

# Altitude Decompression In Simulated Microgravity

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## Background

Astronauts and Cosmonauts must decompress from saturation before extravehicular activities (EVA; "space walks").

Both the International Space Station and the Space Shuttle operate at pressures of 1.0 bar, whereas the US "EMU" and the Russian "Orlan-M" space suits have internal pressures of 0.3 and 0.4 bar respectively.

On ground such decompressions are associated with unacceptable rates of venous gas embolism (VGE) and decompression illness (DCI), even after one hour of oxygen prebreathe (85% incidence of VGE and 78% of DCI after 6h at 0.4 bar).

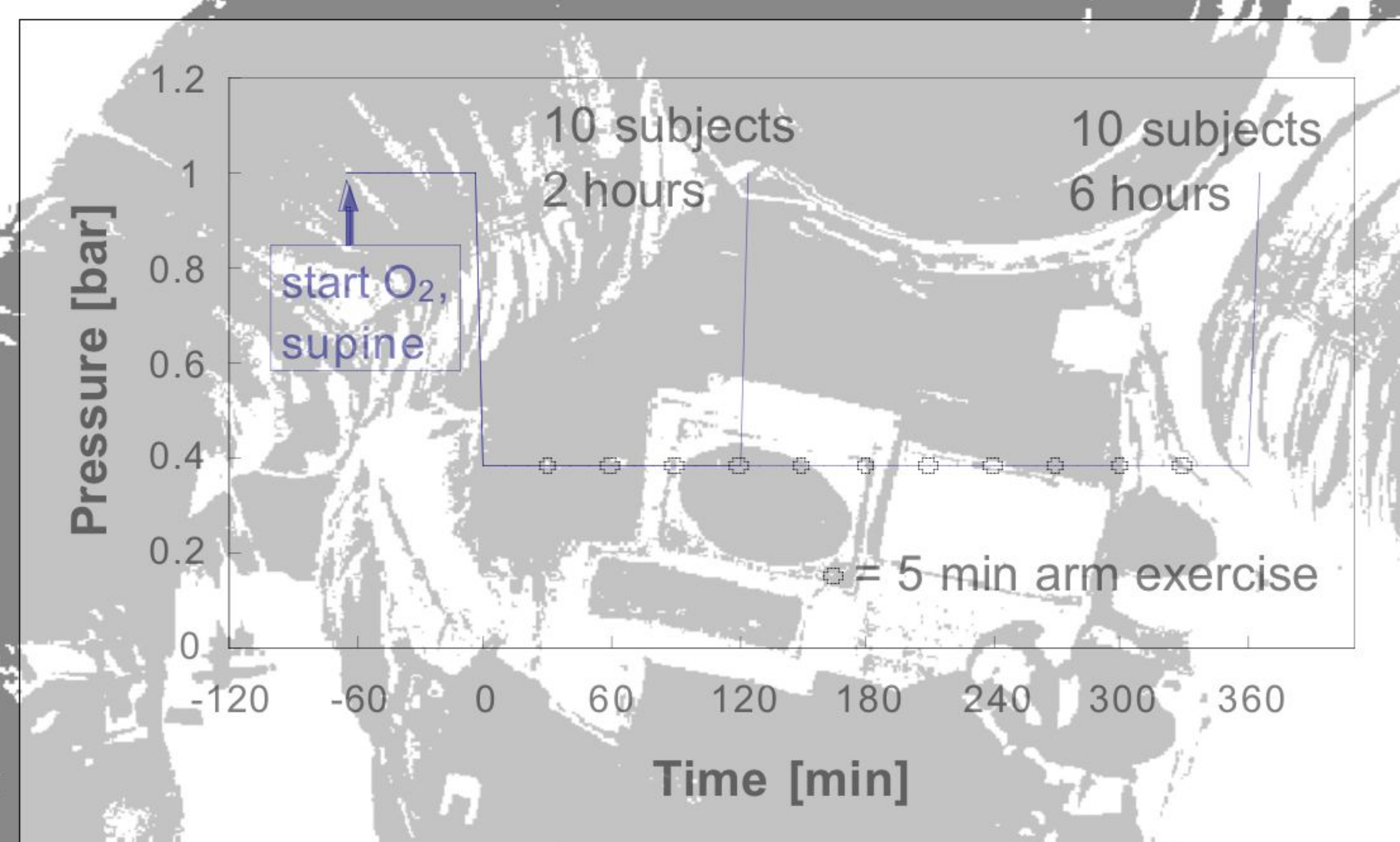
Nevertheless, so far no DCI events have been reported from the US or Russian space activities.

We hypothesized that the microgravity with unloading of the lower extremities would be a protective factor.

## Methods

The Russian pre-EVA/EVA decompression regimen with 1 h prebreathe was simulated in an altitude chamber.

Twenty subjects were decompressed to 0.38 bar (285 mmHg / 7500 m / 25 000 ft) after 1 h of oxygen breathing, and continued to breathe oxygen for 2 hours (n=10) or 6 hours (n=10) at 0.38 bar until recompression.



Subjects were strictly supine and performed intermittent arm exercise of mild intensity (arm flexions at 0.5 Hz ranging 70-180° with weights of 2 x 1\_ or 2 x 2\_ kg).

Pre-cordial Doppler ultrasound was used every 5-15 min to detect VGE, and the subjects were also monitored for symptoms of DCI.

Subjects were studied in pairs and with one or two attendants present in the chamber.

## Results

Out of the 20 subjects, there was only one in whom large numbers of detectable VGE (KM Doppler scores of grade III or above) were measured, and it was found later that this subject had a relatively recent arm fracture (see accompanying poster).

Group	Total	No VGE for		EVA aborted due to	
		2 h	6 h	VGE	Other
2 h	10	8	-	1	1
6 h	10	10	6	0	4

The table shows number of subjects

In addition, one attendant who performed intense loading of the upper and lower extremities while attempting to open a medical lock, had both large numbers of circulating VGE (KM score >III) and symptoms of DCI (knee, wrist and ankle pain/fullness).

## Discussion

The horizontal posture and the complete lower-extremity unloading appeared to have prevented substantial formation of VGE. This lends support to the notion that Russian cosmonauts have a very low, if any, risk of DCI.



Arm exercise at 0.38 bar (285 mmHg / 7500 m / 25 000 ft)

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