

Thrombosis in Space & Clotting Risk in COVID-19

Assoc Prof. Nandu Goswami

“Gravitational Physiology, Aging and Medicine” Research Unit
Medical University of Graz, Austria

European Innovative Partnership Active & Healthy Aging
Falls Prevention Task Force

After over 50 years of spaceflight, a **new risk** with the **potential to derail missions and seriously harm astronauts** appeared,

clot in neck vein

- with little forewarning:

Auñón-Chancellor et al. (2020) *N Engl J Med.* 382(1):89–90

- Started in 2020 January
- Nandu Goswami, Medical University of Graz (Co-Ordinator)
- 22 Members:
 - Austria
 - Belgium
 - Canada
 - France
 - Germany
 - Norway
 - Slovenia
 - UK
 - USA

COVID-19

SARS-Cov2 ORIGIN?
Zoonosis
Laboratory virus leak
Synthetic particle

SEQUENCING VARIANTS

- Brazilian SARS-Cov-2 lineage B.1.1.28 known as P.1 (501Y.V3)
- B.1.1.7 (501Y.V1) reported in the UK
- South Africa B.1.351 (501Y.V2)

THERAPEUTIC SOLUTIONS to COVID-19

1. Antiviral drugs and drug repurposing
2. Monoclonal antibodies
3. Antibiotics and corticosteroids
4. Medical devices

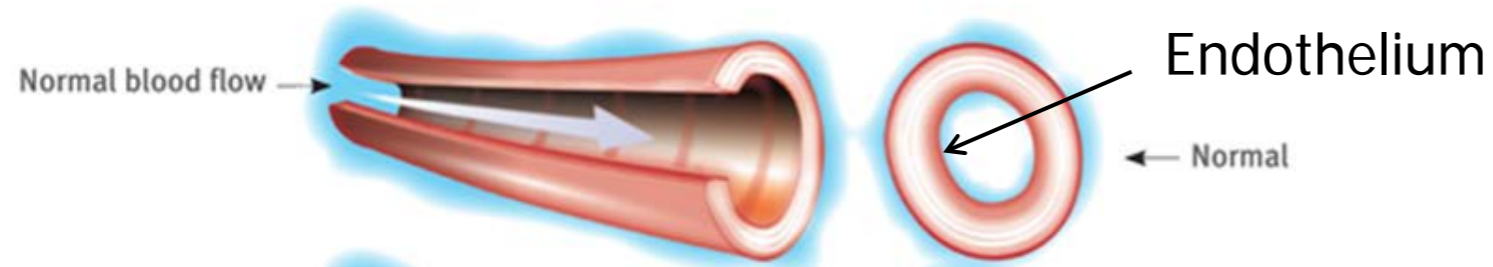
PREVENTION – IMMUNOSTIMULATION

- Natural immunity support
- Vaccination

Many open questions

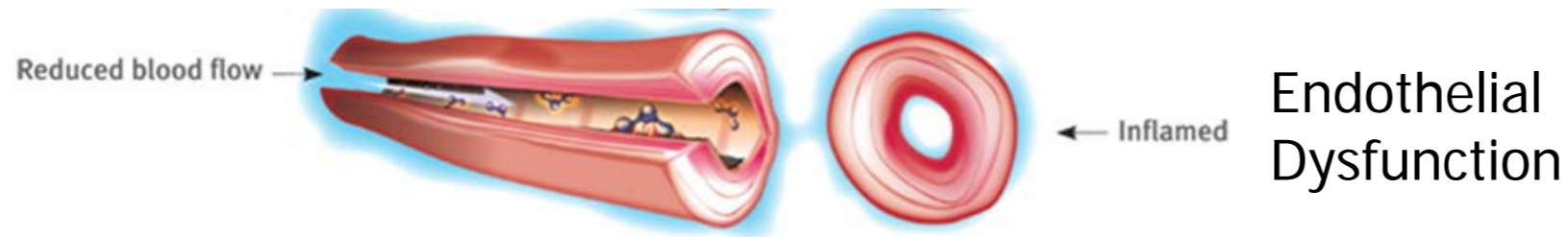
- Inadequate current knowledge
- Need for openness, more research & international collaborations

Pavelić K.....Goswami, N. (2021) *J. Clin. Med.* 10, 1586. <https://doi.org/10.3390/>



Regulation of:

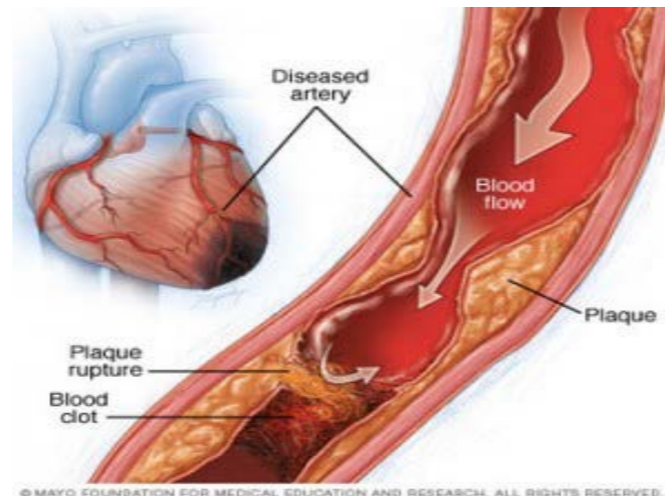
- Coagulation
- Fibrinolysis
- Vascular tone



Pathogenesis:

- Atherosclerosis
- Hypertension
- Heart failure

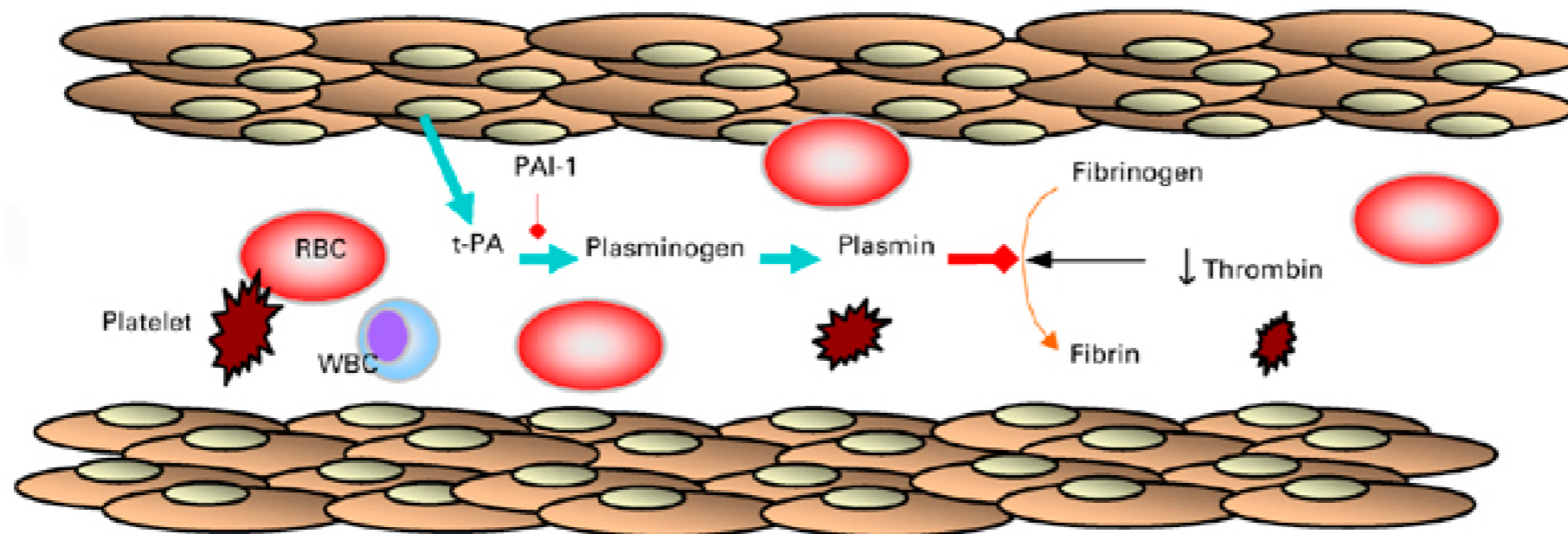
**Heart
Attack**



Atherosclerosis
Coronary Artery Disease

© MAYO FOUNDATION FOR MEDICAL EDUCATION AND RESEARCH. ALL RIGHTS RESERVED.

- Pro-coagulatory parameters
- Anti-coagulatory parameters



Goswami et al. (2020) *J Clin Med.* 9(10)

Goswami et al. (2020) *J Clin Med.* 9(11).

Cvirn, G....Goswami, N. (2019) *J Appl Physiol.* 126:1214-22

ESA bedrest project: "Coagulation and bed rest" (PI)

EDCTP project: "EndoCOVID" (PI)

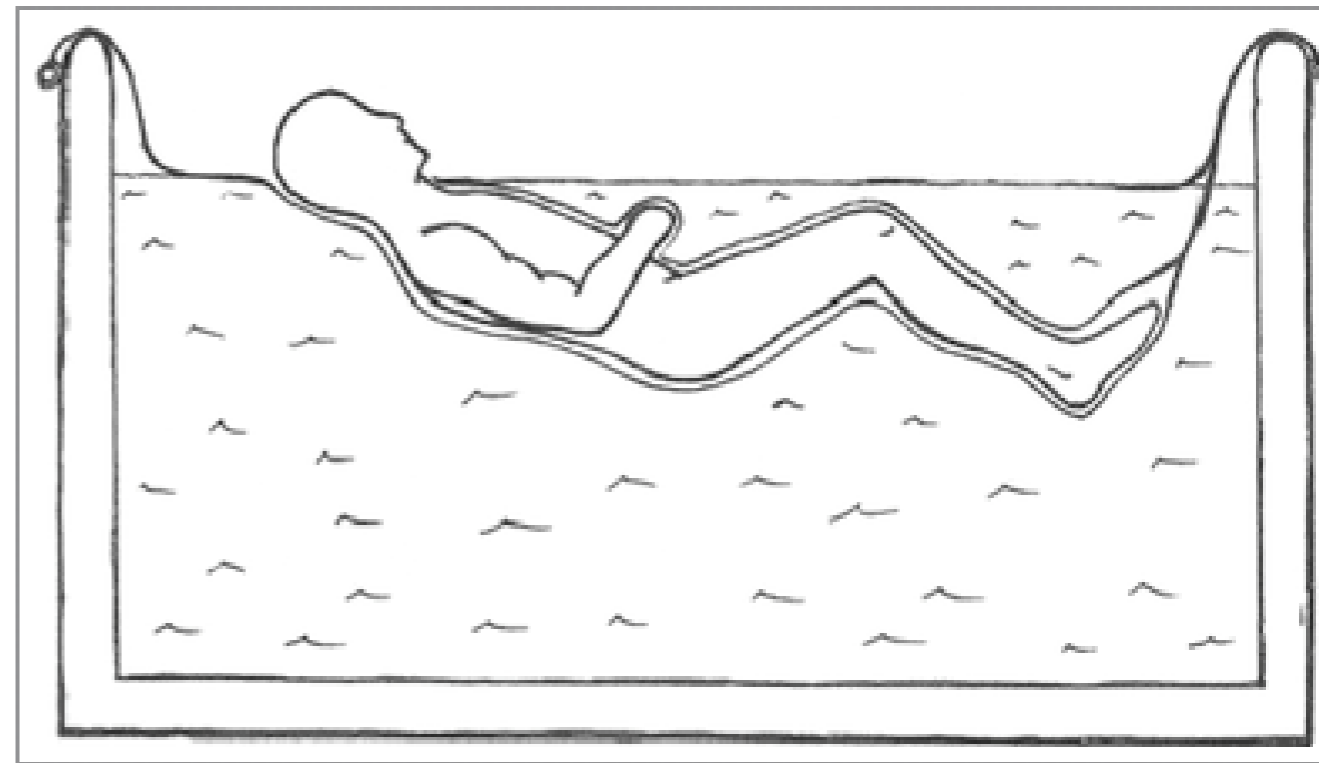
European Developing Countries Trial Partnership (EDCTP) project:

“EndoCOVID” (2021-2023)

Risk of Coagulation in COVID-19 patients with HIV and receiving Anti-Retroviral Therapy

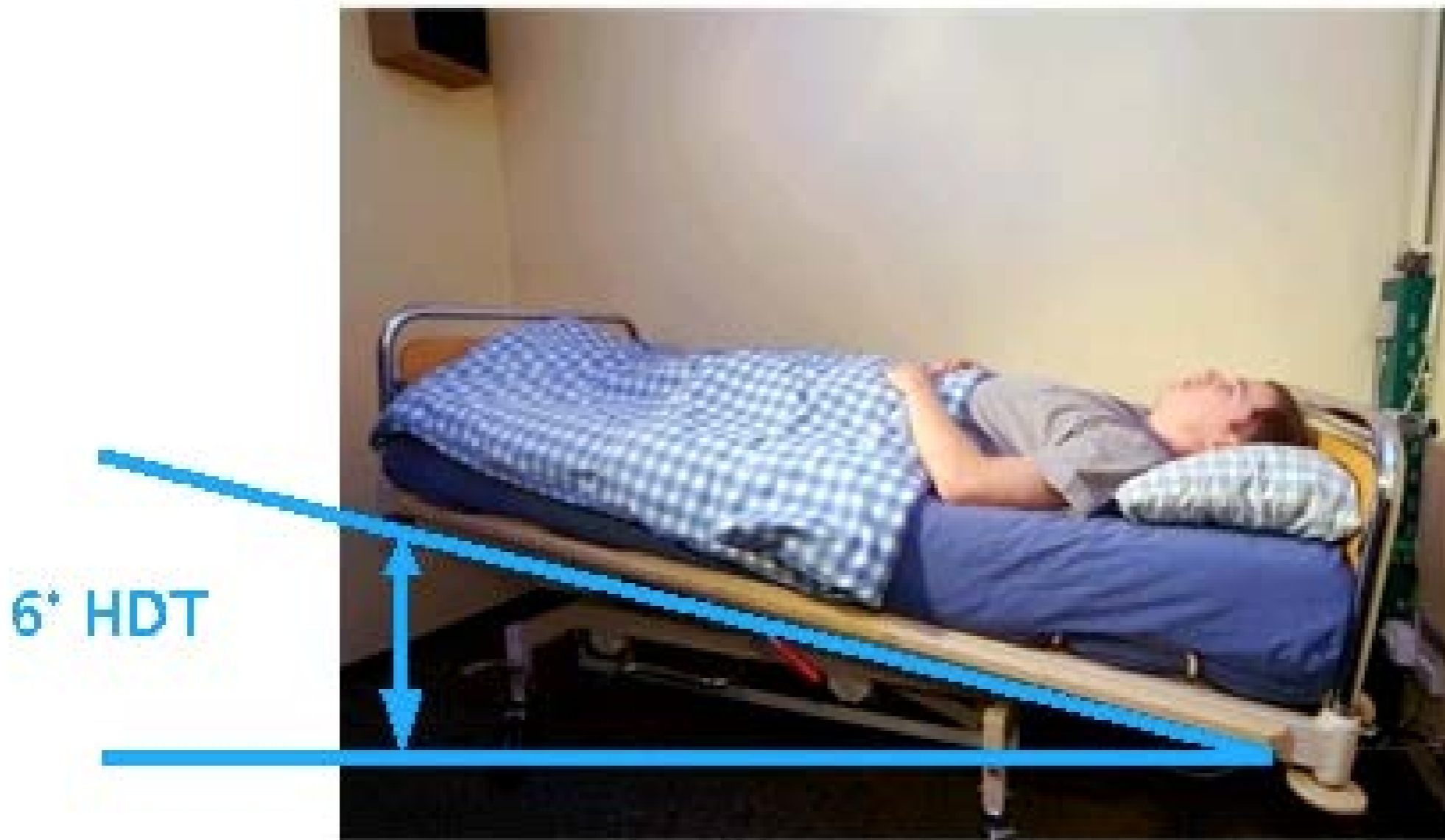
- Nandu Goswami, Medical University of Graz, **Austria (Co-Ordinator)**
- Benedicta Nkeh Chungag, Walger Sisulu University, **S. Africa**
- Simiat Elias, Lagos State Univ College of Medicine, **Nigeria**
- Knut Lundin, University of Oslo, **Norway**

"Dry" Immersion



Navasiolava et al. (2011) *Eur J Appl Physiol.* 111: 1235-1260.

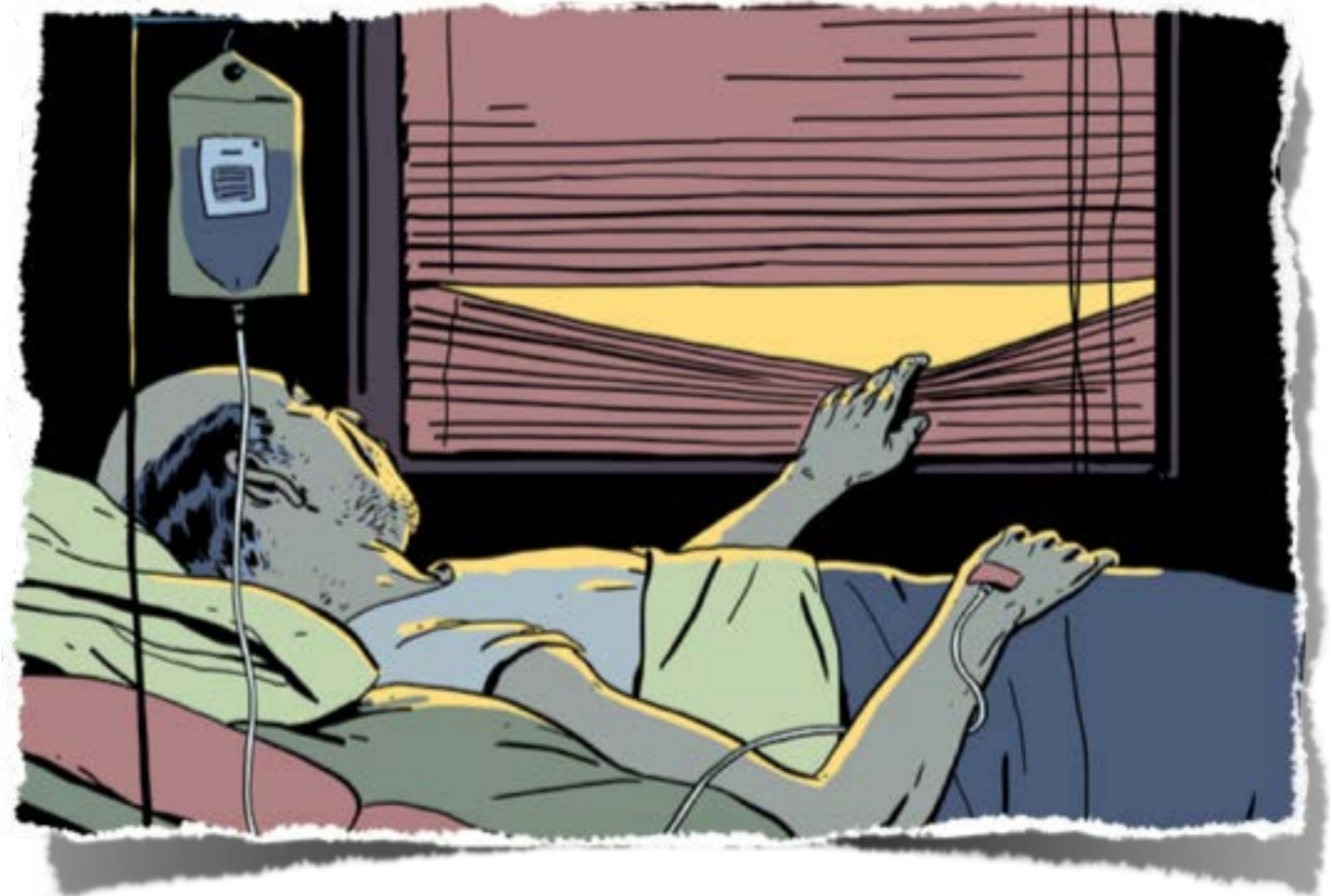
ESA project: Thromboembolism risk (PI)



6 degree Head Down Tilt

Waha, JE; **Goswami, N.** et al (2015) *Medicine (Baltimore)*. 94(38):e1555-e1555
O'Shea, D...**Goswami, N** (2015) *Eur J Clin Invest*. 45(7):679-685

Bedrest Confinement in Older Persons



Frailty: A Vicious Cycle

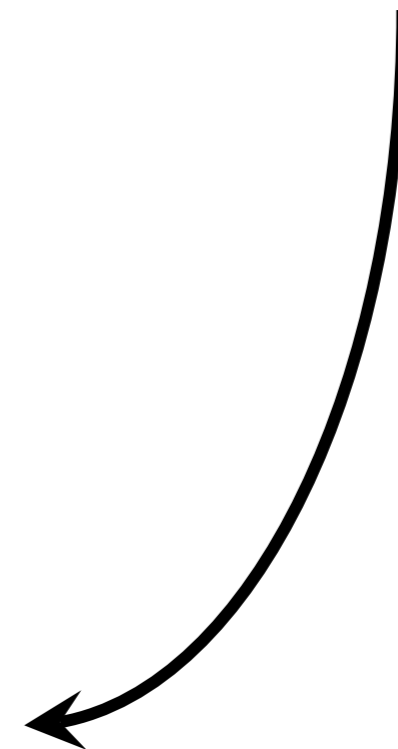
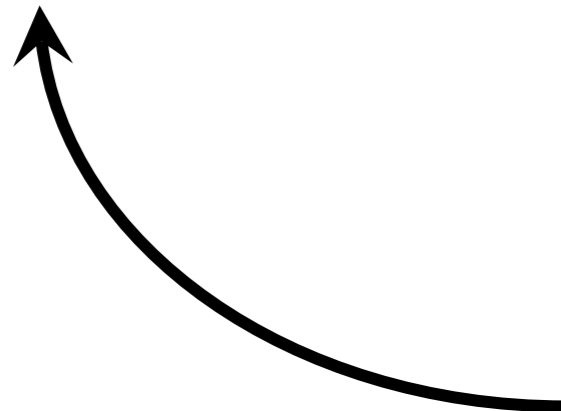


Immobilization



De-conditioning

Falls / Fear of falling





"Gravitational Physiology, Aging and Medicine" Unit

**Johann
Wagner**



**Nandu
Goswami**



**Jerry
Batzel**



**Andreas
Rössler**



**Helmut
Hinghofer-Szalkay**



**Andreas
Jantscher**



**Bianca
Brix**





"Gravitational Physiology, Aging and Medicine" Unit

Geriatric Institutions

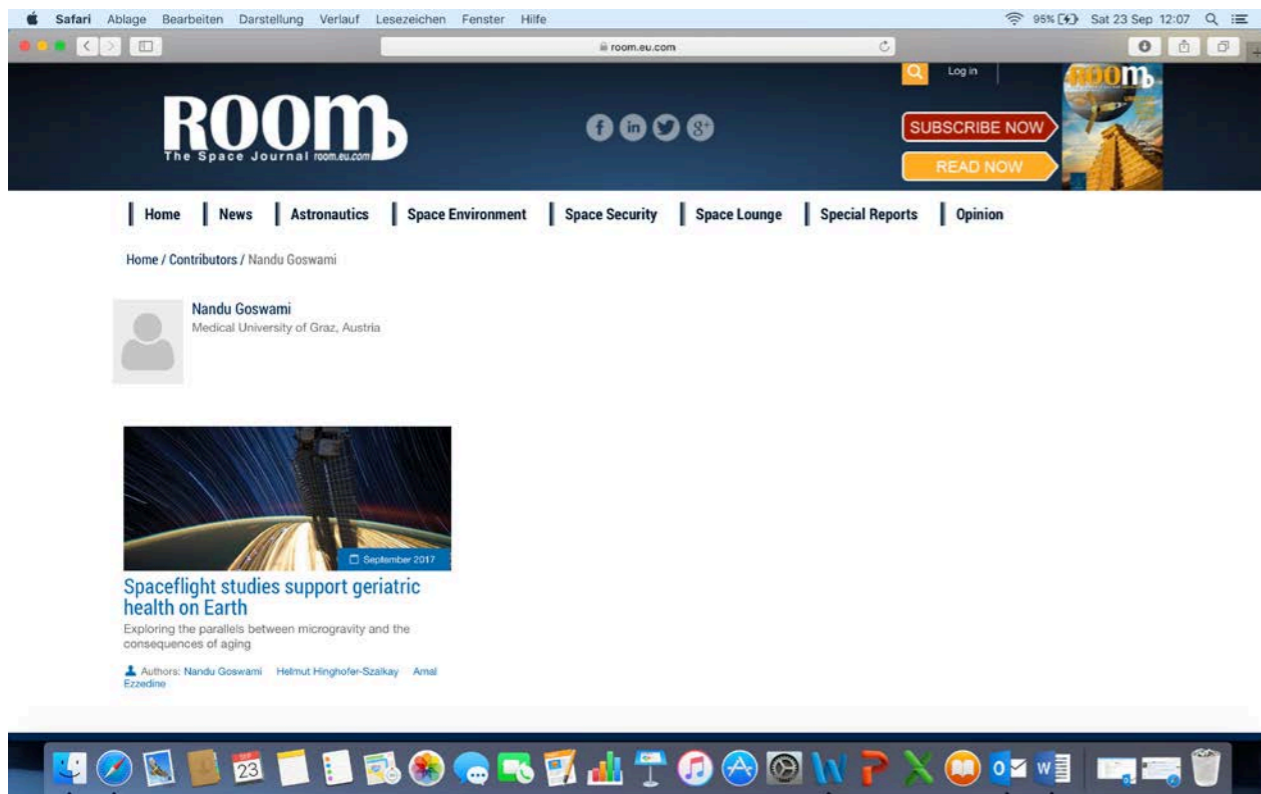
Space Agencies

Expertise

- **Cardiovascular regulation**
 - Hemodynamics
 - Hormones
 - Autonomic function
- **Orthostatic intolerance**
- **Vascular health & function**

Geriatric care institution
Universities
Research Centers
Communication Platforms
Companies

NASA
ESA
IBMP, Russia
DLR, Germany
MEDES, France
Simon Fraser University



Astronautics



Spaceflight studies support geriatric health on Earth

Nandu Goswami & Helmut Hinghofer-Szalkay
Gravitational Physiology & Medicine Research Unit, Institute of Physiology, Medical University of Graz, Austria

Amal Ezzeddine
Senior Director Government and Corporate Affairs, Thuraya Telecommunications Company, Dubai

Understanding the links between spaceflight physiology and the aging process can lead to improvements in human health not only for astronauts living in microgravity but also for older people living on Earth. This article provides a general overview of important physiological consequences of spaceflight, the aging process in humans on Earth, and important connections between these physiological states.

Ever since our ancestors started walking upright, the human body has adapted to the effects of gravity. For example, during standing the human heart - despite being located below the brain - is able to pump enough blood to the brain against the force of gravity to maintain proper brain function. The pooling of blood in the legs - which occurs due to gravitational forces - is counteracted by the

muscle pump in the lower limbs by one-way leg venous valves as well as by the action of breathing. Additionally, the weight-bearing bones and anti-gravity muscles have adapted during evolution to ensure adequate support during standing. Thus humans can stand up without any real problems. The real importance of gravity on physiological systems is, however, seen when gravity is reduced or taken away, as in the microgravity environment

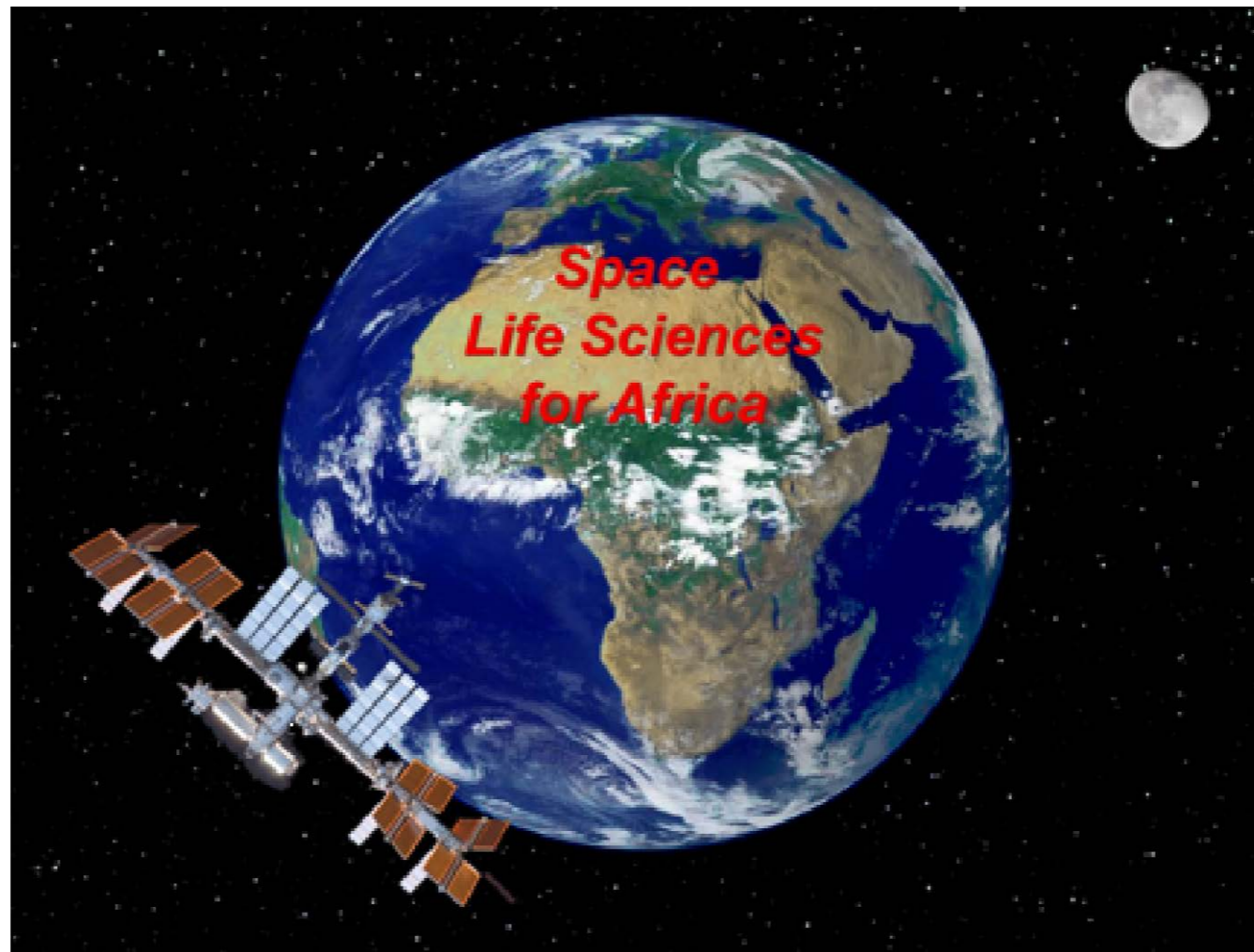


Selected International Collaborators

- Daniel Devigo, Pontifica University, Buenos Aires, **Argentina**
- Patrick DeBoever, VITO, Mol, **Belgium**
- Paul Dendale, University of Hasselt, **Belgium**
- Andrew Blaber, Simon Fraser Univ., Vancouver, **Canada**
- Yunfang Gao, Northwest Univ., Xian, **China**
- Ines Drenjancevic, Univ. Josip Juraj, Osijek, **Croatia**
- Jörn Rittwegger, German Space Agency (DLR), **Germany**
- Laszlo Simon, Semmelweis Univ., Budapest, **Hungary**
- Giovanna Valenti, Univ. of Bari, **Italy**
- Satoshi Iwase, Aichi Medical Univ., **Japan**
- Inessa Kozlovskaya, IBMP, Moscow, **Russia**
- Rado Pisot, Univ. of Primorska, **Slovenia**
- Hans Strijdom, Univ. of Stellenbosch, Cape Town, **South Africa**
- Benedicta Chungag, Walter Sisulu University, Mthatha, **South Africa**
- Jean-Pierre Montani, University of Fribourg, **Switzerland**
- Simiat Elias, Lagos State Univ. College of Medicine, **Nigeria**
- Voyko Kavacic, Institute of Gerontology, Wayne State University, Michigan, **USA**
- Germaine Cornillessen, Halsberg Chronobiology Center, Minnesota, **USA**



Space Life Sciences for Africa



„International Co-operation for Space Life Sciences Knowledge Sharing & Development in Africa“

International Academy of Astronautics (IAA):

Commission 2 – Space Life Sciences Study Group Report

MacLeish MM...**Goswami N**, et al. (2015) *Acta Astronautica*. 116:106-116.



Increasing Awareness and Collaboration: Needs

- Intercollaborative effort
- Interdisciplinarity
- Transdisciplinarity
- More willing partners
- Joint projects
- Repository of knowledge
- Consensus statements
- Systematic reviews/ meta-analysis



Fostering collaboration and dissemination of knowledge : Tools

- Regular meetings via ESA support: Webex
- SharePoint folder provided by ESA
- Tools to perform state-of-the-art systematic literature reviews in the field of Aerospace Medicine: Newcastle University's online resource:

[Space Biomedicine SR Methods \(google.com\)](#)

<https://sites.google.com/view/sr-methods/home>



Challenges Encountered in Developing Collaboration and Knowledge Sharing

- Interdisciplinarity issues
- Transdisciplinarity issues
- Lack of a repository where knowledge could be shared
- Sustainability of the group's interest and focus
- Continuity of the project/ theme/ knowledge in the future