart; Hemodynamic Responses; Posture; Stroke Volume; Weightlessness; Parabolic Flight; Weightlessness Simulation; Heart Function; Aerospace Medicine; Bioastronautics

20000026307 Utah Univ., Salt Lake City, UT USA

Modeling of Cardiovascular Responses to Weightlessness

Sharp, M. Keith, Utah Univ., USA; Pantalos, George, Utah Univ., USA; Gillars, Kevin D., Utah Univ., USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 14-16; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Hemodynamic data recorded during SLS-1 and SLS-2 missions have resulted in the paradoxical finding of increased cardiac stroke volume in the presence of a decreased central venous pressure following entry in weightlessness. Chronic observations from space flight also describe a headward shift of the circulating fluid volume. The investigators have proposed that in the absence of gravity, acceleration-induced effects such as hydrostatic pressure and peripheral vascular compression are relieved, increasing central and peripheral vascular capacity and flow while reducing central and peripheral venous pressure and augmenting cardiac diastole function. This investigation seeks to measure key hemodynamic parameters to assess the purely biomechanical component of these observations in the acute-phase response during parabolic flight for different models postures.

Derived from text

Blood Pressure; Cardiovascular System; Circulation; Heart Function; Hemodynamic Responses; Weightlessness; Microgravity; Gravitational Physiology; Bioastronautics

20000026308 NASA Johnson Space Center, Houston, TX USA

ISS Medical Checklist Procedures Validation and Training

Marshburn, Tom, NASA Johnson Space Center, USA; Goode, Julie, Wyle Labs., Inc., USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 17-20; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The Health Maintenance System (HMS) hardware will be used to support a medical contingency for the International Space Station (ISS). During two test flights, the procedures for performing Advanced Cardiac Life Support (ACLS) were evaluated to determine the required level of detail, assess the logic of the steps and division of tasks among crew members.

Derived from text

Flight Tests; Onboard Equipment; Medical Equipment; Emergency Life Sustaining Systems; First Aid; Resuscitation; Emergency Breathing Techniques; Weightlessness; Aerospace Medicine

20000026309 Wyle Labs., Inc., Life Sciences, Houston, TX USA

Blood Sampling Kit Evaluation

Gunter, Karen, Wyle Labs., Inc., USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 21-24; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The goal of this study is to evaluate the components of a blood sampling kit, designed for use during space flight. The kit contains all the components that astronauts require to obtain necessary blood samples in microgravity.

Author

Blood; Kits; Microgravity; Sampling; Medical Equipment; Aerospace Medicine

20000026312 Washington Univ., Seattle, WA USA

Contribution of Gravity to Lung Blood Flow Heterogeneity

Hlastala, M., Washington Univ., USA; Robertson, H. Thomas, Washington Univ., USA; An, Doan, Washington Univ., USA; Bernard, Susan, Washington Univ., USA; Chornuk, Myron, Washington Univ., USA; Glenny, Robb W., Washington Univ., USA; Lamm, Wayne J. E., Washington Univ., USA; Wagner, Wiltz W., Indiana School of Medicine, USA; KC-135 and Other

Microgravity Simulations; August 1999, pp. 44-47; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The estimation of blood flow distribution in the lung obtained from indirect gas concentration methods on the SLS-1 yielded a very surprising result, in that the distribution of blood flow in the lung did not appear to be substantially altered by weightlessness. The best explanatory model for the distribution of blood flow to the lung prior to those findings had been the three zone model, which postulated that the regional flow differences could be satisfactorily explained by the influence of gravity on the low pressure blood flow circuits of the lung. The measurements obtained by West and colleagues had relatively low spatial resolution. Subsequent investigators using lungs injected with microspheres as flow markers, inflated, and cut into thousands of pieces demonstrated a far greater degree of heterogeneity than would have been predicted from the simple gravitational model, While the gravitational gradient could still be detected by these studies, it was calculated to account for only about 7% of the total flow heterogeneity. The calculations on experiments conducted at 1 G were only indirect evidence of a weaker effect of gravity, however, as the effects of gravity were estimated from the changes measured in blood flow in animals turned from prone to supine position. What was lacking was direct measurement of blood flow distribution at microgravity and at higher G forces in the same animals. The NASA KC-135 aircraft provided the opportunity to directly investigate the effects of microgravity on blood flow distribution on the lungs of anesthetized animals utilizing the high resolution techniques we had developed in our laboratories. Author

Blood Flow; Gravitational Effects; Lungs; Microgravity; Weightlessness; Gravitational Physiology; Aerospace Medicine; Pulmonary Circulation

20000026314 California Univ., San Diego, CA USA

Pulmonary Deposition of Aerosols in Microgravity

Prisk, G. Kim, California Univ., USA; Darquenne, Chantal J., California Univ., USA; West, John B., California Univ., USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 51-58; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The goal of this study is to perform testing aboard the KC-135 resulting in applications that promote a better understanding of pulmonary diseases related to inhaled particles, in studying drugs delivered by inhalation, and in understanding the consequence of long-term exposure to respirable aerosols in long duration space flight. This study was designed to determine the total deposition of aerosols in the human lung in microgravity, in normal gravity (1G) and in hypergravity (about 1.6 G), and to chart the deposition and dispersion of aerosols (inhaled boli of 1 micron particles) as a function of the penetration depth into the lung at microgravity, 1G and about 1.6G.

Derived from text

High Gravity Environments; Long Duration Space Flight; Lungs; Microgravity; Respiratory Diseases; Aerosols

20000026326 NASA Johnson Space Center, Houston, TX USA

Development of a Whole Blood Staining Device for use During Space Shuttle Flights

Sams, Clarence F., NASA Johnson Space Center, USA; Crucian, Brian E., Wyle Labs., Inc., USA; Clift, Vaughan L., Lockheed Nartin, Inc., USA; Meinelt, Ellen M., Wyle Labs., Inc., USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 114-116; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Exposure to microgravity during space flight results in profound physiologic changes. Numerous studies have shown changes in circulating populations of peripheral blood immune cells immediately after space flight. It is currently unknown if these changes result from exposure to microgravity or are caused by the stress of reentry and readaptation to gravity. We have developed the whole blood staining device as a system for the staining of whole blood collected during space flight for subsequent flow cytometric analysis, This device contains all liquids to address safety issues concerned with space flight and also moves the cells through the staining, lyse/fixation and dilution steps.

Derived from text

Blood; Microgravity; Aerospace Medicine; Weightlessness; Medical Equipment

20000026328 Chisum High School, Paris, TX USA

"Fly High" Program: The Effects of Microgravity on the Human Body

Wood, Kris, Chisum High School, USA; Bradberry, Davin, Chisum High School, USA; Cassell, Cari, Pittsburg High School, USA; Cheshier, Matt, Pittsburg High School, USA; Denney, John, Pittsburg High School, USA; Hubbard, Jason, Pittsburg High School, USA; Edwards, Crystal, Satillo High School, USA; James, Ashley, Satillo High School, USA; Brewer, Kelli, Satillo High School, USA; Floyd, Crystal, Satillo High School, USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 121-123;

In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The goal of this project was to measure blood pressure, pulse, and reflexes in a microgravity environment and then compare them to a preflight base line.

CASI

Blood Pressure; Microgravity; Reflexes; Heart Function; Heart Rate; Weightlessness; Bioastronautics

20000026329 New Caney High School, New Caney, TX USA

"Fly High" Program: Development of Motion Sickness and Postural Ataxia in a Reduced Gravity Environment

Parker, Christie, New Caney High School, USA; Pena, Fernando, New Caney High School, USA; Shepard, Vincent, New Caney High School, USA; Yager, Kristy, New Caney High School, USA; Guidry, Amy, New Caney High School, USA; Hobbs, Courtney, New Caney High School, USA; Kahl, Anthony, New Caney High School, USA; Moore, Clint, New Caney High School, USA; Nielson, Jennifer, New Caney High School, USA; Pena, Phillip, New Caney High School, USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 124-127; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Motion sickness and postural ataxia often present a problem for astronauts and cosmonauts on missions, causing delays in schedule, and occasionally causing a mission to be actually inefficient. As evidence provided indicates, 40-70 % of astronauts will experience in-flight neurovestibular effects. These include postural illusions, tumbling sensations, nystagmus, vertigo, and space motion sickness: pallor, cold sweating, nausea or vomiting. These symptoms usually appear early in the course of the flight, and disappear or subside within a few days. Because the effects of motion sickness can inhibit the progress of astronauts in regard to their experiments, the original reason for launching these costly missions can be delayed or essentially lost. Thus, it becomes evident that further research into preventing or alleviating the effects of motion sickness is necessary, and would be highly beneficial to the productivity of space missions. Since the field of subjects that have actually flown on such space missions is limited, and because the onset of motion sickness/postural ataxia is almost immediate upon reaching zero-gravity, experiments using the parabolic flight of the KC-135 can be used to generate data related to this condition.

Derived from text

Ataxia; Microgravity; Motion Sickness; Posture; Vomiting; Weightlessness; Aerospace Medicine; Nausea

20000026335 NASA Johnson Space Center, Houston, TX USA

Medical Operation KC-135 Familiarization Flight

Dawson, Chris, Wyle Labs., Inc., USA; Stoner, Paul, NASA Johnson Space Center, USA; Arenare, Brian, Texas Univ. Medical Branch, USA; Strickland, Angie, Wyle Labs., Inc., USA; Rudge, Fredrick, Patrick Air Force Base, USA; Lowdermilk, Greg, Patrick Air Force Base, USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 151-156; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

As new personnel join the Medical Operations Branch, it is critical that they understand the effects of microgravity on medical procedures, hardware, and supplies. The familiarization flight provided new personnel with a better understanding of the effects of microgravity on (1) medical procedures, (2) patient and rescuer restraint, (3) medical fluids, and (4) medical training for space flight. The flight process also provided experience in flight proposal preparation, flight test plan preparation and execution, and final report preparation. In addition, first time flyers gained insight on their performance level in microgravity for future flights.

Derived from text

Microgravity; Medical Services; Aerospace Medicine

20000026858 Miami Univ., School of Medicine, FL USA

Sensory and Motor Responses to Spinal Cord Injury ***Final Report***

Yezierski, Robert P., Miami Univ., USA; Jan. 01, 1999; 12p; In English

Contract(s)/Grant(s): DAAH04-94-G-0425

Report No.(s): AD-A369855; ARO-32837.ll-LS; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The goal of Dr. Yezierski's research was to gain a better understanding of the anatomical, neurochemical and functional changes that occur within the central nervous system following spinal cord injury (SCI). During the funding period, efforts focused on changes within the injured spinal cord as well as on neurons at supraspinal sites. to survey the functional status of neurons at sites in cortical and subcortical structures three studies were initiated. These included efforts to evaluate changes in: (a) blood flow; (b) metabolic state; and (c) genetic expression in diencephalic structures following SCI. An investigation was completed of the physiological changes in spinal sensory neurons following injury. A study was also completed in which a comparison was made

between the excitotoxic properties of NMDA and AMPA in an effort to further characterize the pathological consequence of different EAA receptor agonists in SCI.
Author
Blood Flow; Metabolism; Spinal Cord; Spine; Sensory Perception; Physiology; Physiological Responses

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BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

20000020503 Johns Hopkins Univ., School of Medicine, Baltimore, MD USA
Stability and Precision of Performance During Space Flight
Brady, J. V., Johns Hopkins Univ., USA; Kelly, T. H., Kentucky Univ., USA; Hienz, R. D., Johns Hopkins Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 139-141; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The success of long-term spaceflights with humans depends critically upon the development of a technology that can effectively manage the imposing behavioral and social complexities inherent in such undertakings. Development of an ecosystem to accomplish these objectives will proceed most effectively with an experimentally-derived database focused upon the prediction and functional management of the behavior of individuals. of primary importance is the development of a means for behavioral support during prolonged exposure to confined microsociety environments such as those associated with long-term space travel. Investigations of the performance of small groups over the past two decades have convincingly demonstrated that the consequences of any single individual's behavior is a critical determinant of both individual and group behavior under conditions of prolonged social and cultural isolation. In the course of ground-based laboratory studies, computerized procedures were developed for engendering and maintaining stable measures of a range of complex human behaviors, including cognitive and psychomotor performances, under conditions that require only minimum training. In studies involving continuous performance monitoring, human participants have been shown to work productively and energetically with this computerized task battery over extended time intervals. The stability and sensitivity of the measures generated have made it possible to assess both decrements in and enhancements of performances that are affected by meal macronutrient content, sleep deprivation, medications, and stressful conditions. The demonstrated sensitivity and utility of these procedures for long-term repetitive assessment of the stability and precision of multiple human behavior dimensions provided the basis for their application to an evaluation of crewmember performance during a space flight mission.
Author
Performance Prediction; Controlled Atmospheres; Environmental Control; Exposure; Human Behavior; Psychomotor Performance; Sleep Deprivation

20000020504 NASA Ames Research Center, Moffett Field, CA USA
Monitoring and Correcting Autonomic Function Aboard Mir: NASA Technology Used in Space and on Earth to Facilitate Adaptation
Cowings, P., NASA Ames Research Center, USA; Toscano, W., California Univ., USA; Taylor, B., Akron Univ., USA; DeRoshia, C., NASA Ames Research Center, USA; Kornilova, L., Institute of Biomedical Problems, USSR; Koslovskaya, I., Institute of Biomedical Problems, USSR; Miller, N., Yale Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 142-144; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The broad objective of the research was to study individual characteristics of human adaptation to long duration spaceflight and possibilities of their correction using autonomic conditioning. The changes in autonomic state during adaptation to microgravity can have profound effects on the operational efficiency of crewmembers and may result in debilitating biomedical symptoms. Ground-based and inflight experiment results showed that certain responses of autonomic nervous system were correlated with, or consistently preceded, reports of performance decrements or the symptoms. Autogenic-Feedback-Training Exercise (AFTE) is a physiological conditioning method that has been used to train people to voluntary control several of their own physiological responses. The specific objectives were: 1) to study human autonomic nervous system (ANS) responses to sustained exposure to microgravity; 2) to study human behavior/performance changes related to physiology; 3) To evaluate the effectiveness of preflight autonomic conditioning (AFTE) for facilitating adaptation to space and readaptation to Earth; and 4)

to archive these data for the NASA Life Sciences Data Archive and thereby make this information available to the international scientific community.
Author
Autonomic Nervous System; Adaptation; Space Flight; Physiological Responses; Human Tolerances; Feedback

20000020505 Air Force Research Lab., HEAS, Brooks AFB, TX USA
Cognitive Performance in Seven Shuttle Astronauts
Eddy, D. R., NTI, Inc., USA; Schiflett, S. G., Air Force Research Lab., USA; Schlegel, R. E., Oklahoma Univ., USA; Shehab, R. L., Oklahoma Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 145-147; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The impact of microgravity and other stressors on cognitive performance need to be quantified before long duration space flights are planned or attempted since countermeasures may be required. Two cooperative USAF/NASA experiments were flown aboard Space Shuttle Columbia to investigate cognitive performance in space. One was a part of the payload for the Second International Microgravity Laboratory (IML-2) in July 1994 (STS-65) and the other was aboard the Life and Microgravity Spacelab (LMS) in June 1996 (STS-78). Cognitive performance tests were selected from the DOD Unified Tri-Service Cognitive Performance Assessment Battery (UTC-PAB) to assess the types of skills required of astronauts working on space-based tasks. A Performance Assessment Workstation (PAWS) was developed and validated for space flight to present the tasks and collect the cognitive performance data. The tests measured working memory, spatial processing, directed attention, tracking, and dual task timesharing. The PAWS battery included the following tests: a Mood Scale, Unstable Tracking, Spatial Matrix Rotation, Stemberg Memory Search, Continuous Recognition Memory, Directed Attention--Manikin and Mathematical Processing, Dual Task, and a Fatigue Scale. Complete descriptions of the tests can be found in Schlegel, Shehab, Gilliland, Eddy and Schiflett (1995).
Author
Cognitive Psychology; Human Performance; Spaceborne Experiments; Performance Tests; Mental Performance; Long Duration Space Flight

20000020507 California Univ., San Francisco, CA USA
Interactions of Crewmembers and Mission Control Personnel During Shuttle/MIR Missions
Kanas, N., California Univ., USA; Salnitskiy, V., Institute for Biomedical Problems, Russia; Grund, E., California Univ., USA; Gushin, V., Institute for Biomedical Problems, Russia; Kozerenko, O., Institute for Biomedical Problems, Russia; Marmar, C., California Univ., USA; Sled, A., California Univ., USA; Weiss, D., California Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 150-151; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Reports from space and space analog studies on Earth have suggested that interpersonal issues play an important role in how crewmembers relate with one another and with people on the ground during long-duration space missions. These sources, along with our previous work (i.e., a questionnaire study of 54 astronauts and cosmonauts who had flown in space; an investigation of psychosocial factors affecting a three-man crew confined for 135 days in the Mir space station simulator in Moscow), have suggested that crew tension, cohesion, and leadership role are important issues warranting further study in the space environment. We also found evidence to support a biphasic model where psychosocial issues are manifested differently in the 2nd half versus the 1st half of a typical mission involving people secluded together for a long period of time. It is important to study such issues, since interpersonal problems can lead to decreased morale and compatibility, withdrawal and territorial behavior, scapegoating and subgrouping, and disruptive crew-ground communication. This paper will present findings from a four-year NASA-funded study that examined how tension, cohesion, and leadership role affect space crews and members of mission control on Earth and how these factors change over time.
Author
Spacecrews; Simulators; Personnel; Morale; Leadership; Crews; Compatibility

20000020508 NASA Johnson Space Center, Houston, TX USA
Predictors of Behavior and Performance During Long Duration Space Missions: The Antarctic-Space Analog Program (ASAP)
Palinkas, L. A., California Univ., San Diego, USA; Gunderson, E. K. E., Naval Health Research Center, USA; Johnson, J. C., East Carolina Univ., USA; Holland, A. W., NASA Johnson Space Center, USA; Miller, C., California Univ., San Diego, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 152-153; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

It is generally acknowledged that long duration space missions will require crewmember personality and social characteristics that differ substantially from those required for short duration missions. However, small sample sizes and relatively few long duration missions have made the identification of such characteristics in astronaut personnel somewhat problematic. Studies of personnel in analog environments such as Antarctic research stations allow for a determination of the characteristics of ideal candidates for long duration missions.
Author
Personality; Performance Prediction; Human Behavior; Space Missions

20000020509 Oklahoma Univ., Norman, OK USA
NASA Performance Assessment Workstation: A Tool for Astronaut Cognitive Performance Evaluation
Schlegel, R. E., Oklahoma Univ., USA; Shehab, R. L., Oklahoma Univ., USA; Schiflett, S. G., Armstrong Lab., USA; Eddy, D. R., NTI, Inc., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 154-157; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The NASA Performance Assessment Workstation (PAWS) is a laptop computer-based battery of tasks designed to evaluate astronaut cognitive performance during space flight. The tasks were selected to examine attention shifting, spatial, mathematical, and memory skills, and tracking ability. The subjective scales were selected to assess overall fatigue and mood state. PAWS was flown on the Second International Microgravity Laboratory (IML-2) and the Life and Microgravity Spacelab (LMS) missions to study the combined effects of microgravity and fatigue on cognitive performance. This paper provides a background on the PAWS battery of tasks, including descriptions of the tasks and information on task reliability, stability and learning curves.
Author
Astronaut Performance; Computer Techniques; Evaluation; Mental Performance; Performance Tests

20000020510 Oklahoma Univ., Norman, OK USA
Cognitive Performance Assessment with a Bed Rest Analog for Microgravity
Shehab, R. L., Oklahoma Univ., USA; Schlegel, R. E., Oklahoma Univ., USA; Schiflett, S. G., Armstrong Lab., USA; Eddy, D. R., NTI, Inc., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 158-161; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The NASA Performance Assessment Workstation (PAWS) is a computer-based battery of tasks designed to evaluate astronaut cognitive performance during space flight. Each PAWS session requires subjects to complete six performance tasks and two subjective scales. The tasks were selected to examine attention shifting, spatial, mathematical, and memory skills, and tracking ability. The subjective scales were selected to assess overall fatigue and mood state. PAWS was flown on the Second International Microgravity Laboratory (IML-2) and the Life and Microgravity Spacelab (LMS) missions to study the combined effects of microgravity and fatigue on cognitive performance. The LMS mission assembled twelve experiments designed to evaluate the impact of space flight on a broad range of human abilities. The experiments examined three general areas: 1) muscle structure and function, 2) metabolism, and 3) performance. The NASA PAWS was included as a performance experiment to evaluate cognitive performance changes during and after flight. One-year prior to the flight of LMS, a bed rest analog was used in a ground-based study to examine the host of proposed life sciences experiments. The bed rest microgravity analog restricts subjects to a prone, 6', head-down posture for the duration of the study. The physiological effects of this postural restriction simulate the physiological effects of a microgravity environment. The bed rest study followed the planned flight schedule and procedures for LMS and served to evaluate the combined sequence of experiments prior to the actual flight. The bed rest study provided the opportunity to identify and resolve conflicts and incompatibilities within the schedule, refine experimental procedures, and optimize proposed timelines. The bed rest study also provided ground-based control group data for comparison with the flight data. As part of the LMS payload, PAWS was included in the LMS bed rest study. This paper details the PAWS bed rest experiment.
Author
Bed Rest; Astronaut Performance; Physiological Effects; Muscular Function; Microgravity; Electric Batteries; Computer Techniques

20000020511 Anacapa Sciences, Inc., Santa Barbara, CA USA
Review and Analysis of Diaries Maintained by the Leaders and Physicians of French Remote Duty Stations
Stuster, J., Anacapa Sciences, Inc., USA; Bachelard, C., Territoire des Terres Australes et Antarctiques Francaises; Suedfeld, P., British Columbia Univ., Canada; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 162-163; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

In previous studies of space analogue conditions it has been impossible to support with objective evidence any scheme that attempts to assign relative priority to the many behavioral issues that must be considered when designing procedures and equipment for long duration isolation and confinement. Psychologist, Peter Suedfeld, voiced the concern of behavioral scientists and perplexed aerospace managers when he commented that a particular study "...does not communicate judgments about the relative importance of the various problems, so the reader is often left wondering about what design or preparation or intervention goals should have priority if one has to make choices--as one often does because of restrictions of time, space, payload capacity, personnel, funds, and so forth." Using data derived from the experiences of actual leaders and physicians during expeditions in remote, isolated, and hostile environments, the current study identifies the major categories of behavioral issues associated with isolation and confinement, and provides quantitative data on which to base judgments concerning the relative importance of the categories and their constituent themes.
Author
Analogs; Expeditions; Isolation; Spacecrews

20000020512 NASA Johnson Space Center, Houston, TX USA
Psychological Adaptation to Extreme Environments: Effects of Team Composition on Individual Adaptation
Wood, J., Baylor Coll. of Medicine, USA; Hysong, S. J., Rice Univ., USA; Lugg, D. J., Australian Antarctic Div.; Harm, D. L., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 164-165; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

This study is part of an ongoing program of research examining the psychological effects of isolation and confinement on individual adaptation, productivity and group relations in Antarctic winter personnel. This environment is used as an analogue for long-duration space mission scenarios, such as a space station sojourn, or a mission to Mars. Earlier results from this and other environments have demonstrated that: (1) most changes in psychological well-being are event-related and of relatively short duration; and (2) the greatest problem facing most individuals is interpersonal conflict. Content analysis of responses to open-ended questions has identified the numerous enjoyable aspects of Antarctic living, and confirmed that many of the problems reported were interpersonal in nature, and that problems varied significantly by station. Current work is exploring the effects of team assignment on the self-reported psychological changes and self-evaluations of members of isolated teams. This work includes identifying the dimensions by which subjects determine how well they are functioning. These dimensions (e.g., work, social life, internal emotional state) appear to play an important role in how subjects evaluate many aspects of life in isolation.
Author
Psychological Effects; Adaptation; Emotional Factors; Isolation; Group Dynamics

20000020513 Wisconsin Univ., Madison, WI USA
Mission Control Information Flow Issues
Caldwell, Barrett S., Wisconsin Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 167-169; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The NASA funded research project, "Control-Crew Network Communication During Routine and Non-Routine Events: Effects on Mission Control-Crew Performance," has only been active since May, 1998. However, the current research is also able to draw on prior work conducted in the PI's research group since 1995. Much of this related research has significant impacts on several biomedical and human performance assessment topics, especially in the area of task coordination and performance enhancement in cognitively demanding tasks. This presentation will provide a brief overview of past studies, outline of the current research, and plans for future investigations from this early research perspective. One human performance concern in supervisory control tasks is the interaction of changes in task demands (workload transitions) and cycles of operator alertness during system monitoring or supervisory system management. The combination of sudden workload transitions with lowered alertness can result in hazardous states of awareness, which may significantly impair the operator's ability to respond effectively to a degraded situation or environmental condition. Hazardous states of awareness can present problems both for mission control console operators, and the astronaut crews themselves, depending on phase of flight and the need for coordinated information flow and task performance. In order to reduce potential performance degradation associated with hazardous states of awareness, research effort has been devoted to identify physiological or behavioral correlates of reduced alertness associated with reduced task performance. Two studies conducted in the PI's Group Performance (GROUPER) research group have addressed the impact of workload transitions on operators at varying states of alertness as measured by EEG and EKG data. One study, conducted at SPAWAR in San Diego, evaluated operators in a air defense task over 96 person-hours (N= 1 2, four two-hour task sessions over two days) of varying alertness. The second study, conducted at the Sleep Research Center at UW- Madison, evaluated performance in a NASA MATB resource management task after a period of low task demands, collecting approximately 50 person-hours (N approx. 100, one 30-minute session) of data. Analysis of both data sets is ongoing. However, initial results from the SPAWAR

study indicated that variations in alertness in the single minute prior to workload transitions could significantly predict variance in task performance during the 5-7 minute high task demand phase following the transition. Initial results of the Sleep Research Center study indicated that persons with serious measured sleep apneas were significantly more impaired in their performance responses to a workload transition after a period of low task demands. The results of these studies clearly indicate that effective information flow regarding operator alertness, as well as increased task coordination support during workload transitions, will be of importance in managing distributed supervisory control task performance between mission control operators and astronaut crews. The current research does not examine operator alertness variables, but focuses instead on the changes in communication patterns associated with routine and non-routine events. Both types of events may represent workload transitions from the crew and mission control, and many require new techniques for adaptive bandwidth allocation to support mission success.
Derived from text

Active Control; Mission Planning; Information Flow; Human Performance; Resources Management; Electroencephalography; Electrocardiography

20000020515 EEG Systems Lab., San Francisco, CA USA

Neurophysiological Indices of Sustained Focused Attention: Application to Monitoring Cognitive Load, Operational Fatigue, and Other Environmental Stressors

Gevins, Alan, EEG Systems Lab., USA; Smith, Michael E., EEG Systems Lab., USA; McEvoy, Linda, EEG Systems Lab., USA; Brown, Halle, EEG Systems Lab., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 173-174; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

In complex work environments, any cognitive overload imposed by high task demands can lead to performance errors and inefficiencies in the acquisition of new procedures. Similarly, personnel who are experiencing a transient cognitive impairment (because of fatigue or sleep loss, illness or medication, intoxication or hangover, etc.) may be error prone in situations that tax the limits of their reduced mental capacity. Such conditions have frequently been implicated in major accidents. Neurophysiological (EEG) measures can provide sensitive indices of an individual's ability to focus and sustain attention and to hold information in working memory. We are evaluating the feasibility of using such measures of brain function to detect changes in cognitive status associated with environmental stressors. Preliminary studies provided initial evidence that multivariate combinations of task-related EEG variables can provide sensitive indices of cognitive load and transient cognitive impairment. Our current NASA-sponsored effort aims to further verify and extend these results.
Author

Mental Performance; Neurophysiology; Electroencephalography; Monitors

20000020518 NASA Johnson Space Center, Houston, TX USA

Evaluations of Three Methods for Remote Training

Woolford, B., NASA Johnson Space Center, USA; Chmielewski, C., Lockheed Martin Corp., USA; Pandya, A., Lockheed Martin Corp., USA; Adolf, J., Lockheed Martin Corp., USA; Whitmore, M., Lockheed Martin Corp., USA; Berman, A., Lockheed Martin Corp., USA; Maida, J., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 182-183; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Long duration space missions require a change in training methods and technologies. For Shuttle missions, crew members could train for all the planned procedures, and carry documentation of planned procedures for a variety of contingencies. As International Space Station (ISS) missions of three months or longer are carried out, many more tasks will need to be performed for which little or no training was received prior to launch. Eventually, exploration missions will last several years, and communications with Earth will have long time delays or be impossible at times. This series of three studies was performed to identify the advantages and disadvantages of three types of training for self-instruction: video-conferencing; multimedia; and virtual reality. These studies each compared two types of training methods, on two different types of tasks. In two of the studies, the subject's were in an isolated, confined environment analogous to space flight; the third study was performed in a laboratory.
Author

Evaluation; Training Analysis; Education; Space Missions; Time Lag

20000020606 Legacy Good Samaritan Hospital, Neurotology Research, Portland, OR USA

Roll-Tilt Perception Using a Somatosensory Bar Task

Black, F. O., Legacy Good Samaritan Hospital, USA; Wade, S. W., Legacy Good Samaritan Hospital, USA; Arshi, A., Legacy Good Samaritan Hospital, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 409-410; In English

Contract(s)/Grant(s): NAGW-3799; NIH-R01-DC-00205; Avail: CASI; A01, Hardcopy; A06, Microfiche

Visual estimates of roll-tilt perception during static roll-tilt are confounded by an offset due to the ocular counterroll that simultaneously occurs. An alternative, non-visual ('somatosensory') measure of roll-tilt perception was developed which is not contaminated by this offset. The aims of this study were to determine: 1) inter-subject variability of somatosensory settings across test session in normal subjects and patients with unilateral or bilateral vestibular loss and 2) intra-subject variability of settings across test session in normal subjects.
Author
Vestibules; Sensory Perception; Losses; Contamination

20000020616 Washington Univ., Dept. of Otolaryngology, Seattle, WA USA
Self-Motion Perception: Assessment by Real-Time Computer Generated Animations
Parker, Donald E., Washington Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 435-436; In English
Contract(s)/Grant(s): NAG5-4074; NAG9-958; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche
Our overall goal is to develop materials and procedures for assessing vestibular contributions to spatial cognition. The specific objective of the research described in this paper is to evaluate computer-generated animations as potential tools for studying self-orientation and self-motion perception. Specific questions addressed in this study included the following. First, does a non-verbal perceptual reporting procedure using real-time animations improve assessment of spatial orientation? Are reports reliable? Second, do reports confirm expectations based on stimuli to vestibular apparatus? Third, can reliable reports be obtained when self-motion description vocabulary training is omitted?
Author
Motion Sickness; Motion Perception; Real Time Operation; Vestibules; Procedures

20000020617 Oregon Health Sciences Univ., Neurological Sciences Inst., Portland, OR USA
Evidence for a Rapid Gain Change Mechanism that Regulates Human Postural Control Dynamics
Peterka, R. J., Oregon Health Sciences Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 437-440; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche
An upright stance position is inherently unstable. A small body sway deviation from a perfect upright position results in a torque due to gravity that accelerates the body farther away from the upright position. to maintain upright stance, the destabilizing torque due to gravity must be countered by corrective torque exerted by the feet against the support surface. This corrective torque is most likely generated through the action of a feedback control system. That is, body motion away from upright is detected by sensory systems, the motion information is processed by the CNS, and the processed signals are used to generate corrective torques that move the body back toward the upright position. The visual, proprioceptive, and vestibular systems are the primary sensory systems contributing to postural control. However, altered environmental conditions can eliminate or compromise the accuracy of sensory information. Examples include: (1) eye closure or darkness that eliminates visual orientation cues, (2) soft or compliant surfaces that alter proprioceptive information related to the feet and ankle joint motion, and (3) altered vestibular cues due to space-flight induced adaptive changes in the interpretation of vestibular sensory information.
Derived from text
Central Nervous System; Cues; Data Processing; Dynamic Characteristics; Eye (Anatomy); Feedback Control; Gravitation; Physiological Responses; Simulation; Vestibules; Visual Stimuli

20000020618 NASA Johnson Space Center, Houston, TX USA
Visual-Vestibular Responses During Space Flight
Reschke, M. F., NASA Johnson Space Center, USA; Kozlovskaya, I. B., Institute of Biomedical Problems, USSR; Paloski, W. H., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 441-442; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche
Given the documented disruptions that occur in spatial orientation during space flight and the putative sensory-motor information underlying eye and head spatial coding, the primary purpose of this paper is to examine components of the target acquisition system in subjects free to make head and eye movements in three dimensional space both during and following adaptation to long duration space flight. It is also our intention to suggest a simple model of adaptation that has components in common with cerebellar disorders whose neurobiological substrate has been identified.
Author
Vestibules; Visual Stimuli; Attitude (Inclination); Head Movement; Sensorimotor Performance

20000020917 Naval Postgraduate School, Monterey, CA USA

Scheduling Aircrew Training at USA Navy Fleet Readiness Squadron HC-3 During Replacements of H-46D Helicopters by CH-60S

Jasperson, Kevin S.; Sep. 1999; 66p; In English

Report No.(s): AD-A370143; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

The USA Navy is replacing the H-46D helicopter with the new CH-60S helicopter. Helicopter Combat Support Squadron Three (HC-3) is the US Navy's Fleet Readiness Squadron, responsible for training the contingent of pilots and aircrewmen to fly this helicopter fleet; it is also responsible for managing their transition to the CH-60S. Each pilot and aircrewman represents a large investment in training and experience, and each is engaged in some stage of a Navy career that is governed by a host of guidelines for training, service experience, sea and shore duty rotations, and so forth. This thesis introduces an optimization model that takes as input the current state of Navy pilots and aircrewmen, the schedule of CH-60S introductions, restrictions on career duty tours and qualifying experience, limits on training resources, and other policy guidelines. The output is a schedule of duty tours, including training, retraining, shore, and sea duty tours, while recommending an optimal set of career paths to accommodate the transition over an 84-month period.

DTIC

Scheduling; Pilot Training

20000021104 Logicon Technical Services, Inc., Dayton, OH USA

Information Dissonance, Shared Mental Models and Shared Displays: An Empirical Evaluation of Information Dominance Techniques ***Interim Report, 1 Jun. 1997-31 Dec. 1998***

Bolstad, Cheryl A.; Endsley, Mica R.; Dec. 1998; 51p; In English; Prepared in cooperation with SA Technologies, Marietta, GA.

Contract(s)/Grant(s): F41624-94-D-6000; AF Proj. 7184

Report No.(s): AD-A371330; AFRL-HE-WP-TR-1999-0213; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This study experimentally tested the use of shared mental models and shared displays as a means of enhancing team situation awareness (SA). Teams were tested using a simulation of an aircraft defense task that incorporated features of a distributed team architecture. As hypothesized, the presence of shared displays and shared mental models improved team performance. However, the mechanism whereby the shared displays aided performance was not direct as expected. Teams were initially slower when first given a shared display, but a residual effect was seen in later trials where it aided performance. While shared displays initially slowed team performance in this task, most likely due to extra attention demands, they also provided for the development of shared mental models that greatly enhanced performance after they were removed. The combination of non-shared displays and no mental model was highly detrimental to performance. Teams who experienced this condition first were unable to ever develop very good performance. Overall, we found that effective team performance could be enhanced by providing teams with sufficient information to build a shared mental model of each other's tasks and goals, either through direct instruction, or through provision of shared displays.

DTIC

Numerical Analysis; Command and Control; Mental Performance; Performance Prediction; Human Performance

20000021387 Institute for Human Factors TNO, Soesterberg, Netherlands

Task Performance Under Fatigue: Effects of Immediate and Delayed Feedback on Individual and Team Tasks ***Final Report Taakprestatie bij Vermoeidheid: Effecten van Directe en Uitgestelde Feedback op Individuelle en Team-Taken***

vanderVegt, G. S., Institute for Human Factors TNO, Netherlands; Hoeksema–vanOrden, C. Y. D., Institute for Human Factors TNO, Netherlands; Langefeld, J. J., Institute for Human Factors TNO, Netherlands; Gaillard, A. W. K., Institute for Human Factors TNO, Netherlands; Nov. 19, 1999; 27p; In English

Contract(s)/Grant(s): A96/KL/303; TNO Proj. 731.2

Report No.(s): TD99-0367; TM-99-A076; Copyright; Avail: Issuing Activity

This is the seventh experiment in a series of studies on the effects of fatigue and sleep deprivation on task performance. Participants worked on two different individual tasks and a team task for 20 hours without sleep, in five sessions of four hours each. The tasks started in the early evening. In the current experiment, the main research question concerned feedback on the team task: which type of group feedback motivates people best when they have to work such long hours without sleep? Two types of feedback were tested: (1) 'immediate group feedback', provided after every block of ten trials; (2) 'delayed group feedback', provided at the end of the experiment. An interaction between feedback and fatigue was expected, in the sense that immediate feedback was expected to be a better motivator over time than delayed feedback. In contrast to our expectations, only a main effect of fatigue appeared. Neither a main effect of feedback nor an interaction between feedback and fatigue emerged. A significant

interaction between task and fatigue revealed that more simple and monotonous individual tasks were more sensitive to fatigue than more complex and demanding individual or team tasks, which confirms earlier findings.
Author
Human Performance; Mental Performance; Tasks; Fatigue (Biology); Work-Rest Cycle; Sleep Deprivation

20000021456 College of William and Mary, Williamsburg, VA USA
Incongruity, Incongruity Resolution, and Mental States: The Measure and Modification of Situational Awareness and Control *Final Report, 1 Jan. 1994 - 31 Dec. 1997*
Derks, Peter L., College of William and Mary, USA; Gillikin, Lynn S., College of William and Mary, USA; 1997; 51p; In English; Original contains color illustrations.
Contract(s)/Grant(s): NCC1-160
Report No.(s): NASA/CR-97-207631; NAS 1.26:207631; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Cognition and emotion combine to define mental states. Situational awareness depends on both knowledge of the environment and the mood of the individual. Cognitive scientists from William James and Sigmond Freud to contemporary theorists in artificial intelligence and neuropsychology have acknowledged the critical role of subjective state in determining the efficiency and flexibility of information processing. One of the most explicit computational models of mental states to incorporate both knowledge and arousal has been described. Knowledge is carried in a typical neural net with categorical nodes and probabilistic links. Arousal determines the focus among these nodes and links. High arousal results in a restricted range of activation. Low arousal causes a wider range of stimulation and a broader linking of categories or "ideas." From this model Gerlernter generates "creativity" in problem solving from a network that is widely active and the possibility of "fixation" from a highly aroused system.
Derived from text
Human Factors Engineering; Psychological Effects; Artificial Intelligence; Cognition; Mathematical Models; Mental Health

20000021561 Institute for Human Factors TNO, Soesterberg, Netherlands
Task Factors Influencing Fascination *Final Report Taakfactoren van Invloed op Fascinatie*
Boer, L. C., Institute for Human Factors TNO, Netherlands; vanSchie, C. C., Institute for Human Factors TNO, Netherlands; Nov. 18, 1999; 24p; In Dutch
Contract(s)/Grant(s): B98-021; TNO Proj. 787.1
Report No.(s): TD99-0366; TNO-TM-B012; Copyright; Avail: Issuing Activity

Fascination occurs when an operator gets preoccupied with a part task, then forgets execution of another task. In the introduction related concepts are discussed such as "cognitive lockup", "narrowing of attention", "simple vs. flexible decomposition", "serial attention", and the general concept of situation awareness. This review shows that no task factors have been identified to explain fascination. In an investigation with 48 volunteers, a test was made whether or not disturbing the perception of time would stimulate fascination. In a role as operator of a space station, the participant was responsible for two tasks: a permanent and an incidental task. The first manipulation was a change in the presentation speed of the incidental task; the second was a "failure" in the equipment. Incident fascination (forgetting the permanent task) turned out to be slightly more frequent during equipment failure (p is less than .05, one-tailed test). Learning effects and a mild SWAT workload were observed. The discussion considers the possibility that equipment error stimulated task forgetting because operators were distracted from their normal duties. Distractions are really dangerous if they "invite" the operator to look for further information.
Author
Human Factors Engineering; Human Performance; Errors; Workloads (Psychophysiology)

20000024895 Fourth Military Medical Univ., Dept. of Aerospace Physiology, Xi'an, China
Comparison of Sensitivity of Mental Load Assessment Indexes
Dong, Ming–Qing, Fourth Military Medical Univ., China; Ma, Rui–Shan, Fourth Military Medical Univ., China; Space Medicine and Medical Engineering; Apr. 1999; ISSN 1002-0837; Volume 12, No. 2, pp. 106-110; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective of this study was to compare the sensitivities of indexes used in the assessment of mental load. Twenty five indexes belonging to primary task performance, additional task performance, subjective rate and psychophysiological measure were recorded during performance of 11 different difficult tasks. The tests showed that tracking error (ER), reaction time (RT), correct rate (C.R), category scale (CS), multistage evaluation scale (MES), multi-dimensional scale (MDS), latency of P3 (I AT), inter beat interval (IBI), inter respiration interval (IRI) and blink rate (BR) were significantly different among the various tasks. CS, MES and MDS were more sensitive to the total load; ER, LAT, IBI and IRI were more sensitive to the load of primary task,

while RT and CR to that of additional task and BR to the visual load. It was demonstrated that the sensitivities of the various indexes are different and the information are limited. multi-indexes may be preferred for mental load assessment .
Author
Human Performance; Mental Performance; Psychophysiology; Reaction Time; Workloads (Psychophysiology); Stress (Psychology)

20000024933 Institute of Space Medico-Engineering, Beijing, China
Psychological Issues in Manned Spaceflight
Zhang, Qi–Ji, Institute of Space Medico-Engineering, China; Bai, Yan–Qiang, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Apr. 1999; ISSN 1002-0837; Volume 12, No. 2, pp. 144-148; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

As the duration. of manned spaceflight becomes longer and as crews become more heterogeneous, psychological and interpersonal factors will be more important in affecting the safety of crew and flight mission. In space environment there are four types of stressors: physical, physiological, psychological and interpersonal. Psychological issues include "Asthenia", alteration in time sense, transcendent experiences, sleep problem, career motivation, psychosomatic symptoms and psychiatric issues. Interpersonal issues include interpersonal tension, interpersonal relationships decreased cohesiveness and deprivation, displacement of anger to outside personnel over time.
Author
Astronauts; Manned Space Flight; Physiology; Psychological Factors; Psychology; Psychosomatics; Signs and Symptoms; Space Psychology; Astronaut Performance; Stress (Psychology); Space Flight Stress; Psychological Effects

20000024979 Army Research Inst. for the Behavioral and Social Sciences, Armored Forces Research Unit, Fort Knox, KY USA
A Review and Annotated Bibliography of the Literature Pertaining to Team and Small Group Performance (1989 to 1999) ***Final Report, Jan. - Sep. 1999***
LaJoie, Andrew S.; Sterling, Bruce S.; Dec. 1999; 89p; In English
Contract(s)/Grant(s): DA Proj. 2O2-62785-A-790
Report No.(s): AD-A371864; ARI-RP-2000-01; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The military, along with private industry, is relying more on small teams of specialized individuals who work together to achieve a common goal. Examples of these teams include emergency medical teams, aircrews, decision-making teams, industrial project teams, Special Forces teams, weapon system crews and everyday work teams. Training and military doctrine has been evolving to reflect this emphasis on teamwork. The purpose of this annotated bibliography is to review literature published over the last ten years concerning team and small group performance. Specifically, the articles reviewed in this report represent a sampling of the research published in the social sciences, including psychology, sociology, and business. The team and small group literature reviewed includes examples of the many types of teams mentioned earlier. A summary and integration of this work is provided. In general, the research suggests that there are several components which contribute to the successful performance of teams, and that some of these components can be explicitly trained. Several training models are discussed.
DTIC
Bibliographies; Annotations; Teams; Education; Group Dynamics; Human Performance

20000025082 Civil Aeromedical Inst., Oklahoma City, OK USA
Measuring Air Traffic Controller Performance in a High-Fidelity Simulation ***Final Report***
Manning, Carol A., Editor, Civil Aeromedical Inst., USA; January 2000; 42p; In English
Contract(s)/Grant(s): AM-B-00-HRR-509
Report No.(s): DOT/FAA/AM-00/2; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In the summer of 1997, the Air Traffic Selection and Training (AT-SAT) High Fidelity Simulation Study was conducted at the FAA Academy in Oklahoma City, OK. The purpose of the study was to test the performance of 107 operational en route controllers during 21/2 days of simulations. The performance of these controllers during the high-fidelity simulations was compared with their performance on two medium-fidelity performance measures to assess the construct validity of the latter measures to serve as criteria against which to validate a set of selection tests. The reports included in this document describe the high-fidelity simulation exercise, the development of performance measures utilized during the exercise, and the interrelationships between the performance measures. The first report describes the development of a work sample approach to capturing air traffic controller performance, and establishes that high fidelity performance measures can adequately reflect the performance of the controller. The work sample was developed in an environment that simulated as nearly as possible the actual conditions existing in the controller's job, but was conducted in a "generic" airspace. Scenario development included the most

important tasks from the task-based 'ob analysis developed for the AT-SAT project. Sufficient time was provided for participating controllers to learn the airspace and procedures and demonstrate their knowledge through 1) a multiple choice test of airspace knowledge and 2) running 8 practice scenarios. Performance was measured by 1) an over-the-shoulder (OTS) rating scale, 2) counts of mistakes, 3) counts of actions that would be required to move aircraft from the sector at the end of the scenario, and 4) statistics derived from aircraft positions and controller/pilot data entries recorded for the simulation. The second report used measures collected during the high-fidelity simulation study to predict the overall OTS performance rating. It was found that a model that included both counts of mistakes and the computer-derived performance measures predicted the OTS rating reasonably well, while a model containing only the computer-derived measures did not. Remaining actions did not contribute to the prediction of the OTS rating in addition to the contribution provided by the other types of measures.
Author
Air Traffic Control; Air Traffic Controllers (Personnel); Simulation; Performance Tests; Human Performance

20000025224 Institute for Human Factors TNO, Soesterberg, Netherlands
The Influence of Cross-Training on Teams with Changing Team-Members ***Interim Report De Invloed van Cross-Training op Teams Die van Samenstelling Veranderen***
Schaafstal, A. M., Institute for Human Factors TNO, Netherlands; Bots, M. J., Institute for Human Factors TNO, Netherlands; Dinnessen, M., Institute for Human Factors TNO, Netherlands; Nov. 16, 1999; 50p; In Dutch
Contract(s)/Grant(s): B99-052; TNO Proj. 730.2
Report No.(s): TD99-0363; TNO-TM-99-B011; Copyright; Avail: Issuing Activity

Earlier research by Schaafstal and Bots has shown that 'explicit instruction', directed at the interdependencies between the tasks of the various team members, is an efficient method for team training. The question is whether this cross- training method also leads to a relatively good performance in situations where there is a change in team composition in between training and testing, compared to a method for cross-training geared towards the complete task of other team members. The results show that it is not possible to show that 'explicit instruction' leads to better performance than instruction geared towards the complete task of other team members. It is concluded that the currently used team performance and team process measures are possibly not sensitive enough to pick up differences between conditions and between teams. Therefore, it is recommended to add other process measures in future experiments, such as various teamwork dimensions (e.g. team initiative/leadership, backup behaviour, feedback, situation awareness). Also, the role of team learning capabilities, such as team self-correction, could be of more importance than assumed in the experimental research so far. It is recommended to study these factors explicitly in future experiments, In addition, the report contains recommendations for diminishing the variance between teams.
Author
Education; Human Performance; Teams

20000025226 Institute for Human Factors TNO, Soesterberg, Netherlands
Measurement of Appreciation by the Personnel": A Basis for a Questionnaire ***Final Report Meten van "Waardering door het Personeel": Aanzet Tot en Vragenlijst***
Hoeksema–van Orden, C. Y. D., Institute for Human Factors TNO, Netherlands; Nov. 11, 1999; 58p; In Dutch
Contract(s)/Grant(s): A97/KLu/320; TNO Proj. 731.2
Report No.(s): TD99-0362; TNO-TM-99-A073; Copyright; Avail: Issuing Activity

The section of Behavioural Sciences (SGW) of the Dutch Air Force intends to come to an integration of ail questionnaires on work stress, work satisfaction and other related topics that have been used in the last couple of years in the Air Force. These questionnaires partly overlap and the risk of the personnel becoming 'tired of questionnaires' is real. Besides, a newly developed questionnaire should fit within the framework of the INK-model (institute Netherlands Quality), a system that the Air Force has currently adopted to enhance integral quality in the organization. On request of SGW, the TNO Human Factors Research Institute has gathered existing questionnaires on well being, satisfaction and work stress, as well as more detailed information on the INK-model. All constructs from the existing questionnaires have been clustered around five themes from the INK-model, completed with a sixth: i 1) leadership; (2) policy and strategy; (3) personnel management: (4) management of means; @5) management of processes: (6) motivation. A 'gross list' of items that belong with each theme is attached to the report. Furthermore, one chapter is devoted to questionnaire construction theory, in which a few directives are given that SGW can use when developing the actual questionnaire,
Author
Human Factors Engineering; Personnel Management; Management Planning; Employee Relations

20000025530 Civil Aeromedical Inst., Oklahoma City, OK USA

The Effects of Napping on Night Shift Performance *Final Report*

DellaRocco, Pamela S., Civil Aeromedical Inst., USA; Comperatore, Carlos, Civil Aeromedical Inst., USA; Caldwell, Lynn, Civil Aeromedical Inst., USA; Cruz, Crystal, Civil Aeromedical Inst., USA; February 2000; 38p; In English

Report No.(s): DOT/FAA/AM-00/10; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This study represents a collaborative effort between the Federal Aviation Administration's Civil Aeromedical Institute and the US Army Aeromedical Research Laboratory to investigate the effects of napping on the midnight shift as a potential countermeasure to sleepiness during the shift. The purpose of the present paper was to examine the patterns of performance degradation along with the subjective measures of mood, sleep quality, and sleepiness as a function of napping condition and time on task during the midnight shift. Sixty Air Traffic Control Specialists (ATCSS) were randomly assigned to one of the three midnight shift napping conditions: a long nap (LN) of 2 hours, a short nap (SN) of 45 minutes, and a no nap condition (NN). ATCSs completed a four-day protocol during which they worked three early morning shifts (0700-1500) followed by a rapid rotation to the midnight shift (2300-0700). Subjects completed three 1.5 hour test sessions (one session before the nap and 2 sessions after the nap) during the midnight shift involving two computer-based tasks: (1) the Air Traffic Scenarios Test (ATST), a task developed for selection of ATCSS; and (2) the Bakan, a test of vigilance. Data were analyzed using repeated measures analysis of variance and post-hoc multiple comparisons. Both cognitive performance and subjective measures of sleepiness supported the use of naps during the midnight shift. In fact, both the long nap of 2 hours and the short nap of 45 minutes resulted in better performance than no nap on the Bakan test at the end of the midnight shift. A dose-response relationship existed such that the long nap also resulted in better performance than the short nap. The ATST, on the other hand, was much less sensitive to differences in napping condition and even to the natural circadian trough, which would have been expected to affect all groups. Sleepiness ratings on the Stanford Sleepiness Scale suggested that, while sleepiness increased across the midnight shift for all groups, ratings were generally lower for the LN condition and were lower for males in the SN condition, when compared with the NN condition. The present study suggests that naps taken during the midnight shift could be useful as a countermeasure to performance decrement and sleepiness on the midnight shift.

Author

Air Traffic Controllers (Personnel); Operator Performance; Sleep; Mental Performance; Fatigue (Biology); Stress (Psychology); Night

20000026311 Naval Aerospace Medical Research Lab., Pensacola, FL USA

Vestibular Interactions During and After Head Movements in Hypergravity: Constant 2G Acceleration with Negligible Angular Velocity

Rupert, Angus H., Naval Aerospace Medical Research Lab., USA; Raj, Anil K., Naval Aerospace Medical Research Lab., USA; Muth, Eric R., Naval Aerospace Medical Research Lab., USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 31-43; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

The G-excess illusion has been implicated in a significant number of aviation mishaps involving loss of situation awareness. The G-excess illusion can occur when head movements are made in an elevated gravity field, such as in a banked turn or in an accelerating space vehicle. This can cause illusory attitude changes of as much as 90 degrees, depending on type and rate of head movement. In addition, head movements in an elevated gravity field can lead to the development of motion sickness symptoms. The level of motion sickness encountered during a preliminary hypergravity study performed on the KC-135 in 1991 could not be accounted for by coriolis cross coupling effects (the nauseating sense of tumbling produced by head movements in a rotating environment). We employed the KC-135 (as in the 1991 study) as a large centrifuge, flying in a banked turn to generate hypergravity (1.8G). We proposed to investigate the human physiological response to head movements during increased linear acceleration by measuring the vestibulo-ocular reflex (VOR). We recorded perceptual reports of visual illusions of motion as a result of these head movements. We also monitored the onset and progression of motion sickness symptoms during hypergravity with subjective symptom reporting and an objective measure of gastric activity (electrogastrogram). These experiments should lead to better understanding of the mechanism of the g-excess illusion and help develop effective countermeasures for pilots and astronauts returning to the relatively high gravity of the earth after adaptation to microgravity,

Author

High Gravity Environments; Human Reactions; Motion Sickness; Aerospace Medicine; Head Movement; Acceleration Stresses (Physiology)

20000026315 Dartmouth Coll., Hanover, NH USA

Head Direction Cell Activity under Microgravity Conditions

Taube, Jeffrey S., Dartmouth Coll., USA; Oman, Charles S., Dartmouth Coll., USA; Stackman, Robert W., Dartmouth Coll., USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 59-61; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The goal of this study is to understand the neurobiology underlying visual reorientation illusions and the etiology of motion sickness. The long-term objectives of the proposed research are to improve our understanding of how spatial orientation information is processed in the vertebrate brain. Specifically, what are the underlying physiological and cognitive mechanisms which normally support an animal's sense of direction and enable it to orient and navigate within a three-dimensional environment? Previous studies in rat hippocampus, subicular complex, and thalamus have identified two classes of exocentric spatial cells in the brain. One type discharges whenever the animal is in a specific location ("place" cells), while the second ("head direction" cells) discharge as a function of the animal's head direction in the earth's horizontal plane, independent of the animal's behavior and location. Based on well established ground-based experimental paradigms, we propose a series of rodent electrophysiological experiments to characterize the behavior of head direction cells in freely moving animals in various non-gravity orientations. Because astronauts frequently experience spatial disorientation during space flights, it is important to understand the underlying neurophysiological mechanisms contributing to spatial orientation in order to eventually develop appropriate countermeasures. The experiments will be performed aboard the KC-135 aircraft; this aircraft flies parabolic flights in order to simulate the effects of micro-gravity.

Derived from text

Brain; Electrophysiology; Motion Sickness; Neurophysiology; Position (Location); Illusions; Microgravity

20000026322 Massachusetts Inst. of Tech., Cambridge, MA USA

Undergraduate Program Flights: PREVIEW (PeRiphEral VIsion Experimentation in Weightlessness)

Hallam, Cory R. A., Massachusetts Inst. of Tech., USA; Chen, Stephanie, Massachusetts Inst. of Tech., USA; Gesch, Julie, Massachusetts Inst. of Tech., USA; Newman, Dava, Massachusetts Inst. of Tech., USA; Rivkin, Tyra, Massachusetts Inst. of Tech., USA; Sienko, Kathy, Massachusetts Inst. of Tech., USA; Sun, Mark, Massachusetts Inst. of Tech., USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 94-98; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

It is well-known that humans subjected to hyper-gravity environments experience the phenomenon of peripheral light loss (PLL) or tunnel vision as it is more commonly known, which is characterized by a narrowing of the visual field. Research on this subject has developed largely in connection with the advent of the high-performance combat aircraft where pilots are routinely subjected to loads of up to 9G for brief periods of time. This information has led to new design considerations for cockpit layouts, in particular the position of mission critical equipment; however, little research has been done to explore the effects of micro-gravity on the peripheral vision field of view (FOV) limits in humans. With the increase in human space-based activity planned for the International Space Station (ISS), the question of knowing if there is a corollary FOV design concern for spacecraft and space station working environments becomes important. This experiment was established to explore the peripheral vision FOV limits in humans in the micro-gravity environment.

Derived from text

Field of View; Microgravity; Peripheral Vision; Visual Fields; Weightlessness

20000026325 Maryland Univ., College Park, MD USA

Undergraduate Program Flights: Correlation of Microgravity Simulation through Fitt's Law

Bendor, Dan, Maryland Univ., USA; Fiterman, Eric, Maryland Univ., USA; Smith, Cristin, Maryland Univ., USA; Johnson, Larry, Maryland Univ., USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 111-113; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Our project consists of a correlation study of upper arm mobility in microgravity, neutral buoyancy, and normal 1-g conditions. In order to contrast the different environments, a design to collect data based on Fitt's Law will be used as a measure of coordination.

Author

Microgravity; Weightlessness Simulation; Human Factors Engineering; Human Reactions

20000026331 Brandeis Univ., Waltham, MA USA

Adaptation of Reaching Movements in Artificial Gravity

Lackner, James R., Brandeis Univ., USA; DiZio, Paul, Brandeis Univ., USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 134-137; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The goal of this experiment was to understand the role of cutaneous contact cues in control of reaching movements and posture. The objective was to evaluate the force applied by the fingertip when it lands on a horizontal work surface at the end of a reaching movement aimed at a target on the surface.

Derived from text

Artificial Gravity; Posture; Human Performance; Sensorimotor Performance; Reaction Time; Human Reactions

20000026332 Brandeis Univ., Waltham, MA USA

Effects of Background Force Level and Body Orientation on Arm Movement Control

Lackner, James R., Brandeis Univ., USA; DiZio, Paul, Brandeis Univ., USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 138-141; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Previous parabolic flight experiments showed that within one second after a transition to 0 g or 1.8 g background force subjects can reproduce a pattern of rhythmic forearm flexion-extension movements that they had learned in a I g environment. Our last set of parabolic flight experiments (6/98) showed that vestibular information about the force background is not necessary for this type of compensation, because a subject lacking vestibular function was as invariant in performance across g levels as normal subjects. Thus, we hypothesized that somatic mechanoreceptors provide cues about the gravitational loads that are automatically compensated. We tested this by observing a deafferented subject and fully sensate control subjects attempting to produce a constant pattern of arm movement while passively placed in different body orientations, in 0 g, 1 g and 1.8 g.

Author

Human Performance; Psychomotor Performance; Human Reactions; Microgravity; High Gravity Environments

20000026859 Utah Univ., Psychology Dept., Salt Lake City, UT USA

1998 Winter Conference on Neurobiology of Learning and Memory

Kesner, Raymond P., Utah Univ., USA; Sep. 29, 1999; 5p; In English; 22nd; Annual Neurobiology of Learning and Memory Conference, 10-13 Jan. 1998, Park City, UT, USA

Contract(s)/Grant(s): N00014-98-I-0141

Report No.(s): AD-A369842; Rept-5-28244; No Copyright; Avail: CASI; A01, Microfiche; A01, Hardcopy

The twenty-second annual Neurobiology of Learning and Memory conference was held in Park City, January 10-13,1998. The conference was organized b Sheri Mizumori, Bryan Kolb, Raymond Kesner, Jim McGaugh, Aryeh Routtenberg and Lary Squire. The conference was well attended with 80 scientists from all parts of the USA as well as 20 graduate and/or postdoctoral students. The topics that were covered included 1) a "data blitz" which was lead by Sheri Mizumori and Bryan Kolb. 2) "Molecular genetics and Biochemistry of learning and memory consolidation" which was led by Jim MeGaugh and Aryeh Routtenberg. 3) "Behavioral and Neural plasticity in Old Age" which was lead by Michels. Gallagher. 4) "Drug-induced Sensitization: A Model for Studying Experience-Dependent neuroplasicity" which was led by Terry Robinson. 5) "Representational and Reorganization as an Adaptive Mechanism of Behavior" which was led by Sheri Mizumori 6) "Memory Consolidation Revisited with Animal Models" which was lead by Lyn Nadel. 7) "Interactions of attention with learning and memory" which was lead by Rebecca Burwell. All of the sessions of the conference were well attended and resulted in extensive discussion with each session as well as discussion throughout the conference period. It is hoped that many new ideas were generated as a result of the many excellent presentations and the ensuing discussions.

Author

Conferences; Learning; Memory; Retention (Psychology); Information Processing (Biology)

54
MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human factors engineering; bionics, man-machine, life support, space suits and protective clothing. For related information see also 16 Space Transportation and 52 Aerospace Medicine..

20000020500 Air Force Research Lab., HEPR, Brooks AFB, TX USA
Staged Decompression to a 3.5 PSI EVA Suit Using An Argon-Oxygen (ARGOX) Breathing Mixture
Pilmanis, A. A.; Krause, K. M.; Webb, J. T.; Petropoulos, L. J.; Kannan, N.; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 124-126; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Long-term NASA goals include permanent occupation of the International Space Station (ISS) and missions to both the moon and Mars. One of the critical issues for reaching these goals is the definition of an optimum pressure for extravehicular activity (EVA) suits. Currently, a 4.3 psia pressure suit is used for space shuttle EVAS. This suit, in combination with current preoxygenation schedules, is effective for decompression sickness (DCS) prevention. However, at 4.3 psia, the astronauts experience hand and arm fatigue. Also, due to the gravitational forces that exist on the moon and Mars, the current suit will be too heavy for planetary EVA. A 100% oxygen breathing gas at an ambient pressure of 2.8 psia, is physiologically equivalent to breathing air at 10,000 feet altitude. However, because there will be some minimal performance decrement from mild hypoxia at that pressure and to provide a margin of safety, we propose a lower limit for the suit pressure of 3.5 psia. A soft, lower pressure suit requires a trade-off between preoxygenation time and suit weight and mobility. Development of a new 3.5 psia EVA pressure suit would reduce structural complexity, leak rate, and weight while increasing mobility, comfort, and maintainability. The trade-off for these advantages will be an increase in decompression time.
Derived from text
Decompression Sickness; Argon; Oxygen Breathing; Extravehicular Activity; Breathing Apparatus; Gas Mixtures; Pressure Gradients; Pressure Suits; Safety

20000020502 Duke Univ., Hypo/Hyperbaric Center, Durham, NC USA
An Understanding of Decompression Physiology Leads to Safer and More Efficient ExtraVehicular Activity (EVA)
Vann, R. D., Duke Univ., USA; Gerth, W. A., Duke Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 132-134; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Extravehicular activity (EVA) in the U.S. space program requires decompression from a sea level cabin pressure to an oxygen-filled space suit with a pressure equivalent to an altitude of 30,000 feet. Immediate decompression to this altitude would result in incapacitating or fatal DCS from the formation of nitrogen bubbles in blood and tissue. to avoid this problem, astronauts breathe oxygen at sea level or remain at an intermediate decompression stage of 10,000 feet to eliminate dissolved tissue nitrogen prior to further decompression for EVA. In ground-based EVA simulations, the DCS incidence has been 20-30% pain and 2-3% chokes or cerebral symptoms. This is despite breathing oxygen at sea level for 3.5-4 hours or remaining at 10,000 feet for 12 hours. Results from mathematical simulations of decompression are in agreement with these tests and indicate that a 12-hour decompression stage at 10.2 psia is inadequate to avoid significant DCS risk. DCS has not been reported during actual Shuttle EVAS, on the other hand, but these operations generally stayed at 10,000 feet for longer than one day (mean 37.8 hrs in 59 EVAs from Shuttle through February 1996). Such procedures are too long for construction of the International Space Station (ISS) where fast and frequent EVA will be required. A solution to this practical problem was found as a direct result of studies that addressed the fundamental mechanisms of decompression sickness.
Author
Decompression Sickness; Physiological Factors; Extravehicular Activity; Signs and Symptoms; Pressure Reduction

20000020514 NASA Johnson Space Center, Houston, TX USA
Microgravity Workstation and Restraint Evaluations
Chmielewski, C., Lockheed Martin Corp., USA; Whitmore, M., Lockheed Martin Corp., USA; Mount, F., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 170-172; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Confined workstations, where the operator has limited visibility and physical access to the work area, may cause prolonged periods of unnatural posture. Impacts on performance, in terms of fatigue and posture, may occur especially if the task is tedious and repetitive or requires static muscle loading. The glovebox design is a good example of the confined workstation concept. Within the scope of the 'Microgravity Workstation and Restraint Evaluation' project, funded by the NASA Headquarters Life Sciences Division, it was proposed to conduct a series of evaluations in ground, KC-135 and Shuttle environments to investigate the human factors issues concerning confined/unique workstations, such as gloveboxes, and also including crew restraint

requirements. As part of the proposed integrated evaluations, two Shuttle Detailed Supplementary Objectives (DSOs) were manifested; one on Space Transportation System (STS)-90 and one on STS-88. The DSO on STS-90 evaluated use of the General Purpose Workstation (GPWS). The STS-88 mission was planned to evaluate a restraint system at the Remote Manipulator System (RMS). In addition, KC- 1 35 flights were conducted to investigate user/workstation/restraint integration for long-duration microgravity use. The scope of these evaluations included workstations and restraints to be utilized in the ISS environment, but also incorporated other workstations/ restraints in an attempt to provide findings/requirements with broader applications across multiple programs (e.g., Shuttle, ISS, and future Lunar-Mars programs). In addition, a comprehensive electronic questionnaire has been prepared and is under review by the Astronaut Office which will compile crewmembers' lessons learned information concerning glovebox and restraint use following their missions. These evaluations were intended to be complementary and were coordinated with hardware developers, users (crewmembers), and researchers. This report is intended to provide a summary of the findings from each of the evaluations.
Author
Microgravity; Human Factors Engineering; Life Sciences; Muscles; Physical Work; Posture; Remote Manipulator System; Visibility

20000020516 Pennsylvania Univ., Dept. of Computer and Information Science, Philadelphia, PA USA
Noninvasive Motion Capture and Analysis
Metaxas, Dimitris, Pennsylvania Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 176-178; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Noninvasive computer-vision methods have begun to play an increasingly important role in applications like anthropometry, human factors design, ergonomics, teleconferencing, virtual reality and performance measurement of both athletes and patients with psychomotor disabilities. All of these areas require the identification of the parts of a human body and/or the estimation of their shape and motion parameters. The main difficulties in developing algorithms for human shape and motion analysis stem from the complex 3D no-n-rigid motions of humans and the occlusion among body parts. The solution to the above problems requires the development of an algorithm that: (1) integrates the processes of segmentation and fitting, (2) allows reliable shape description of the parts, (3) estimates the true location of the joints between the parts, (4) detects multiple joints, (5) copes with the problem of occlusion, (6) makes no assumptions of a prior model or part segmentation, and (7) obviates the need for markers and special equipment. We have developed physics-based vision techniques for the development of algorithms to automatically capture human motion from multiple single and multiple cameras. Using the captured data we can analyze the motions of humans during a variety of applications.
Author
Algorithms; Anthropometry; Computer Vision; Human Factors Engineering; Psychomotor Performance; Virtual Reality

20000020517 NASA Langley Research Center, Hampton, VA USA
Measuring Astronaut Performance in Microgravity: Loads and Modeling
Newman, D., Massachusetts Inst. of Tech., USA; Beck, S., NASA Langley Research Center, USA; Amir, A., Massachusetts Inst. of Tech., USA; Baroni, G., Politecnico di Milano, Italy; Ferrigno, G., Politecnico di Milano, Italy; Pedotti, A., Politecnico di Milano, Italy; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 179-181; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Quantitative analysis of human performance in microgravity is important for both scientific investigations and spacecraft engineering design. By collecting and evaluating the kinematics and kinetics data of astronauts in space, it becomes possible to characterize human motor strategies, postural behavior in weightlessness, improve the design of orbital modules, help maintain a quiescent microgravity for acceleration-sensitive material science and life science experiments (NASA JSC, 1996), and optimize the human operative capabilities during long-duration space missions. Hence, there is a need for a precise measurement of the forces and moments exerted by the astronauts on the space station and their postures and movements.
Author
Astronaut Performance; Human Behavior; Human Performance; Microgravity; Long Duration Space Flight; Quantitative Analysis

20000020551 NASA Ames Research Center, Moffett Field, CA USA
Exercise Training During +Gz Acceleration
Greenleaf, J. E., NASA Ames Research Center, USA; Chou, J. L., Lockheed Martin Corp., USA; Simonson, S. R., Lockheed Martin Corp., USA; Jackson, C. G. R., Fresno State Univ., USA; Barnes, P. R., San Francisco State Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 278; In English; No Copyright; Avail: CASI; A01,

Hardcopy; A06, Microfiche

The overall purpose is to study the effect of passive (without exercise) and active (with exercise) +Gz (head-to-foot) acceleration training, using a short-arm (1.9m radius) centrifuge, on post- training maximal oxygen uptake (VO2 max, work capacity) and 70 deg head-up tilt (orthostatic) tolerance in ambulatory subjects to test the hypothesis that (a) both passive and active acceleration training will improve post-training tilt-tolerance, and (b) there will be no difference in tilt-tolerance between passive and active exercise acceleration training because increased hydrostatic and blood pressures, rather than increased muscular metabolism, will provide the major adaptive stimulus. The purpose of the pilot study was to test the hypothesis that there would be no significant difference in the metabolic responses (oxygen uptake, heart rate, pulmonary ventilation, or respiratory exchange ratio) during supine exercise with moderate +Gz acceleration.

Author

Attitude (Inclination); Blood Pressure; Respiratory Physiology; Physical Exercise; Physiological Responses; Heart Rate

20000020563 University of North Texas Health Science Center, Forth Worth, TX USA

Carotid Baroreflex Function During Prolonged Exercise

Raven, P. B., University of North Texas Health Science Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 305-307; In English

Contract(s)/Grant(s): NAG5-4668; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Astronauts are often required to work (exercise) at moderate to high intensities for extended periods while performing extra-vehicular activities (EVA). Although the physiologic responses associated with prolonged exercise have been documented, the mechanisms involved in blood pressure regulation under these conditions have not yet been fully elucidated. An understanding of this issue is pertinent to the ability of humans to perform work in microgravity and complies with the emphasis of NASA's Space Physiology and Countermeasures Program. Prolonged exercise at a constant workload is know to result in a progressive decrease in mean arterial pressure (MAP) concomitant with a decrease in stroke volume and a compensatory increase in heart rate. The continuous decrease in MAP during the exercise, which is related to the thermoregulatory redistribution of circulating blood volume to the cutaneous circulation, raises the question as to whether there is a loss of baroreflex regulation of arterial blood pressure. We propose that with prolongation of the exercise to 60 minutes, progressive increases on central command reflect a progressive upward resetting of the carotid baroreflex (CBR) such that the operating point of the CBR is shifted to a pressure below the threshold of the reflex rendering it ineffectual in correcting the downward drift in MAP. In order to test this hypothesis, experiments have been designed to uncouple the global hemodynamic response to prolonged exercise from the central command mediated response via: (1) continuous maintenance of cardiac filling volume by intravenous infusion of a dextran solution; and (2) whole body surface cooling to counteract thermoregulatory cutaneous vasodialation. As the type of work (exercise) performed by astronauts is inherently arm and upper body dependent, we will also examine the physiologic responses to prolonged leg cycling and arm ergometry exercise in the supine positions with and without level lower body negative pressure (-10 torr) to mimic spaceflight- related decreases in cardiac filling volumes.

Author

Arteries; Blood Circulation; Blood Pressure; Countermeasures; Heart Rate; Lower Body Negative Pressure; Microgravity; Physical Exercise; Stroke Volume

20000020573 Houston Univ., TX USA

Microbial Monitoring Technology for Long Duration Space Flights

Fox, George E., Houston Univ., USA; Wibbenmeyer, Jamie, Houston Univ., USA; Larios–Sanz, Maia, Houston Univ., USA; Kourentzi, Katerina, Houston Univ., USA; Murphy, Jason C., Houston Univ., USA; Willson, Richard C., Houston Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 335; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Crew health is a dominant issue in space flight. As mission duration and resupply intervals increase it is essential to be able to effectively monitor air and water supplies for gradual or acute buildup of microorganisms. We are developing methods that will allow simultaneous monitoring for multiple bacterial types in space environments.

Author

Health; Long Duration Space Flight; Monitors; Microorganisms

20000020579 NASA Johnson Space Center, Houston, TX USA

Analysis of MIR Condensate and Potable Water

Pierre, L. M., Wyle Labs., Inc., USA; Bobe, L., NIICHIMMASH; Protasov, N. N., RSC-Energia; Sauer, R. L., NASA Johnson Space Center, USA; Schultz, J. R., Wyle Labs., Inc., USA; Sinyak, Y. E., Institute of Biomedical Problems, USSR; Skuratov, V.

M., Institute of Biomedical Problems, USSR; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 345-347; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Approximately fifty percent of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the current Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. The remainder comes from ground supplied potable water that is delivered on a Progress resupply spacecraft, or processed fuel cell water transferred from the Shuttle. Reclamation of water for potable and hygiene purposes is considered essential for extended duration missions in order to avoid massive costs associated with resupplying water from the ground. The Joint U.S/Russian Phase 1 program provided the U.S. the first opportunity to evaluate the performance of water reclamation hardware in microgravity. During the Phase I program, the U.S. collected recycled water, stored water, and humidity condensate samples for chemical and microbial evaluation. This experiment was conducted to determine the potability of the water supplied on Mir, to assess the reliability of the water reclamation and distribution systems, and to aid in developing water quality monitoring standards for International Space Station.

Author

Condensates; Ground Water; Hygiene; Microorganisms; Potable Liquids; Potable Water; Water Quality

20000020594 NASA Johnson Space Center, Houston, TX USA

CO2 Accumulation in the Non-Conformal Helmet of the NASA Launch and Entry Suit During Simulated Unaided Egress

Greenisen, M. C., NASA Johnson Space Center, USA; Bishop, P. A., Alabama Univ., USA; Lee, S. M. C., Wyle Labs., Inc., USA; Moore, A., Wyle Labs., Inc., USA; Williams, J., Wyle Labs., Inc., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 377; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The Launch and Entry Suit (LES) has been worn by astronauts since 1988 for Space Shuttle launch and landing. Previous work indicated that carbon dioxide (CO2) accumulation in the LES non-conformal helmet might be high during locomotion while wearing the LES. The purpose of this study was to characterize the inspired CO2%, metabolic requirements, and egress performance during a simulation of an unaided egress from the Space Shuttle in healthy male subjects wearing the LES and walking on a treadmill. With the helmet visor closed, 12 male subjects completed a 6-min seated prebreathe with 100% O2 followed by a 2-min stand and 5 min of walking at 1.56 m/sec (5.6 km/h, 3.5 mph) as a simulation of unaided egress. All subjects walked with four different G-suit pressures (0.0, 0.5, 1.0, 1.5 psi). After a 10-min recovery, subjects walked 5 min with the same G-suit pressure and helmet visor open for the measurement of metabolic rate (VO2). When G-suit inflation levels were 1.0 or 1.5 psi, only 4 of our 12 healthy, non-micro-gravity exposed subjects completed the unaided egress. Inspired CO2 levels greater than 4% were routinely observed during walking. The metabolic cost at the 1.5 psi G-suit inflation was over 135% of the metabolic cost at 0.0 psi inflation. During unaided egress, G-suit inflation pressures of 1.0 (required inflation for missions greater than 11 days) and 1.5 psi resulted in elevated CO2 in the LES helmet and increased metabolic cost of walking, either of which could impact unaided egress by returning space flight crews.

Author

Carbon Dioxide; Accumulations; Helmets; Metabolism; Microgravity; Simulation

20000020621 NASA Johnson Space Center, Houston, TX USA

Nutrition Session Summary

Lane, Helen, NASA Johnson Space Center, USA; Stein, T. P., Medicine and Dentistry Univ. of New Jersey, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 452-454; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Nutrition deficiencies affect multiple systems including muscle, bone, cardiovascular, renal, and gastrointestinal. Humans require many nutrients, ranging from the macronutrients (water, protein, energy sources) to micronutrients (minerals, vitamins). The ability to withstand shortfalls in intake of individual nutrients ranges from one or two days (e.g., water) to weeks (energy, protein, potassium) and months (some vitamins, minerals). In addition to putting humans at risk for nutrition deficiencies, space flight may also change the absorption, hence the pharmacodynamics, of several important medications. Papers given in this session dealt with all of these nutritional and pharmacological factors related to space flight: (1) Protein metabolism and muscle formation. (2) Pharmacodynamics. (3) Calcium metabolism and bone formation/resorption. and (4) Fluid and electrolytes.

Author

Nutrition; Bone Demineralization; Calcium Metabolism; Vitamins; Proteins; Potassium; Minerals; Electrolytes

20000020624 Cornell Univ., Dept. of Agricultural and Biological Engineering, Ithaca, NY USA

Food System Challenges for Long-Duration Space Missions

Hunter, Jean B., Cornell Univ., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 459-460; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

On long-duration manned space missions food is at once a key habitability issue, a biomedical issue, and an issue of engineering and systems design . As mission duration increases, a bioregenerative lifesupport system becomes more cost-effective than the physico-chemical regeneration systems now used on Shuttle and ISS; however, bioregenerative life support requires growing and processing of in-situ grown crops, treatment of food wastes, and preparation of daily meals, all within severe labor constraints. Though plant production for space missions has been extensively studied, space-compatible technologies for processing crops and preparing ready to eat foods have yet to be developed. These processing and preparation problems constitute a major engineering challenge for food systems in space. The goal of our project is to develop an expandable database of food processing information and a user-friendly optimization system to support informed decisions regarding food processing and preparation for long-duration space missions. We are developing a "bioregenerative cuisine" of 200+ nutritious and appealing dishes that an astronaut crew can prepare and eat during a long- duration mission. This large number is required to provide future crews with a range of dietary choices, and to allow mission management to optimize the menu for closure, labor costs, or other constraints. The dishes include both familiar and novel menu items. Each food is evaluated for palatability, nutrient content and preparation cost in terms of equivalent system mass. The project includes the following components: Development and testing of foods (recipes) intended for a bioregenerative lifesupport system with around 90% food closure. Currently, at the halfway point of the project, around 120 recipes have been tested, with another 120 to be developed. Estimation of labor and equipment costs of food ingredient manufacture from CELSS crops and of food preparation from these ingredients. Our current spreadsheet models predict the portion of food costs traceable to energy, cooling, processing equipment, and non-renewable resources. Labor costs, the most challenging to predict and to scale, are now under study. Evaluation of the acceptability of a chiefly plant-based diet to an omnivorous population, through a 30-day closed feeding study near the end of the project Nutritional analysis of individual foods and ingredients, ongoing with their development Linear programming optimization of the diet to arrive at low-cost diets satisfying given constraints on nutrient content, labor requirements and acceptability of the overall menu. to date we have performed "proof of concept" optimizations and are now working on larger scale runs and sensitivity analyses to predict the marginal cost of food quality, variety, and other habitability criteria for the menu.

Derived from text

Acceptability; Diets; Eating; Food Processing; Long Duration Space Flight; Regeneration (Physiology)

20000020625 NASA Johnson Space Center, Houston, TX USA

Fluid and Electrolyte Nutrition

Lane, Helen W., NASA Johnson Space Center, USA; Smith, Scott M., NASA Johnson Space Center, USA; Leach, Carolyn S., NASA Johnson Space Center, USA; Rice, Barbara L., Enterprise Advisory Services, Inc., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 461; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Studies of fluid and electrolyte homeostasis have been completed since the early human space flight programs, with comprehensive research completed on the Spacelab Life Sciences missions SLS-1 and SLS-2 flights, and more recently on the Mir 18 mission. This work documented the known shifts in fluids, the decrease in total blood volume, and indications of reduced thirst. Data from these flights was used to evaluate the nutritional needs for water, sodium, and potassium. Interpretations of the data are confounded by the inadequate energy intakes routinely observed during space flight. This in turn results in reduced fluid intake, as food provides approximately 70% water intake. Subsequently, body weight, lean body mass, total body water, and total body potassium may decrease. Given these issues, there is evidence to support a minimum required water intake of 2 L per day. Data from previous Shuttle flights indicated that water intake is 2285 +/- 715 ml/day (mean +/- SD, n=26). There are no indications that sodium intake or homeostasis is compromised during space flight. The normal or low aldosterone and urinary sodium levels suggest adequate sodium intake (4047 +/- 902 mg/day, n=26). Because excessive sodium intake is associated with hypercalciuria, the recommended maximum amount of sodium intake during flight is 3500 mg/day (i.e., similar to the Recommended Dietary Allowance, RDA). Potassium metabolism appears to be more complex. Data indicate loss of body potassium related to muscle atrophy and low dietary intake (2407 +/- 548 mg/day, n=26). Although possibly related to measurement error, the elevations in blood potassium suggest alterations in potassium homeostasis. The space RDA for minimum potassium intake is 3500 mg/day. With the documented inadequate intakes, efforts are being made to increase dietary consumption of potassium.

Author

Fluid Dynamics; Electrolytes; Research; Blood Volume; Body Fluids; Homeostasis; Losses; Nutrition

20000020670 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

Wireless Augmented Reality Prototype (WARP)

Devereaux, A. S., Jet Propulsion Lab., California Inst. of Tech., USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 573-575; In English; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Initiated in January, 1997, under NASA's Office of Life and Microgravity Sciences and Applications, the Wireless Augmented Reality Prototype (WARP) is a means to leverage recent advances in communications, displays, imaging sensors, biosensors, voice recognition and microelectronics to develop a hands-free, tetherless system capable of real-time personal display and control of computer system resources. Using WARP, an astronaut may efficiently operate and monitor any computer-controllable activity inside or outside the vehicle or station. The WARP concept is a lightweight, unobtrusive heads-up display with a wireless wearable control unit. Connectivity to the external system is achieved through a high-rate radio link from the WARP personal unit to a base station unit installed into any system PC. The radio link has been specially engineered to operate within the high- interference, high-multipath environment of a space shuttle or space station module. Through this virtual terminal, the astronaut will be able to view and manipulate imagery, text or video, using voice commands to control the terminal operations. WARP's hands-free access to computer-based instruction texts, diagrams and checklists replaces juggling manuals and clipboards, and tetherless computer system access allows free motion throughout a cabin while monitoring and operating equipment.

Derived from text

Wireless Communication; Prototypes; Voice Control; Product Development; Fabrication; Bioinstrumentation; Head-Up Displays; Imaging Techniques; Real Time Operation

20000020684 NASA Johnson Space Center, Houston, TX USA

An EVA Suit Fatigue, Strength, and Reach Model

Maida, James C., NASA Johnson Space Center, USA; Proceedings of the First Biennial Space Biomedical Investigators' Workshop; 1999, pp. 175; In English; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The number of Extra-Vehicular Activities (EVAs) performed will increase dramatically with the upcoming Space Station assembly missions. It is estimated that up to 900 EVA hours may be required to assemble the Space Station with an additional 200 hours per year for maintenance requirements. Efficient modeling tools will be essential to assist in planning these EVAS. Important components include strength and fatigue parameters, multi-body dynamics and kinematics. This project is focused on building a model of the EVA crew member encompassing all these capabilities. Phase 1, which is currently underway, involves collecting EMU suited and unsuited fatigue, strength and range of motion data, for all major joints of the body. Phase 2 involves processing the data for model input, formulating comparisons between the EMU suits and deriving generalized relationships between suited and unsuited data. Phase 3 will be formulation of a multi-body dynamics model of the EMU capable of predicting mass handling properties and integration of empirical data into the model. Phase 4 will be validation of the model with collected EMU data from the Neutral Buoyancy Laboratory at NASA/JSC. Engineers and designers will use tie EVA suit database to better understand the capabilities of the suited individuals. This knowledge will lead to better design of tools and planned operations. Mission planners can use the modeling system and view the animations and the visualizations of the various parameters, such as overall fatigue, motion, timelines, reach, and strength to streamline the timing, duration, task arrangement, personnel and overall efficiency of the EVA tasks. Suit designers can use quantifiable data at common biomechanical structure points to better analyze and compare suit performance.

Author

Extravehicular Activity; Fatigue (Biology); Biodynamics; Data Structures; Predictions; Muscular Strength

20000020999 Biodynamic Research Corp., San Antonio, TX USA

A Personal Computer-Based Head-Spine Model *Final Report, May 1996 - Sep. 1998*

Pancratz, David J., Biodynamic Research Corp., USA; Rogers, Linda J., Biodynamic Research Corp., USA; Bomar, John B., Jr., Biodynamic Research Corp., USA; Sep. 1998; 151p; In English

Contract(s)/Grant(s): F41624-95-C-6010; AF Proj. 3005

Report No.(s): AD-A370895; AFRL-HE-WP-TR-1999-0175; No Copyright; Avail: CASI; A02, Microfiche; A08, Hardcopy

The Head-Spine Model (HSM) originally developed for the UNIX environment was recoded for the personal computer. This recode included code improvements and bug fixes, as well as the development of a graphical interface for creating simulations. The HSM can be used to predict the forces and motions of a human spinal column. The vertebrae are modeled with rigid bodies while hydrodynamic elements model the intevertebral discs. A full set of ligamenteous and active muscular models is also incorporated. External accelerations can be applied to the system and the resulting response calculated. A novel method of

calculating an initial equilibrium position was incorporated. Several simulations of frontal and vertical accelerations were conducted to demonstrate the utility of the software. Along with the HSM, a database of spinal element properties was created. This database can be separately used from the software to determine mass, material, and geometric properties of the spinal elements as derived from a variety of sources in the literature.
DTIC
Computer Programs; Human-Computer Interface; Head (Anatomy); Spine; Computer Techniques

20000021263 Naval Health Research Center, San Diego, CA USA
Comparison of Circumference-and Skinfold-Based Body Fat Estimation Equations *Final Report, Oct. 1993 - Jul. 1998*
Kujawa, K., Naval Health Research Center, USA; Hodgdon, J. A., Naval Health Research Center, USA; November 1998; 17p; In English
Report No.(s): AD-A370117; Rept-98-34; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The U. S. Navy employs equations that use height and body circumferences to estimate percent body fat However, many sailors question the accuracy of the Navy's body fat estimation equations. The Health and Physical Fitness Branch (Pers 601) of the Naval Bureau of Personnel frequently receive; requests to substitute a percent body fat obtained with skinfold- or bioimpedance-based body fat estimation equations (Pets 601, personal communication). There may be a perception that skinfold-bioimpedance-based equations are more accurate than circumference-based equations since the fon= equations are more commonly used in settings such as hub clubs. The purpose of this study was to compare the accuracy of the Navy's circumference-based equations to the accuracy of three well-known skinfolf- and bioimpedance-based equations. Skinfold equations were those of Behnke and Wilmore, Durnin and Womersley, and Jackson and Pollock. Bioimpedance equations were those of Segal et al. and Lohman. Accuracy was compared for both Caucasian and African-American sailors. The criterion for accuracy was percent body fat determined by hydrostatic weighing.
Derived from text
Adipose Tissues; Health; Physical Fitness; Skin (Anatomy); Fat Embolisms

20000021287 School of Aerospace Medicine, Brooks AFB, TX USA
The 1995 Aircrew Operational Vision Survey: Results, Analysis, and Recommendations *Final Report, Oct. 1995 - May 1999*
Baldwin, J. B.; Dennis, Richard J.; Ivan, Douglas J.; Miller, Robert E., II; Belihar, Robert P.; May 04, 1999; 147p; In English
Contract(s)/Grant(s): Proj-7755
Report No.(s): AD-A371597; SAM-AF-BR-TR-1999-0003; No Copyright; Avail: CASI; A02, Microfiche; A07, Hardcopy

The Visual Enhancement and Eye Protection, Integrated Product Team (VEEP-IPT) designed and distributed in early fiscal year 1996 the "1995 Aircrew Operational Vision Survey." This comprehensive, operationally relevant survey with 161 questions was sent to all 31,205 total force, rated, US Air Force aircrew members (Active Duty, Air National Guard, Reserve). The survey included sections on general information, aircrew spectacles, contact lenses, clinic support, sunglasses, aircrew clear, sun, and high contrast visors, laser eye protection, night vision goggles, ballistic protective dust/wind goggles, vision standards, and a section for written comments. The total force return rate was over 55% with 60% of Active Duty aircrew returning their surveys. Data from the 17,282 returned surveys are being used to define aircrew vision problems, prioritize mission deficiencies, validate user requirements, modify aeromedical policy, and establish valid research requirements. Included in this initial report are the results and analysis of responses from the returned surveys. Survey questions and the raw question by question results are included as Appendices 1 and 2. Selected data have been compiled and cross-correlated, and are found in Appendix 3. The data provide a cross-section of aircrew demographics and opinions, and highlight critical vision and safety issues. Each section has a summary of VEEP-IPT recommendations and recognition of safety of flight issues. Data are maintained in an accessible database at the Ophthalmology Branch at Brooks AFB, and efforts are under way to continue analysis and cross-correlation of the data, including 3400 hand written comments.
DTIC
Surveys; Flight Crews; Eye Protection; Aerospace Medicine

20000021348 Institute for Human Factors TNO, Technische Menskunde, Soesterberg, Netherlands
Fit of the Gentex Jet Helmet with Viper and ITT Night Vision Goggles *Final Report Pasvorm van de Gentex Jachtvliegerhelm met het Viper en ITT Nachtzichtsysteem*
Daanen, H. A. M., Institute for Human Factors TNO, Netherlands; Dec. 27, 1999; 32p; In Dutch; Original contains color illustrations
Contract(s)/Grant(s): A99/KLu/354; TNO Proj. 789.2

Report No.(s): TD99-0374; TM-99-A084; Copyright; Avail: Issuing Activity, Hardcopy

The Royal Netherlands Air Force has the intention to acquire night vision goggles for F-16 pilots. Two systems are considered: the Viper of Delft Instruments and ITT from the US. Both test pilots experienced serious headaches when using the Viper system. It is investigated if improper fit of the helmet with the Viper system is a possible explanation for this problem. Therefore, the two test pilots were scanned with and without helmets with the ITT and Viper night vision goggles using 3D scans. After proper alignment of the scans, the positioning of the helmets on the head can be visualized and investigated. The position of the helmet remained unchanged when an ITT system was added to the helmet. The Gentex helmet, however, rotated forward by about 5 degrees when a Viper system was connected to it. Adding a counter weight did not change the helmet position as compared to the situation without counter weight. Possible explanations for the different position of the Gentex helmet with Viper system on the head are: poor optic adjustability leading to helmet adjustments, differences in the head connection system of the Gentex with Viper system and the Gentex with or without ITT system. the increased weight and moment of the Viper compared to ITT, leading to forward rotation. The latter argument is less likely since a counter weight did not change the position of the helmet @vith the Viper system. Probably, the forward rotation of the helmet with Viper system resulted in an increased pressure on the forehead and may partially explain the occurrence of head aches.

Author

Scanners; Goggles; Forehead; Alignment; Helmets

20000021356 Institute for Human Factors TNO, Soesterberg, Netherlands

Human Modelling Systems in Ship Design, Phase 1, Ship Design and Human Factors ***Interim Report Mensmodellen in Het Scheepsontwerpproces, Fase 1, Scheepsontwerp en Ergonomie***

Punte, P. A. J., Institute for Human Factors TNO, Netherlands; Hin, A. J. S., Institute for Human Factors TNO, Netherlands; Dec. 02, 1999; 90p; In Dutch

Contract(s)/Grant(s): A98/KM/352; TNO Proj. 789.1

Report No.(s): TD99-0369; TM-99-A079; Copyright; Avail: Issuing Activity

As a part of the project, the possibilities for the application of human modelling systems at the department MARTECH of the Royal Netherlands Navy were investigated. The aim of this project is to investigate which human modelling systems can be integrated into the design process of ships. The systems should have an added value to the existing ergonomic analysis tools which are used during the design process at the Royal Netherlands Navy. For each phase in this design process of ships, a list of ergonomic aspects has been made which are of importance during that part of the design process. Furthermore, an overview of ergonomic analysis tools has been made, i.e. design drawings and models, handbooks and norms, human modelling systems, mock-ups, virtual environments and hybrid mock-ups. For each phase in the design processes of ships, the most useful and efficient tools are selected. It is concluded that human modelling systems have an added value to the design process of ship as performed by MARTECH, especially during the design of layouts of rooms and the design of workstations. Human modelling systems offer the designer ergonomic information during the design process which makes it possible to base design decisions on technical as well as ergonomical requirements. This decreases the chance of making design mistakes which are hard to correct in a later phase of the design process. Human modelling systems are not able to replace other ergonomic tools completely. to evaluate a design using scenarios in which several operators play their role, the application of mock-ups is the best alternative. to evaluate outside views, for instance from a ship bridge, virtual environments or hybrid mock-ups are to be preferred. For part two of the project 'Human modelling systems for ship design processes', it is recommended to compare existing human modelling systems within the framework of their application in the design process of ships at MARTECH.

Author

Human Factors Engineering; Models; Ships; Design Analysis

20000021357 Institute for Human Factors TNO, Soesterberg, Netherlands

Workstation Design, Lighting Conditions/ Visual Information Presentation, and Indoor Climate at CAWCS: Bottlenecks and Recommendations ***Final Report Werkplekinrichting, Verlichting/Visuele Informatiepresentatie en Binnenklimaat Bij CAWCS: Knelpunten en Aanbevelingen***

Delleman, N. J., Institute for Human Factors TNO, Netherlands; vanBergem, P. M., Institute for Human Factors TNO, Netherlands; Varkevisser, J., Institute for Human Factors TNO, Netherlands; denHartog, E. A., Institute for Human Factors TNO, Netherlands; Nov. 04, 1999; 40p; In Dutch

Contract(s)/Grant(s): A99/KM329; TNO Proj. 789.1

Report No.(s): TD99-0360; TM-99-A071; Copyright; Avail: Issuing Activity

Within the framework of the obligatory risk assessment on working conditions the Centre for Automation of Weapon and Command Systems JCAWCS) of the Royal Netherlands Navy asked TNO Human Factors Research Institute to assess the

bottlenecks concerning workstation design, lighting conditions / visual information presentation, and indoor climate at CAWCS, as well as to give recommendations for improvement if necessary. The bottlenecks on the above mentioned areas were determined by means of a questionnaire that was filled out by the employees, followed by dedicated data acquisition during worksite visits. On the basis of the musculoskeletal complaints mentioned by the employees it is recommended to replace the current 'mixed' workstations each gradually by two workstations, i.e. one for the VDU (video display unit), and one for other deskwork (reading, writing, phoning, etcetera). Besides purchasing document holders and proper supports for the VDU screens, it is strongly recommended to search for significantly less wide keyboards (with functions and numerics on the upper rows). On the basis of the bottlenecks concerning lighting conditions and visual information presentation, it is recommended to provide the rooms at the front side of the building with sunshades, and to position the workstations in the rooms such that the viewing direction of a VDU user is parallel to the windows. On the basis of the climate problems in the building it is recommended to build in a climate control system. As the employees are most dissatisfied with the indoor climate, it is recommended to give priority to the climate control system if the recommendations above have to be carried out one after the other.
Author
Design Analysis; Workstations; Illuminating; Visual Perception; Indoor Air Pollution; Climate; Human Factors Engineering; Display Devices

20000021358 Prins Maurits Lab. TNO, Rijswijk, Netherlands
Evaluation of Eight Kinds of Decontamination Suits *Final Report Evaluatie van Acht Soorten Ontsmetterskleding*
Oudmayer, H. F. G., Prins Maurits Lab. TNO, Netherlands; November 1999; 25p; In Dutch
Contract(s)/Grant(s): TNO Proj. 014.11404
Report No.(s): TD99-0149; PML-1999-A54; Copyright; Avail: Issuing Activity

At the request of a section of the Dutch army (LBBKL KPU), eight kinds of decontamination suits meant for single use have been evaluated. It was assessed whether the suits would meet the most important demands as posed by the the KPU department. The tests were split up roughly into three categories: ergonomical evaluation of the suits as a whole (performed by TNO Human Factors) and chemical and physical - mechanical evaluation of the material and its interconnections (performed by TNO Prins Maurits Laboratory and TNO Industry). None of the types met all the requirements. Based on the burst-, pull and tear strength and the adhesion of the coating, the Geomet suit and the Boye suit qualify positively compared to the other suits. Both suits are thicker; with the Geomet suit just exceeding the demand on the thickness with, at the same time, a little more weight compared to the other suits (weight just within the demand). The CGF suit, qualified best by TNO Human Factors, shows good protection against chemical warfare agents but is not strong enough. The suit qualified 3rd by TNO Human Factors, also is not strong enough and additionally shows penetration by Lewisite. The Geomet suit is recommended based on the investigated technical aspects. The protection offered by the suit was decisive for this recommendation.
Author
Decontamination; Suits; Protective Clothing; Human Factors Engineering

20000021430 Institute for Human Factors TNO, Soesterberg, Netherlands
The Feasibility of a Three-Crew Concept for the NFH90: Exploring Workload Bottlenecks (TNO-HFRI Part of Study) *Final Report De Haalbaarheid van een Drie-Mans Concept voor de NFH90: Onderzoek Naar Werkbelastingsproblemen (TNO-TM-Deel)*
Veltman, J. A., Institute for Human Factors TNO, Netherlands; Nov. 18, 1999; 28p; In English
Contract(s)/Grant(s): A96/KM/327; TNO Proj. 788.1
Report No.(s): TD99-0365; TNO-TM-99-A075; Copyright; Avail: Issuing Activity

An experiment was conducted by the TNO Human Factors Research Institute and the National Aerospace Laboratory (NLR) in the tactical trainer of the Orion in order to get insight into the tasks and the workload of tactical coordinators (TACCOs). This report presents the results of the TNO part of the study only. The Lynx helicopter will be replaced by the NFH90 within a few years. To determine the feasibility of a three crew concept, similar to the Lynx helicopter, several studies commissioned by the Royal Netherlands Navy are (and will be) conducted to get insight into the workload of the future crew. The TACCO in the Orion works with a display for tactical information. Because the TACCO in the NFH90 will also work with information displays, the present study focuses on the workload and tasks of an Orion TACCO. During an anti submarine warfare (ASW) and anti surface warfare (ASUW) mission the workload was measured of an experienced and inexperienced TACCO with physiological measures (heart rate, respiration and eye blinks). The missions were recorded on videotape. After the missions the TACCOs analysed the mission by means of a special purpose computer program. They indicated the moments during which tasks were executed and gave ratings of the workload and the amount of routine handling each minute. Together with the physiological recordings, this provided time lines of tasks and workload. The data indicated that the TACCOs had the highest workload before and directly after

an attack in an ASW mission. The joining segment of the ASW mission and an ASUW mission were far less demanding. The attack during an ASW mission was demanding because this situation is always unique and therefore, no standard procedures can be obtained. Further- more, the TACCOs have to interpret a lot of information with a high level of uncertainty. The work of the TACCO in the NFH90 will change from actively controlling instruments and retrieving information to managing large amounts of information. The workload of the TACCO in the NFH90 will depend on the level of equipment automation that can be obtained and the level of management that is required for adequate task performance. Future studies will address these issues.
Author
Helicopters; Human Factors Engineering; Physiology; Workloads (Psychophysiology)

20000021487 NASA Ames Research Center, Moffett Field, CA USA
NASA Task Load Index (TLX), Volume 1.0, Computerized Version
Hart, Sandra G., NASA Ames Research Center, USA; 1986; 26p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This booklet and the accompanying diskette contain the materials necessary to collect subjective workload assessments with the NASA Task Load Index on IBM PC compatible microcomputers. This procedure for collecting workload ratings was developed by the Human Performance Group at NASA Ames Research Center during a three year research effort that involved more than 40 laboratory, simulation, and inflight experiments Although the technique is still undergoing evaluation, this package is being distributed to allow other researchers to use it in their own experiments Comments or suggestions about the procedure would be greatly appreciated This package is intended to fill a "nuts and bolts" function of describing the procedure. A bibliography provides background information about previous empirical findings and the logic that supports the procedure.
Author
Workloads (Psychophysiology); Human Performance; Bibliographies

20000021488 NASA Ames Research Center, Moffett Field, CA USA
NASA Task Load Index (TLX), Volume 1.0, Paper and Pencil Package
Hart, Sandra G., NASA Ames Research Center, USA; 1986; 26p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This booklet contains the materials necessary to collect subjective workload assessments with the NASA Task Load Index. This procedure for collecting workload ratings was developed by the Human Performance Group at NASA Ames Research Center during a three year research effort that involved more than 40 laboratory. simulation. and inflight experiments. Although the technique is still undergoing evaluation. this booklet is being distributed to allow other researchers to use it in their own experiments. Comments or suggestions about the procedure would be greatly appreciated. This package is intended to fill a "nuts and bolts" function of describing the procedure. A bibliography provides background information about previous empirical findings and the logic that supports the procedure.
Author
Workloads (Psychophysiology); Human Performance; Bibliographies

20000024872 Institute of Space Medico-Engineering, Beijing, China
An Experimental Study of the Sabatier CO2 Reduction Subsystem for Space Station
Li, Jun, Institute of Space Medico-Engineering, China; Ai, Shang–Kun, Institute of Space Medico-Engineering, China; Zhou, Kang–Han, Institute of Space Medico-Engineering, China; Space Medicine and Medical Engineering; Apr. 1999; ISSN 1002-0837; Volume 12, No. 2, pp. 121-124; In Chinese
Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective of this study was too develop and fabricate a prototype Sabatier CO2 reduction subsystem for long duration manned space missions. The rationale, equipment and function of the CO2 reduction subsystem were introduced. Groundbased experiments with CO2 flows equivalent to a crew size of 3 persons were conducted to verify the operation performance of the prototype. The start-up temperature is less than 165 C when the start-up time is 14 minutes; the lean component H2/CO2 conversion efficiency is over 95 percent when H2/CO2 molar ratios is 1.9 to about 5.0. The water produced is nearly colorless and neutral. The prototype Sabatier CO2 reduction subsystem is simple in operation and the test results showed that design goals were achieved.
Author
Carbon Dioxide; Manned Space Flight; Space Stations; Bioprocessing; Life Support Systems; Spacecraft Environments; Bioastronautics; Decontamination; Carbon Dioxide Removal; Air Purification

20000024934 Beijing Univ. of Aeronautics and Astronautics, Beijing, China

The Present Status and Development of Thermal Control System of Spacesuits for Extravehicular Activity

Zhao, Chao–Yi, Beijing Univ. of Aeronautics and Astronautics, China; Sun, Jin–Biao, Beijing Univ. of Aeronautics and Astronautics, China; Yuan, Xiu–Gan, Beijing Univ. of Aeronautics and Astronautics, China; Space Medicine and Medical Engineering; Apr. 1999; ISSN 1002-0837; Volume 12, No. 2, pp. 149-153; In Chinese

Report No.(s): CN-11-2774/R; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

With the extension of extravehicular activity(EVA) duration, the need for more effective thermal control of EVA spacesuits is required. The specific schemes investigated in heat sink system for EVA are discussed, including radiator, ice storage, metal hydride heat pump, phase-change storage/radiator and sublimator. The importance and requirements of automatic thermal control for EVA are also discussed. Existing automatic thermal control for EVA are reviewed. Prospects of further developments of thermal control of spacesuits for EVA are proposed.

Author

Extravehicular Activity; Space Suits; Temperature Control; Cooling Systems; Heat Sinks; Thermal Absorption

20000025225 Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Bureau for Biotechnology, Zeist, Netherlands

Modernization Military Rations, Part 5, Nutritional Need Under Hot Environments during Military Field Operations *Final Report Modernisering Ratsoenen, Deel 5, Voeding Bij Militaire Operaties Onder Warme Klimatologische Omstandigheden*

vanErp–Baart, A. M. J., Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Netherlands; November 1999; 45p; In Dutch

Contract(s)/Grant(s): A97/KL/105; TNO Proj. 70155.01.03

Report No.(s): TD99-0352; TNO-Voeding-V99.886; Copyright; Avail: Issuing Activity

Information on Dutch military actions in hot climates is limited. Therefore the handbook 'Nutritional needs in hot environments' edited by Marriot is used as the primary source for formulating the nutritional requirements of military rations in hot climates. Information about Dutch military action, held yearly in Spain in July, forms the basis for the establishment of level of energy expenditure in hot weather conditions. These figures are compared to values from the literature. The need for water is briefly discussed, because of its importance and its influence on the composition of the military rations. Finally a model is introduced to calculate risks for heat injuries whilst planning military actions.

Author

Hot Weather; Nutritional Requirements; Rations; Nutrition

20000025228 Defence Science and Technology Organisation, Electronics and Surveillance Research Lab., Salisbury, Australia

Protocol Analysis as a Tool in Function and Task Analysis

Lees, Catherine; Manton, Jeremy; Triggs, Tom; Oct. 1999; 50p; In English

Report No.(s): AD-A371883; DSTO-TR-0883; DODA-AR-011-105; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A protocol is a record of procedural steps undertaken in a process. In studying human-machine systems, observations of human operators obtained from sources such as videotapes are coded to create a descriptive protocol of behaviours, task elements, goals, etc. This record is essentially sequential in nature, but methods for analysing sequential data are relatively new. The kinds of information that protocol analysis can provide, that might be useful in function/task analysis, are examined. Methods for analysing sequences are surveyed, and recent developments in using minimum message length methods for producing probabilistic finite state automaton models of sequential behaviour are discussed.

DTIC

Man Machine Systems; Functional Analysis; Operators (Personnel); Functions (Mathematics)

20000025324 Civil Aeromedical Inst., Oklahoma City, OK USA

Testing the Structural Integrity of the Air Force's Emergency Passenger Oxygen System at Altitude *Final Report*

Garner, Robert P., Civil Aeromedical Inst., USA; Murphy, Richard E., Civil Aeromedical Inst., USA; Donnelley, Steve S., Army Test and Evaluation Command, USA; Thompson, Ken E., Army Test and Evaluation Command, USA; Geiwitz, Kevin L., Army Test and Evaluation Command, USA; February 2000; 14p; In English

Report No.(s): DOT/FAA/AM-00/6; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The chemical bond attaching the elastic neck seal to the body of the protective breathing equipment (PBE) procured by the U.S. Air Force as an emergency passenger oxygen System (EPOS) was alleged to be inadequate to allow the PBE to perform as intended at altitude. to test this possibility, EPOS units were collected from Air Force Bases and systematically tested at altitude.

The Civil Aeromedical Institute was requested to participate in the testing through the FAA Office of the Inspector General and the U.S. Air Force's Office of Special Investigations due to the Institute's longstanding expertise in the area of PBE. Eighty-four of the EPOS units collected were divided into four groups of 21. Since the PBE in question were of relatively recent manufacture, three of the four groups were artificially aged. Altitude testing was conducted in a hypobaric chamber at a simulated altitude of 40,000 feet above sea level. An EPOS unit from each of the "aged" groups was placed on one of the four mannequin heads that were instrumented for monitoring pressure, temperature, and atmospheric gas concentrations. The EPOS units were activated at altitude with the primary data collection continuing for a minimum of five minutes after activation. The neck seal/hood interface did not fail on any of the 84 devices during altitude exposure. A destructive test series conducted on an additional 16 EPOS units indicated that an internal pressure approximately six times that observed at altitude was required to result in structural failure of the EPOS units. Based on the data collected in the performance of these tests, the neck seal/hood body interface bond utilized in the construction of these devices is sufficient to allow the PBE to perform as intended at altitude.
Author
Breathing Apparatus; Oxygen Supply Equipment; Passengers; Life Support Systems; Emergency Life Sustaining Systems; Survival Equipment; Destructive Tests

20000025449 Institute for Human Factors TNO, Soesterberg, Netherlands
The Effects of Monocular and Binocular Nightvision Devices on Driving Behaviour and Comfort *Interim Report De effecten van monoculaire en binoculaire helderheidsversterkers op het rijgedrag en comfort*
VanWinsum, W.; Kooi, F. L.; Nov. 22, 1999; 32p; In Dutch
Report No.(s): AD-A372685; TNO-TM-99-A077; TDCK-TD99-0368; No Copyright; Avail: Defense Technical Information Center (DTIC)

Under contract of the Royal Dutch Army, a field experiment was conducted in which night-time driving with monocular and binocular night vision goggles (NVGs) was tested in rough terrain. The effects of the NVGs was tested on driving behavior and on various aspects of comfort. The results give answer to a number of questions that were raised concerning the optimal configuration of NVGs while driving at night. Drivers are able to drive safely at night with binocular night vision devices, also with a binocular alignment error. No serious problems related to a lack of wearing comfort or visual comfort were found. Driving with a monocular NVG results in equally good performance. However, some of the drivers were not able to complete the two hour session, implying that binocular devices are more suitable for prolonged driving. Also. the visual comfort was rated lower for the monocular NVG.
DTIC
Night Vision; Human Factors Engineering; Monocular Vision; Binocular Vision; Goggles

20000025767 Civil Aeromedical Inst., Oklahoma City, OK USA
The Human Factors Analysis and Classification System-HFACS *Final Report*
Shappell, Scott A., Civil Aeromedical Inst., USA; Wiegmann, Douglas A., Illinois Univ., USA; February 2000; 22p; In English
Contract(s)/Grant(s): AAM-A-00-HRR-520; 99-G-006
Report No.(s): DOT/FAA/AM-00/7; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Human error has been implicated in 70 to 80% of all civil and military aviation accidents. Yet, most accident reporting systems are not designed around any theoretical framework of human error. As a result, most accident databases are not conducive to a traditional human error analysis, making the identification of intervention strategies onerous. What is required is a general human error framework around which new investigative methods can be designed and existing accident databases restructured. Indeed, a comprehensive human factors analysis and classification system (HFACS) has recently been developed to meet those needs. Specifically, the HFACS framework has been used within the military, commercial, and general aviation sectors to systematically examine underlying human causal factors and to improve aviation accident investigations. This paper describes the development and theoretical underpinnings of HFACS in the hope that it will help safety professionals reduce the aviation accident rate through systematic, data-driven investment strategies and objective evaluation of intervention programs
Author
Aircraft Accident Investigation; Aircraft Accidents; Data Bases; Human Factors Engineering; Human Performance; Pilot Error

20000026305 NASA Johnson Space Center, Houston, TX USA
Evaluation of RME 1318/TVIS Configuration C New ISS Restraint Harness and Modified Subject Load Device (SLD)
Bostick, Laura L., Wyle Labs., Inc., USA; Schmalholz, Don, NASA Johnson Space Center, USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 7-10; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Although the treadmill system had flown numerous times on the KC-135 and on the Shuttle, the new Treadmill (TM) Subject Restraint System had not been tested in zero-gravity conditions. The objectives of this investigation were:(1) To evaluate the New ISS Restraint Harness and Modified Subject Load Device (SLD) for physical comfort, stability, and effectiveness for exercise at different restraint loads; (2) to compare load variance of the modified SLDs which will fly on STS-93 and ISS (cam design) vs. the SLDs which flew on STS-81 and STS-84 (constant-radius hub design); (3) to identify operational constraints with the cam design SLDS.
Author
Harnesses; Treadmills; Weightlessness; Safety Devices

20000026310 NASA Johnson Space Center, Houston, TX USA
Ergonomic Evaluation of the Foot Restraint Equipment Device (FRED)
Whitmore, Mihriban, Lockheed Martin, USA; Chmielewski, Cindy, Lockheed Martin, USA; Qazi, A. S., Lockheed Martin, USA; Mount, Francis, NASA Johnson Space Center, USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 25-30; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Within the scope of the Microgravity Workstation and Restraint Evaluation project, funded by the NASA Headquarters Life Sciences Division, evaluations were proposed to be conducted in ground, KC-135, and/or Shuttle environments to investigate the human factors engineering (HFE) issues concerning confined/unique workstations, including crew restraint requirements. As part of these evaluations, KC-135 flights were conducted to investigate user/ workstation/ restraint integration for microgravity use of the FRED with the RMS workstation. This evaluation was a pre-cursor to Detailed Supplementary Objective (DSO) - 904 on STS-88. On that mission, a small-statured astronaut will be using the FRED restraint while working at the Aft RMS workstation. The DSO will collect video for later posture analyses, as well as subjective data in the form of an electronic questionnaire. This report describes the current FRED KC-135 evaluations. The primary objectives were to evaluate the usability of the FRED and to verify the DSO in-flight setup. The restraint interface evaluation consisted of four basic areas of restraint use: 1) adjustability; 2) general usability and comfort; 3) usability at the RMS workstation; and 4) assembly and disassembly.
Author
Astronauts; Confinement; Human Factors Engineering; Microgravity; Crew Workstations

20000026313 Wyle Labs., Inc., Life Sciences, Houston, TX USA
KC-135 Hardware Evaluation of the HRF Lower Body Negative Pressure Device
Collier, Kevin, Wyle Labs., Inc., USA; Nobmann, Peter, Daimler-Benz Aerospace; KC-135 and Other Microgravity Simulations; August 1999, pp. 48-50; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The Lower Body Negative Pressure (LBNP) system is an instrument that encloses the lower body of the test person within a tubular structure and allows the application of a pressure differential inside the system lower than the ambient environment. The pressure differential causes a redistribution of body fluids in the microgravity environment comparable to the fluid distribution that occurs in the upright position in the 1-g environment.
Author
Body Fluids; Lower Body Negative Pressure; Microgravity; Bioastronautics

20000026318 Colorado State Univ., Fort Collins, CO USA
Undergraduate Program Flights: Physiologic Testing of a Constant Force Resistive Exercise Unit in Microgravity
Ruttley, Tara, Colorado State Univ., USA; Colosky, Paul, Jr., Colorado State Univ., USA; Dory, Johnathan, Colorado State Univ., USA; Zenter, Jack, Colorado State Univ., USA; Tong, Timothy, Colorado State Univ., USA; Sutlive, Vinson, Colorado State Univ., USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 73-79; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

As the future of the space program promises long-term exploration missions, lunar habitation, and the building of the space station, production of reliable countermeasures for muscle atrophy and bone calcium loss in microgravity has become increasingly essential. Since typical weight stacks are useless in microgravity, a similar means by which to provide constant force during eccentric and concentric contraction is necessary during exercise. The KC-135 flight provided a valuable means by which to validate the Modified Constant Force Resistive Exercise Unit (CFREU-A) and the unique force pack design in microgravity. SEMG data reflected real-time muscle response during in-flight and ground-based exercise, and force gauge readings validated the constant force capabilities of the constant torque springs within each uniquely designed force pack. As we expected, SEMG data and force gauge data indicate that the force packs within the CFREU-A performed as well as the weight stacks on the Cybex

unit, both in microgravity and on the ground. The constant torque springs within each force pack maintained their resistance level and a constant force over the entire range of each exercise. SEMG data concerning concentric and eccentric contractions further validated the force packs within the CFREU-A as a means by which to obtain an effective strengthening routine both in microgravity and on the ground.
Derived from text
Countermeasures; Microgravity; Muscular Function; Physical Exercise; Bioastronautics

20000026327 Longview High School, Longview, TX USA
"Fly High" Program: Human Interface Demonstration
Grubbs, Amanda, Longview High School, USA; Mayes, Jason, Longview High School, USA; Lawson, Bryan, Longview High School, USA; Welge, Kirsten, Longview High School, USA; Robinett, Don, Longview High School, USA; Pope, Ruth Ann, Longview High School, USA; Moore, Alicia, Longview High School, USA; Shivers, Suzette, Longview High School, USA; Beene, Rachel, Longview High School, USA; Zountendam, Michel, Longview High School, USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 117-120; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The goal of this experiment was to determine which of the four Interface Control Devices (ICDs) performed the best in a zero-G environment, based on accuracy maneuverability, and comfort. The objective of the flight tests in the KC-135 and the ground tests in the X-38/CRV Remote Cockpit Van were to evaluate the four different ICDS: Smart Cat Touchpad, NEcrosoft SideWinder 3D-Pro Joystick, Microsoft SideWinder Gamepad, and the Logitech Trackman Marble (Optical Trackball). The major design issues that were addressed during this experiment were the ability to maneuver the ICDS, how easily they handled blind operations, and comfort in micro-gravity.
Author
Control Equipment; Maneuverability; Microgravity; Weightlessness; Spacecraft Control; Indicating Instruments

20000026330 Van Alstyne High School, Van Alstyne, TX USA
"Fly High" Program: Night Cap Monitor
Dobbins, Miriam, Van Alstyne High School, USA; Dyer, Rusty, Van Alstyne High School, USA; Haddox, Ashley, Van Alstyne High School, USA; Potter, Heather, Van Alstyne High School, USA; Taylor, Erin, Van Alstyne High School, USA; Taylor, Daniel, Van Alstyne High School, USA; Sauer, Lizabeth, Van Alstyne High School, USA; Butcher, Toni, Van Alstyne High School, USA; Powers, Whitney, Van Alstyne High School, USA; Mosca, Jessica, Van Alstyne High School, USA; KC-135 and Other Microgravity Simulations; August 1999, pp. 128-133; In English; See also 20000026303; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The goals of this investigation are to measure head motion during micro-gravity in duplication of an experiment aboard the Mir, to make the accelerometer more comfortable, and to make sure the accelerometer works in microgravity conditions
CASI
Accelerometers; Microgravity; Head Movement

Subject Term Index

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Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA/SP—2000-7011/SUPPL498		

4. Title and Subtitle	5. Report Date
Aerospace Medicine and Biology A Continuing Bibliography (Supplement 498)	March 2000
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
	10. Work Unit No.
9. Performing Organization Name and Address	
NASA Scientific and Technical Information Program Office	11. Contract or Grant No.

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
National Aeronautics and Space Administration Langley Research Center Hampton, VA 23681	Special Publication
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This report lists reports, articles and other documents recently announced in the NASA STI Database.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Aerospace Medicine Bibliographies Biological Effects	Unclassified – Unlimited Subject Category – 52

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	144	

For sale by the NASA Center for AeroSpace Information, 7121 Standard Drive, Hanover, MD 21076-1320