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STUDY OF PHYSIOLOGICAL CHANGES OCCURS IN HUMAN BODY IN SPACE: A REVIEW

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ABSTRACT

The patterns determined by research in space physiology are the basis for biological and medical prognoses and for the planning of optimum routines for work and rest, sleep, and eating, and the living conditions of the cosmonauts and astronauts. Space physiology also seeks ways and means of increasing and maintaining bodily resistance during space flight—for example, by the development of rational physical exercise programs and use of certain prophylactic agents, including drugs. The findings of space physiology are taken into account not only in the selection of cosmonauts and astronauts and development of training programs but also in the solution of certain physiological problems arising under ordinary (terrestrial) conditions.

KEYWORDS: space physiology, cosmonauts, astronauts.

INTRODUCTION

Space, High altitude and Aviation physiology is a field of physiology that deals with how the body works or adjusts when exposed to high altitudes. One key thing to note is as you ascend high up in the skyThe impact of the space environment upon living organisms is profound. Its effects range from alterations in sub-cellular processes to changes in the structure and function of whole organ systems. As the number of astronaut and cosmonaut crews flown in space has grown, so to has our understanding of the effects of the space environment upon biological systems. There are many parallels between the physiology of space flight and terrestrial disease processes, and the response of astronaut crews themselves to long-duration space deployment is therefore of central interest. To achieve an understanding of the mechanisms underlying relevant biological and biomedical phenomena, it will be necessary to approach the problems at all levels of biological organization—the molecule, the cell, the organ system, and the whole organism. For example, loss of bone mass from weight-bearing bones is one of the issues of greatest concern in maintaining astronaut health and safety during prolonged spaceflight and upon return to Earth. Understanding the mechanisms responsible for the observed bone loss and the development of effective physical and/or pharmacological countermeasures will require the following at a minimum: characterization of the effects of microgravity on the cells responsible for bone growth and bone resorption; analysis of the molecular and cellular mechanisms whereby cells in weight- bearing bone perceive and respond to the force of gravity; identification and analysis of possible effects of microgravity-induced changes in muscle activity and blood flow on.bone metabolism; and determination and understanding of the changes in levels of the many hormones induced by stress and the environment that contribute to the regulation of bone metabolism, both positively and negatively.

Need of study

Humans venturing into the environment of space can have negative effects on the body. Significant adverse effects of long-term weightlessness include muscle atrophy and deterioration of the skeleton (spaceflight osteopenia). Other significant effects include a slowingnof cardiovascular system functions, decreased production of red blood cells, balance disorders, eyesight disorders and a weakening of the immune system. Additional symptoms include fluid redistribution (causing the "moon-face" appearance typical in pictures of astronauts experiencing weightlessness), loss of body mass, nasal congestion, sleep disturbance, and excess flatulence. The engineering problems associated with leaving Earth and developing space propulsion systems have been examined for over a century, and millions of man-hours of research have been spent on them. In recent years there has been an increase in research on the issue of how humans can survive and work in space for extended and possibly indefinite periods of time. This question requires input from the physical and biological sciences and has now become the greatest challenge (other than funding) facing human space exploration. A fundamental step in overcoming t7his challenge is trying to understand the effects and impact of long-term space travel on the human body. Microgravity significantly reduces normal spinal compression and the diurnal loading cycle, increasing the risk of disc prolapse or herniation when returning to a gravitational environment. Long term (6 months) microgravity exposure may also have adverse effects that can ultimately weaken disc tissues. The purpose of this study is to address and quantify the physiological changes occurring in the body after prolonged space flight to help reduce the incidences of damage of systems.

Space physiology

Space physiology is the study of physiological responses of the body in space & spacecrafts There are currently seven billion people living on Earth. almost all of us share some common experiences. But there are six people out of seven billion whose daily experience sets them apart. These six are floating 400km above our heads in the International Space Station. Their daily routine is both recognisably the same and also different from ours.

Why Space is different from Earth

1) Atmosphere

2) Radiation

3) Gravity

1) Atmosphere

Containing a low density of particles predominantly a plasma of hydrogen and helium as well as magnetic fields, dust)

* atmospheric pressure-Air pressure decreases with altitude. At sea level, it is 14.7 pounds per square inch (1 kilogram per square centimeter). At 10,000 feet (3km), it is 10 pounds per square inch (0.7kg per square cm).

* temperature(1500°C)

*humidity

*gas composition

2) Radiation

(electromagnetic radiation, cosmic rays).

3) Gravity

Called as weightlessness or microgravity.

The Greatest Moments in Flight

On 12 April 1961, Russian cosmonaut Yuri Gagarin became the first human to travel into space when he launched into orbit on the Vostok 3KA-3 spacecraft (Vostok 1).

1st moon walkers - Neil Alden Armstrong

INTERNATIONAL SPACE STATION

A partnership between European countries(represented by ESA), the United States (NASA), Japan (JAXA), Canada (CSA) and Russi(Roscosmos), the International Space Station is the world's largest international cooperative programmein science and technology 400 km above the Earth's surface. weighs almost 400 tonnes.

There are two main research facilities on the Space Station.

Human Research Facility and the Microgravity Science Glovebox.- Many experiments are done at the Human Research Facility to determine how well the human body can adapt to living in space.-The Microgravity Science Glovebox (MSG) makes it possible to do investigations in microgravity that are similar to those carried out in ground-based laboratories. liquids and particles in microgravity for science and technology experiments.

Lifestyle in space

1) space food
2) you will be drinking everyone's sweat
3) NASA s safe -to-swallo toothpaste
4) washing hair by rinseless shampoo
5) sponge bath
6) sneezing in space is messy
7) your fingernails probably fall off

Effects of microgravity on body

1) Space motion sickness
2) puffy face - bird leg syndrome
3) Effects on Cardiovascular system
4) Effects on Musculoskeletal system
5) Effects on Bone
6) Effects on Immune system
7) Effect of radiation on body
8) Effect on menstrual system
9) Effect on respiratory system

1) Space motion sickness

Nausea

Vomiting

Headache

malaise

2) Puffy face - bird leg syndrome During space flight, the volume in lower limb decreasd by 10%. Giving you like chicken legs bloated head red eyes Bones weaken Neck veins will stand out more Nose & sinuses blocked You feel the same way on Earth when you bend over or stand upside down, because the blood rushes to your head.

1) Blood pressure reflex/ baroreceptor reflex

2) magnesium decreased

3) catecholamine level increased(catecholamine cardiomyopathy)

Animal studies

A significant increase in the concentration of norepinephrine in heart tissue was found in experimental rats after a flight on the Kosmos 936 biosatellite. A nonuniform distribution of epinephrine and norepinephrine in the ventricles was also observed in these animals after a flight on the Kosmos 1129 biosatellite. In many tissues, including cardiac muscle, there were changes in the structure of the mitochondria, and a reducedrate of ATP synthesis due to a lesser degree of conjugation of oxidative phosphorylation. In cardiac muscle, there were pronounced atrophic and dystrophic changes, a decrease in the size and integrity of muscle fiber structure, and suppressed synthesis of myocardial proteins, as well as evidence of impairment in the repair mechanism.

Upon returning to Earth, gravity will pull those fluids back down to your legs and away from your head causing you to feel faint when you stand up. But you will also begin to drink more and your fluid levels will return to normal in a few days.

3) Effects on Cardiovascular system

Due to microgravity heart size increased and kidney excrete large amount of fluid.

Anemia

kidneys eliminate excess fluid decrease secretion of erythropoietin

Anemia occurs within 4 days of spaceflight)

The number of red blood cells will decrease by about 15% after a 3-month stay

4) Effects on Musculoskeletal system

1. In microgravity you do not use the muscles that help you stand and maintain posture (anti-gravity muscles).
2. After 2 weeks space flight muscle mass diminished by upto 20% & on longer mission(3-6 mon) 30% loss.
3. Each astronauts returning from space station participate in muscle rehabilitation program & muscle mass, strength recovered in 1-2 months back on Earth.

 # Advanced Resistive Exercise Device (ARED).

ARED, in the Tranquilitymodule, is the most recent addition and is a weightlifting gym that uses vacuum tubes to work without weights.

The Lower Body Negative Pressure (LBNP) device relies on suction to provide negative pressure over the lower body.

The LBNP helps with cardiovascular function by increasing blood pressure to the legs When it includes a treadmill, it helps with muscles by allowing astronauts to exercise more efficiently It also seems to reduce some bone loss.

5) Effects on bone

1) due to microgravity

2) low level of light

Increased in urinary & fecal calcium excretion blood level of parathyroid hormone & 1,25 - dihydroxy vitamin D decreased.

The loss of bone density is about 1-2% per month (that is >twice in adult in entire year) & in 6 mon 8-12%

Bone demineralization

The bones most commonly affected are the lumbar vertebrae and the leg bones.

Bone recovery is very problematic For a 3 to 6 month space flight it may require 2 to 3 years to regain lost bone.

You really have to exercise a lot both in space and after returning to Earth.

In addition to weak bones, your blood’s calcium concentration increases as your bones get chewed up by osteoclasts.

Your kidneys must get rid of the excess calcium, which makes them susceptible to forming painful kidney stones.

6) Effects on immunity system

Humans have many viruses in their bodies.

Space flight is very stressful and latent viruses are very often activated.

This can make astronauts susceptible to viral infections.

Sky lab space station show that lymphocyte is reduced.

Pre & post blood samples.

Reactivation of latent Herpes virus.

Decreased function of granunocytes,

Decreased activity of natural killer cells, Tcells, cytokines.

7) Effects of radiation on body

On Earth the atmosphere and magnetic field provides a shield for humans to prevent space radiation from penetrating.

The absence of this shield in space exposes astronauts to greater amounts of radiation.

Radiation ionizes molecules in the body and can cause damage to DNA

central nervous system, tissues of the heart, eyes and digestive tract

It can also include sterility, cataracts, neurological damage, cancer.

Years after exposure to space radiation many astronauts have developed cataracts—a clouding of the lens in the eye.

Lunar dust

Contaminated by uv rays & high iron content.

8) Effects on menstruation cycle

For female astronauts gravity assists in the menstruation process by "pulling" the uterine lining blood out during her menstrual period.

In microgravity this pull is not there and in long space flights this can cause problems like clotting, toxic shock and bleeding into, rather than away from, the uterus.

9) Effect on respiratory system

#Respiratory system more affected due to circulatory system

#Major Respiratory distress are atelectasis, airway closure, increased transudation of fluid from capillaries & marked variation in ventilation perfusion ratio.

Respiratory rate increased of about 30/min

Tidal volume decreased.

DISCUSSION

Space exploration has produced an impressive record of benefits for humanity. Space exploration has driven scientific and technological innovation that benefits people around the globe every day. Sending humans and machines into space presents challenges that are overcome only by the utmost ingenuity; this leads to new knowledge and technical innovations that are used on Earth in ways that can be dramatic and unpredictable. Space exploration serves a cultural and inspirational purpose by fulfilling a deep need to understand the world, address questions about the origins of life and the nature of the Universe, and to expand the notion of what it means to be human. Because space exploration stimulates significant global investment and international partnerships, and because of its extremely challenging nature, demands the development of cutting edge technical capabilities, it provides unique opportunities to address some of the global challenges facing society today.

CONCLUSION

Space physiology and medicine is a young discipline that has made great strides in the first half century of human space flight. We have a good understanding of the medical problems associated with short-duration space flight, and have successfully developed countermeasures. The new challenge is long-duration space flight. Clinicians are currently refining the delivery of medical care for astronauts who live for longer periods aboard the International Space Station. They also seek to better understand the medical issues that future astronauts will face when we venture back to the moon and eventually on to Mars.

When nations work together on challenging space missions, this promotes international cooperation beyond the realm of space. It aligns interests and forges relationships that further peace and stability on Earth. There is no activity on Earth that matches the unique challenges of space exploration. The first fifty years of space activity have generated benefits for people around the globe. This past record gives strong reason for confidence that renewed investments in space exploration will have similarly positive impacts for future generations.

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