Xenon-1

Effect of Microgravity on the Peripheral Subcutaneous Veno-Arteriolar Reflex in Humans

Principal Investigator:

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Summary

VA (veno-arteriolar) reflex pushes blood against gravity back to the heart.

Astronauts' VA Reflexes stop in space, and don't return immediately upon landing, handicapping the astronauts for a few days.

Questions that this study aims to answer:

Is this temporary suspension responsible for post-spaceflight Orthostatic Intolerance?

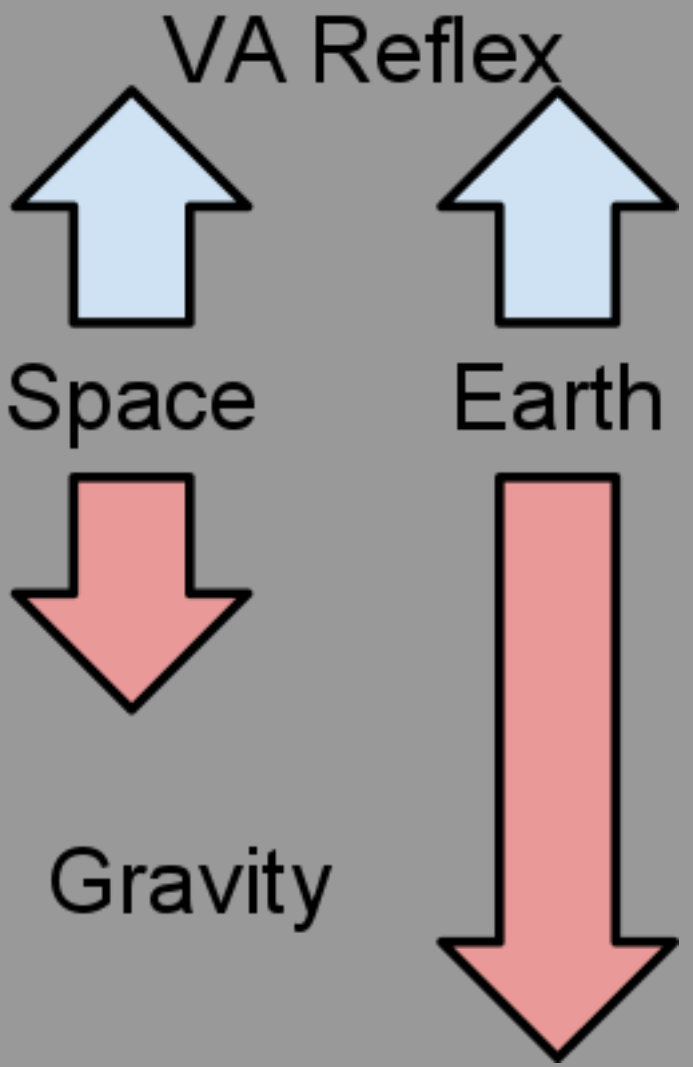
How does Orthostatic Intolerance work?

About Xenon-1

Payload Developer
Johnson Space Center, Human Research Program, Houston, TX
Sponsoring Space Agency
National Aeronautics and Space Administration (NASA)
Supporting Organization:
Exploration Systems Mission Directorate (ESMD)
ISS Expedition Duration:
August 2001 - December 2002
Expeditions Assigned
|3|4|5|

What in the World is a Veno-Arteriolar Reflex?

- Whenever a person stands up, blood rushes down to the lower part of their body.
- The Veno-Arteriolar Reflex is a special mechanism that is designed to facilitate blood flow in the legs while standing up.
- The VA Reflex contracts muscles in the lower half of the body, forcing blood back to the heart against the flow of gravity.



Why Do We Care?

Since there is no need for the VA Reflex in space due to weightlessness, the VA Reflex of astronauts doesn't kick in during spaceflight. When the astronauts land, they are incapacitated for a few days because blood in the legs doesn't get returned to the heart.

This reflex is necessary in ensuring that astronauts do not get edema (swelling of the tissues due to excess fluid) in the legs. In addition, it helps in keeping an adequate supply of blood to the brain while standing.[1]

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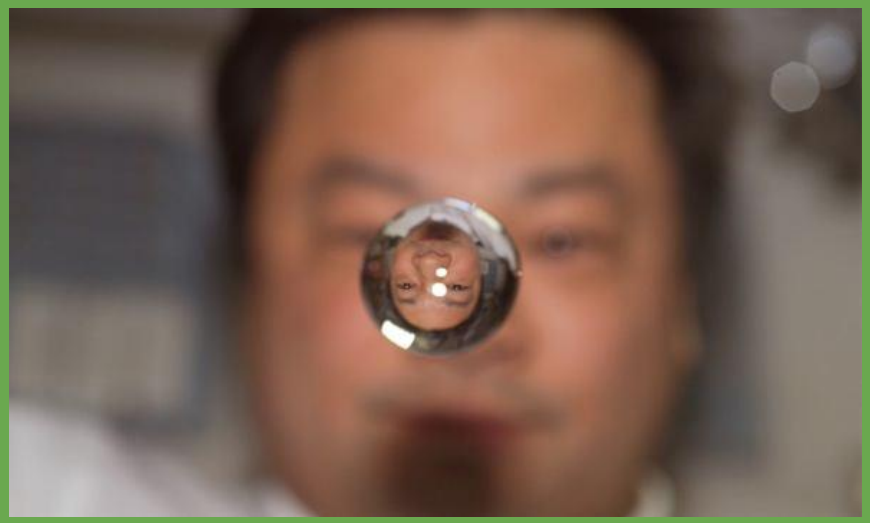


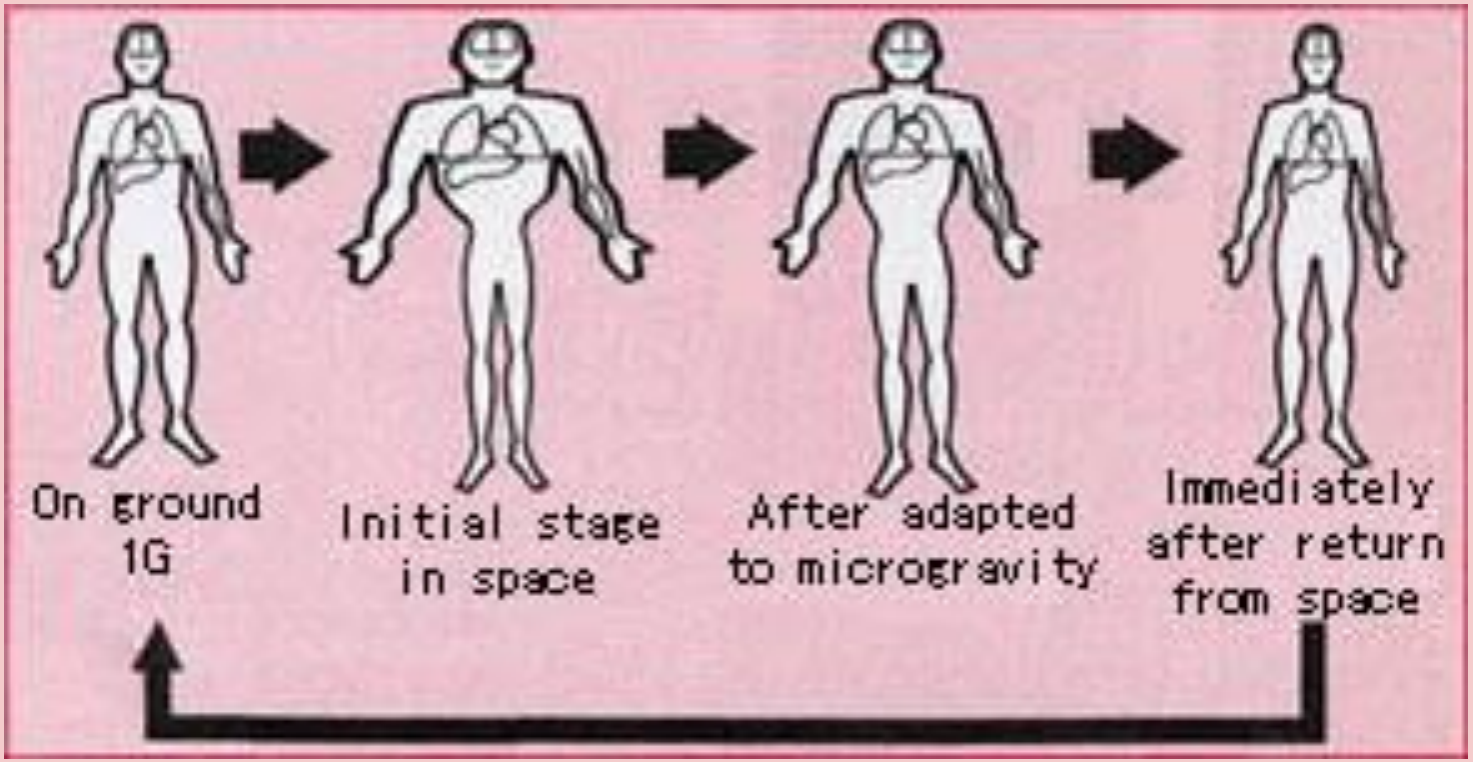
Orthostatic Intolerance

If the VA reflex does not kick in, then "blood circulation is impeded, and blood pressure drops, causing dizziness and possibly fainting"[1], common symptoms associated with OI.

Orthostatic - (adj.) Standing.
Intolerance - (n.) Incapacity or indisposition to bear or accept

Orthostatic Intolerance - (n.) A condition triggered while standing that results in dizziness or fainting

Stage 1: VA Reflex prevents orthostatic intolerance.
Stage 2: VA Reflex still works in space, reducing lower-body blood flow
Stage 3: Body adapts to microgravity, normalizing distribution of blood.
Stage 4: VA Reflex hasn't kicked in yet, pooling blood in legs.



Goals of Xenon-1

- Investigate the mechanism governing the regulation of the VA reflex
- Measure VA reflex before and after flight
- Determine whether spaceflight affects the VA reflex to see if post-flight VA reflex suppression is responsible for orthostatic intolerance

The goals of Xenon 1 are to observe and discover how space flight (micro-gravity) affects the VA reflex. This reflex is necessary in ensuring that astronauts do not get edema (swelling of the tissues due to excess fluid) in the legs. In addition, it helps in keeping an adequate supply of blood to the brain while standing.[1]

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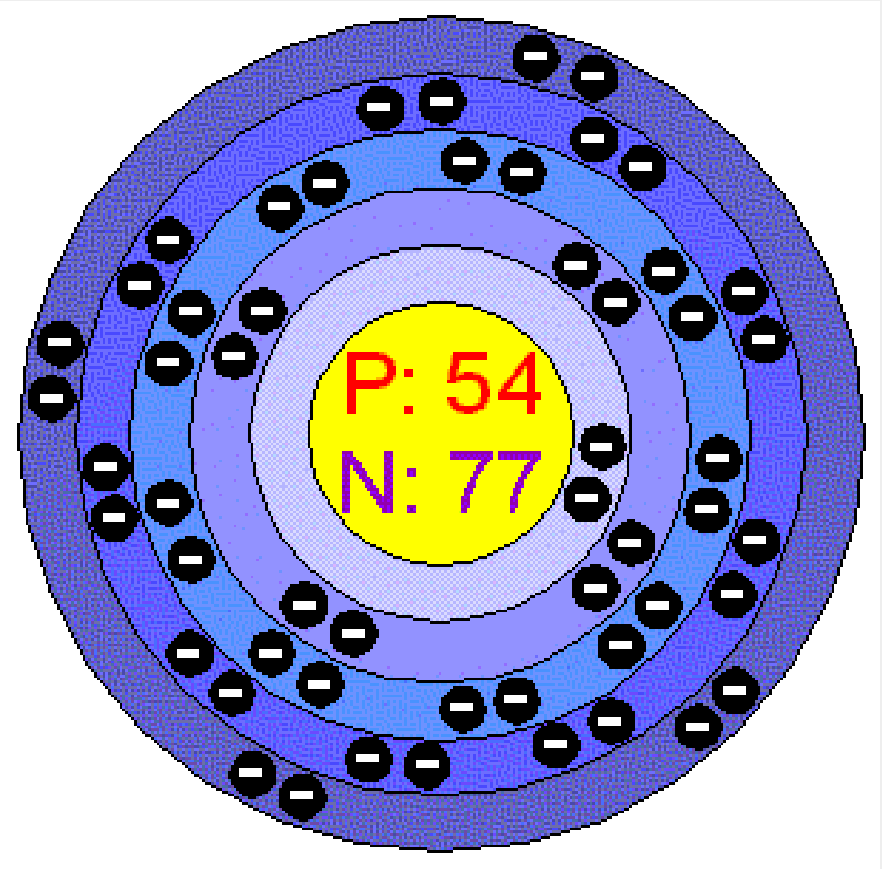
Edema (swelling) of the ankles and feet

Example of edema caused by buildup of fluid in body tissue

Procedure

1. Inject the inert radioactive tracer (Xenon-133) into leg to monitor subcutaneous blood flow.
2. Use a Xenon Detector Unit to monitor flow of Xe
3. Monitor flow while standing, wait 7 minutes.
4. Monitor flow while supine (laying down).
5. Perform steps 1-4 pre-flight and post-flight to monitor differences



Results

Investigators reported how much blood was kept out of the legs by the VA Reflex before and after spaceflight. High post-spaceflight blood return indicates that the VA reflex does not contribute to postflight OI. [1]

Before: Δ Blood Flow, %
-37 +/- 9 %

After: Δ Blood Flow, %
-64 +/- 8%

Applications

Current

Little is known about the causes of OI, and this experiment's methods and data can be used to shed light on this condition.

The drug Midodrine is already being tested by astronauts on the ISS for OI treatment.

Future

This experiment can help elucidate the mechanism of OI and its hypothesized relationship with the VA reflex.

This experiment's methods of monitoring of blood flow can be used to study the root and symptoms of OI, and eventually develop a treatment or cure for it.

Works Cited

1) http://www.nasa.gov/ mission_pages/station/ research/experiments/ Xenon1.html#description
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6http://www.everydayhealth.com/drugs/images/multum/Midodrine%2010%20mg-MYL.jpg
7) https://lh6.googleusercontent.com/-o1zR07XyPmg/TXGJQ1aRE4I/AAAAAAAAA0E/DwUCYuZf3ZM/water+in+space.jpg

Thank You!

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