The No-Input Syndrome: From Space to Patient

Franz Gerstenbrand, Austria

Not the first step on the moon but the abandoning of the earth atmosphere using rockets was the greatest adventure of the human beings. With the decision to start entering in the orbit the human brain lost the important information of the gravidy in weightlessness .The reaction of the human organism was open. The research started with animal tests. The first was Leika, a Siberian dog, sent 1957 into orbit, followed by a chimpanzee, the "Astro Chimp". These first tests with anima beings were successful. The first man in space was Juri A. Gagarin, only a few weeks later A. Shepard followed, mankind entered the space. In the MIR Space station many new experiments could be performed. The modern orbit base station, the ISS, is used from an international crew.

Space medicine was started with the important activities of Inessa Kozlovskaya and Anatoly Grigoriev. Oleg Georgevic Gazenko introduced examinations on earth in simulated micro-gravity using the Bed Rest Method and the Dry Water Immersion Method. Special space research on men can be performed in ground base laboratories on earth.

A not surprising result was the insight of the dysfunction of the proprioceptive system as the main disturbance. The Space Adaptation Syndrome during the start of the rocket shows only initial problems, which will be compensated after a short time in the stable weightlessness. Countermeasures for the Astronauts/Cosmonauts to diminish the disturbances during the space flight had to be developed. The newly created methods and devices were incorporated in the neurorehabilitation. In daily medicine the consequences of simulated microgravity developing after long lasting bed stay, called Bed Rest Syndrome, have to be observed as a severe disturbing complication.

This new field is in need of new treatment methods and activities for prevention.

Tuesday, September 24, 2013

11:00-12:30 | **Hall E**

Climate and the Global Change

A presentation of the World Federation of Neurology's Applied Research Group on Environmental Neurology

Chairpersons: **J. Reis**, *France*
F. Gerstenbrand, *Austria*

11:00 **THE WEST NILE VIRUS STORY**
G. Roman, *USA*

11:30 **THE NO INPUT SYNDROME: FROM SPACE TO PATIENT**
F. Gerstenbrand, *Austria*

12:00 **NEUROLOGICAL CONSEQUENCES OF RADIATION: THE JAPANESE EXAMPLE**
Y. Ogawa, *Japan*

12:30 Lunch Break, Poster and Exhibition Visit

11:00-12:30 | **Hall F**

Interventional Neuroradiology

Chairpersons: **W. Hacke**, *Germany*
L. Csiba, *Hungary*

11:00 **NEW TECHNIQUES AND DATA IN THE INTERVENTIONAL THERAPY OF RUPTURED ANEURYSM**
P. Lylyk, *Argentina*

11:20 **THE NEED OF RANDOMIZED EVIDENCE FOR RECANALIZATION DEVISES - A GENERAL STATEMENT**
W. Hacke, *Germany*

11:40 **STATUS AND PRELIMINARY RESULTS OF IMS III**
J. Broderick, *USA*

12:00 **SWIFT, A RANDOMIZED COMPARISON BETWEEN MERCI AND SOLITAIRE**
O. Zaidat, *USA*

12:30 Lunch Break, Poster and Exhibition Visit

XXI WORLD CONGRESS OF NEUROLOGY

WCN 2013

XXI WORLD CONGRESS OF NEUROLOGY

Vienna, Austria, 21-26 September 201

EFNS EUROPEAN FEDERATION OF NEUROLOGICAL SOCIETIE

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The No-Input Syndrome: From Space to Patient

F. Gerstenbrand

Karl Landsteiner Institute for Neurorehabilitation and Space Neurology

XXI World Congress of Neurology

Environmental Neurology Research Group's sessions at the WCN

Climate and the Global Change

September 21-25, 2013

Vienna

The Input Syndrome - I

- J.Ayres „Sensory Integration and Learning Disorders" (1973)
- C.Kranowitz, L.Silver: „The Out-of-Sync-Child, recognizing and coping with sensory integration dysfunction" (1998)

- Dysfunction of sensory integration in all sensory systems, auditory, olfactory and gustatory, vestibular, proprioceptive system, tactile system

Normal condition: Well functioning sensory integration to use the own body effectively within the environment.

Disturbance of the sensory interpretation, sensory integration disorder (SID)

The Input Syndrome - II

- Clincial symptoms:
  - Disturbance in body position (trunk, head, extremities, disturbed body awareness and body movements
  - Hypersensitivity/Hyposensitivity
  - Behavioural disturbances with emotional resonance
- Symptoms of a posterior thalamus syndrome, mainly influenced by the dysfuntion of the proprioceptive system

Human Brain Function in Weighlessness

- Reduced and disturbed function of the proprioceptive system
- Guidance of the visual and auditory system
- Increased influence on the tactile system
- Changement in all vital functions
- In weightlessness not fully adapted in the first phase
- Habituation of body control during flights
- Psychological factors influencing brain functions

Prerequisites for Human Space Missions

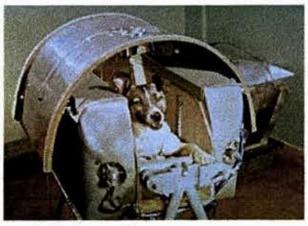
- Development of technical equipment
- Communication system with ground based control centers
- Solution of biomedical problems in manned space mission
  - biophysiological exposure
  - radiation exposure

Research in manned Space Missions Preparation for Human Beings

- Biological predisposition for a stay out of earth gravity
- Adaptation to microgravity (weightlessness)
- Selection, preparation and training of the crew for space flights
- Countermeasures for pathophysiological problems during space flight
- Readaption program after return to earth gravity

History of Space Medicine I

- Take-over of experiences from aviation medicine
- Special Research Institute for Biomedical Problems (IBMP), Moscow, Russia (1950)
- Department for Space Medicine in Randolphsville, TX, USA (1951)
- Animal experiments in the orbit)
- Laika, first dog in space (1957, IBMP Moscow)
- Ham, the Astro Chimp (1962, NASA)



Laika, Nov 3rd,1957

„Ham the Astrochimp", Jan 31st, 1962

History of Space Medicine II

- April 12th, 1961 - Juri A. Gagarin
  first manned space flight, space capsule Wostok 1
- May 5th, 1961- A. Shepard
  first American in space,
- March 18th, 1965 - Alexei Leonov
  first space walk
- July 16th, 1969 - first moon landing
- July 20th, 1969 - Neil Armstrong,
  first moon walk
- Feb 20nd, 1986 - start of space station MIR
  (base module)
- Nov 20nd, 1989 - start of construction of ISS –
  first module SARJA
- Manned Mission to Mars, in preparation

MIR in space,
destroyed March 23rd 2001

Launch of Soyuz TMA-5

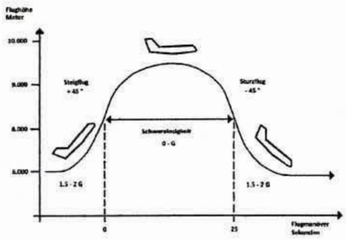
Selection of the Space Crew

- Military pilots prefered (Russia, China)
- Technical education required
- Age 35 to 42, male preferred
- Health test
- Psychological examination
- Ultra centrifuge test
- Intensive program for preparation in special training camps

Preparation for Manned Space Mission

- Training in ground based laboratories, simulated micro gravity
- Parable flights
- Training for rocket start ultra centrifuge (rocket sledge)
- Intensive tecnical training
- Consequent training program in special camps

Transient Microgravity - Parable Flight



Microgravity only for few seconds.
Diminishes research program.

Simulated microgravity
Ground based laboratory

- Methods
  - Bed Rest Model
    - Head down tilt-system – HDT
    - Dry water immersion system – DWI
- Results of the experiments
  - Symptoms of a deficit in the proprioceptive system, the Hypogravidational Syndrome
  - Discovery of minimal brain lesions

Simulated microgravity
Dry water immersion model – DWI-method

DWI institution, Innsbruck, Neurospace Institute, 2 healthy volunteers, 48 hours experiment

DWI experiment, healthy volunteer lift out for showering

Hypogravidational Symptoms
in real and simulated microgravity

- Structural lesion of muscles, primary atrophy (Changes of muscle proteins, enzymes)
- Polyneuropathy symptoms
- Disturbance in function of proprioceptive system (deep sensory symptoms, gait disturbances)
- Thalamic symptoms (body scheme)
- Decrease in vigilance

Pathophysiological sequences in real and simulated microgravity

- Weightlessness influencing the gravity receptors
- Dysfunction of the proprioceptive system
  - Disturbances of the body position
  - Bodily awareness
- Disturbances of thalamic integration
- Disturbances of thalamocortical function
  - frontal lobe, temporal lobe
- Disturbances psychomotor coordination
- Impairment of vigilance

Neurological Disorders in Real Microgravity

- Adaptation phase to real microgravity
  - disturbances during start phase
    - Space Adaptation Syndrome
- Neurological disorders during space flights
  - Cosmonaut Syndrome
  - Hypogravidational Ataxia Syndrome
- Neurological disorders after space flights
  - Hypogravidational Ataxia Syndrome, persistent

Hypogravidational Ataxia Syndrome (I. B. Kozlovskaya)

- Impairment of motor strength (hyporeflexia, hypotonia, muscle atrophy)
- Changes of muscle substance, primary atrophy (increased myoglobin, muscle enzymes)
- Sensibility disturbances (deep sensibility, proteopatic sensibility)
- Disturbance of proprioceptive system (postural dysregulation, gait ataxia, Pseudotabic Syndrome)
- Thalamic sensation, body scheme disturbances
- Cognitive impairment

Cosmonaut Syndrome

- Primary muscle atrophy
- Polyneuropathy
- Proprioceptive system disturbances (vibration perception, hypo-/areflexia, spinal ataxia)
- Disturbances of eye-head-coordination,
- Thalamic disturbances (changes of body scheme)
- Cerebellar ataxia
- Decrease in vigilance
- Vegetative dysregulation
- Osteoporosis

Counter Measures in Real Microgravity

- Treadmill exercises
  - Daily fixed program
- Special exercises legs and arms
- Adaptation of fine motor skills
  - Target training
- Adaptation training of cognitive functions
- Use of Space Trousers

Real Microgravity


Cosmonauts at MIR in training

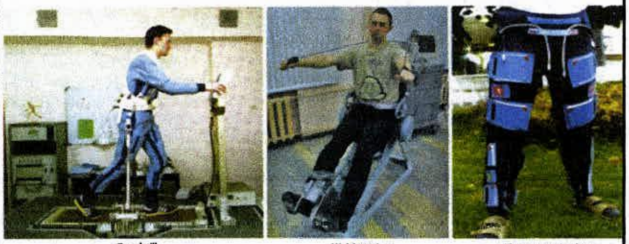
Research results for Neurology and Neurorehabilitation

- Use of bed rest examinations
  - discovery of minimal brain lesions
- Use of research results from real and simulated microgravity
  - Neurorehabilitation, new methods
  - Therapy for children with Input Syndrome
  - Treatment for thalamic syndromes
  - Geriatrics
  - Psychiatric disorders

Use of counter measures in Neurorehabilitation

- Motoric disturbances (Parkinson Syndrome, spasticity, cerebellar disturbances, lesions of the peripheral nerve system)
- Severe conditions after stroke
- Severe conditions after traumatic brain injury
- Apallic Syndrome/Vegetative State, Locked-in syndrome
- Prevention of Bed Rest Syndrome
- Dementia

Additional Neurorehabilitation Methods



Treadmill — Weight trainer — Electromyostimulator

Prevention tools for space mission

Used in:
minimal neurological disturbances (spasticity, cerebellar disturbances, Parkinson Disease, polyneuropathy, early dementia state)
Geriatrics, wellness training

Source: Manned Mission to Mars, Russian Academy of Cosmonautics, 2006

Research in Space Neurology

- New knowledge in brain functions (proprioceptive system, thalamic function etc.)
- Use of countermeasures in real microgravity for neurorehabilitation and neuroscience
- Use of research results in simulated microgravity for neurodiagnosis, drug effects, drug side effects
- New methods for prevention of the Human Bed Rest Syndrome
- Research results necessary for a continuation of manned space missions