Rigshospitalet

UNIVERSITY OF COPENHAGEN

PLOS ONE

RESEARCH ARTICLE

Impaired Cerebral Autoregulation during Head Up Tilt in Patients with Severe Brain Injury

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How it all started!

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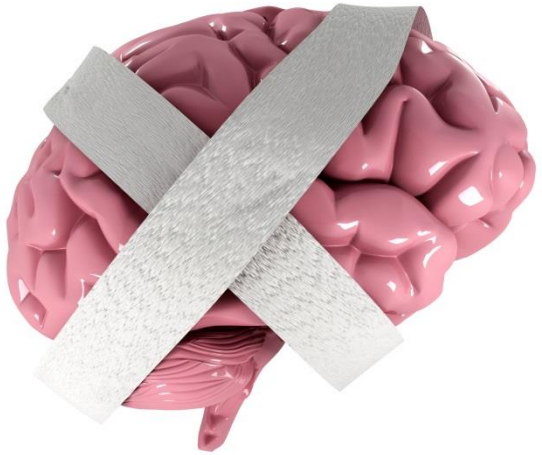
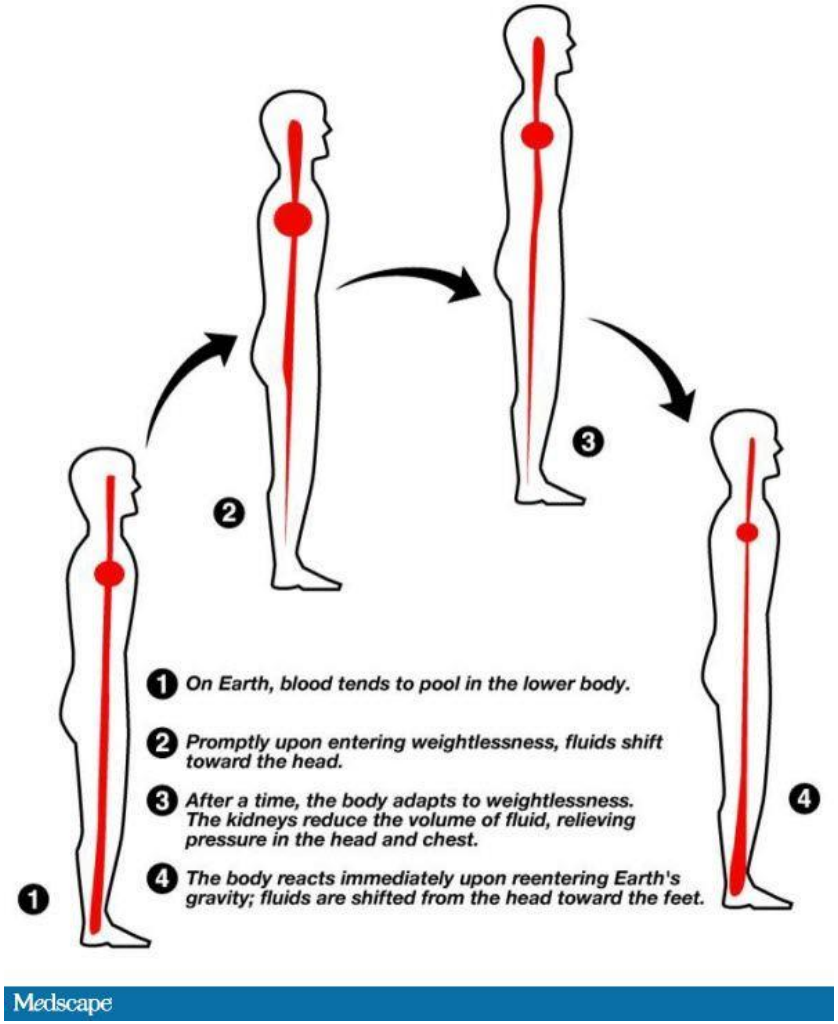


Gravity affecting the cardiovascular system



Gravity affecting the cardiovascular system

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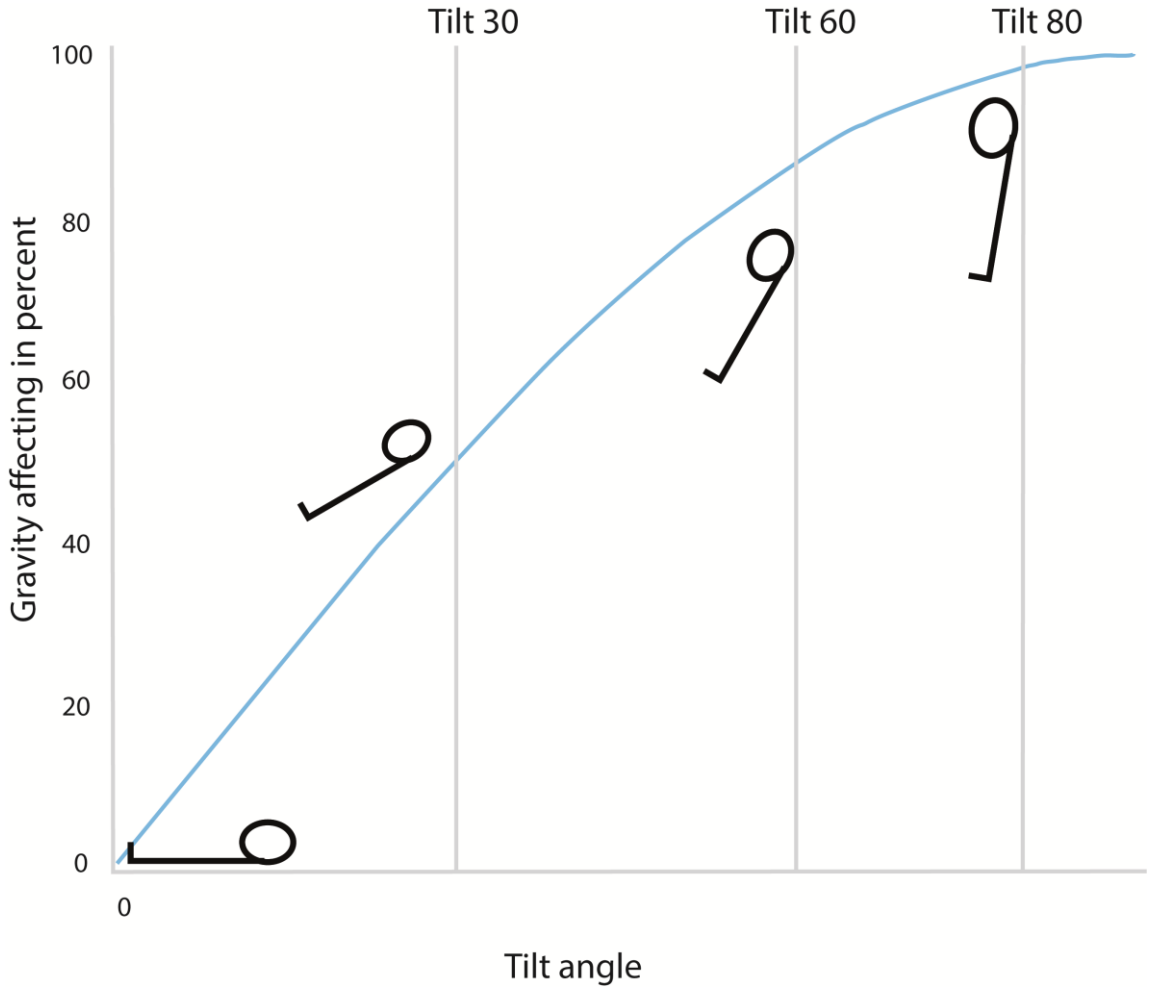

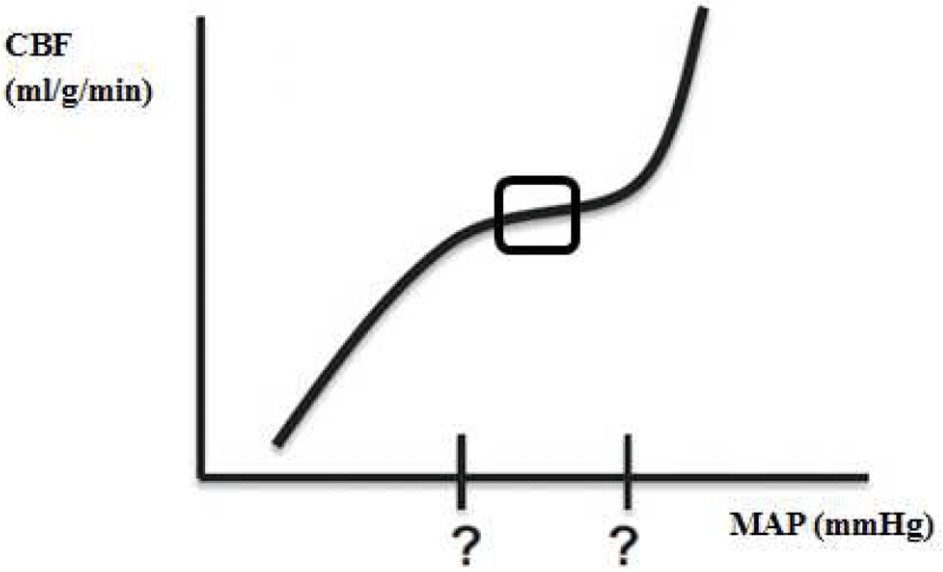

Moerman A and De Hert S. Recent advances in cerebral oximetry. Assessment of cerebral autoregulation with near-infrared spectroscopy: myth or reality? [version 1]. F1000Research 2017, 6:1615 (doi: 10.12688/f1000research.11351.1)

Orthostatic hypotension: 20/10 mmHg
Tachycardia: 30 bpm

Symptoms

Orthostatism

- Loss of consciousness
- Sweating
- Dizziness
- Blurry vision
- Yawning

Clinical question

Do patients with severe **brain injury**, low level of **consciousness** and **orthostatic hypotension** have impaired cerebral autoregulation before, during, and after mobilisation on a tilt table.

Methods

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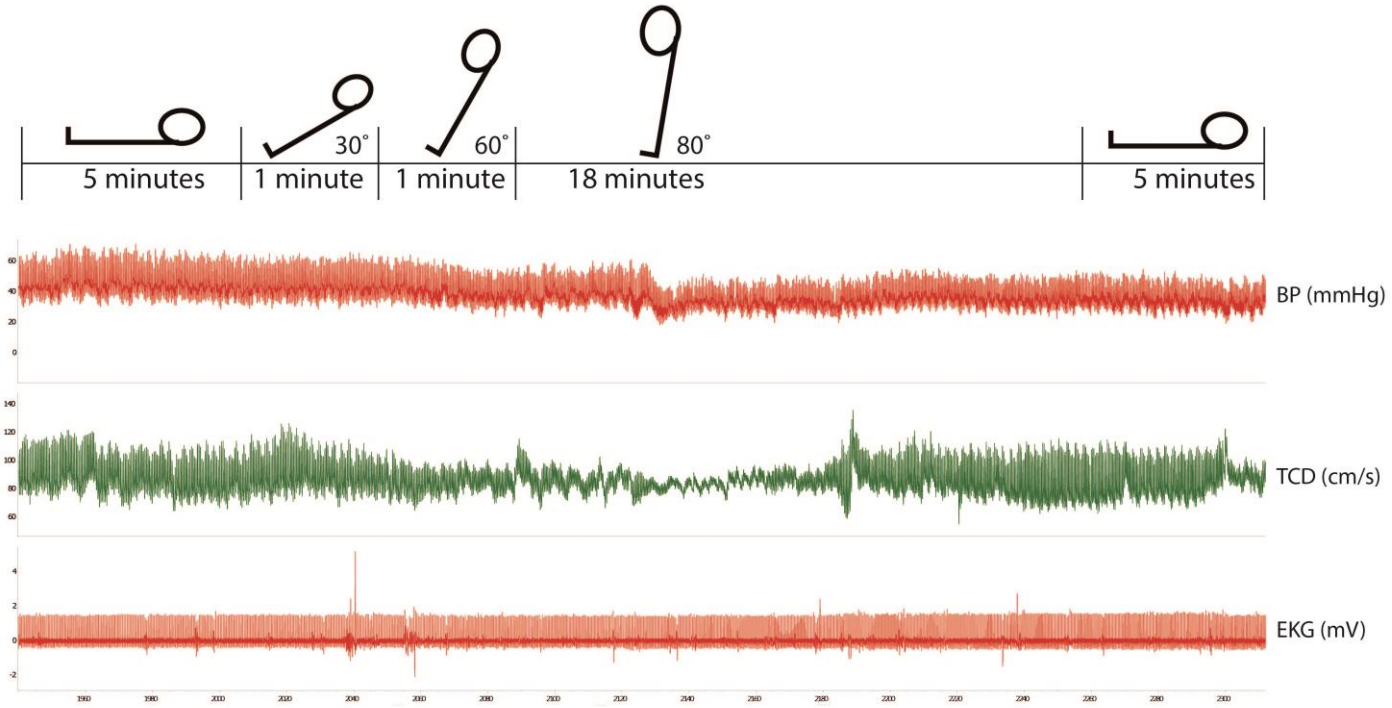
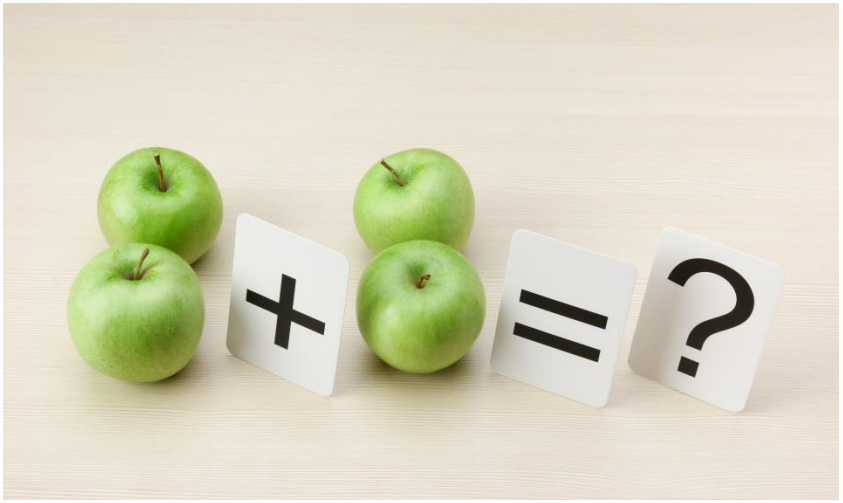
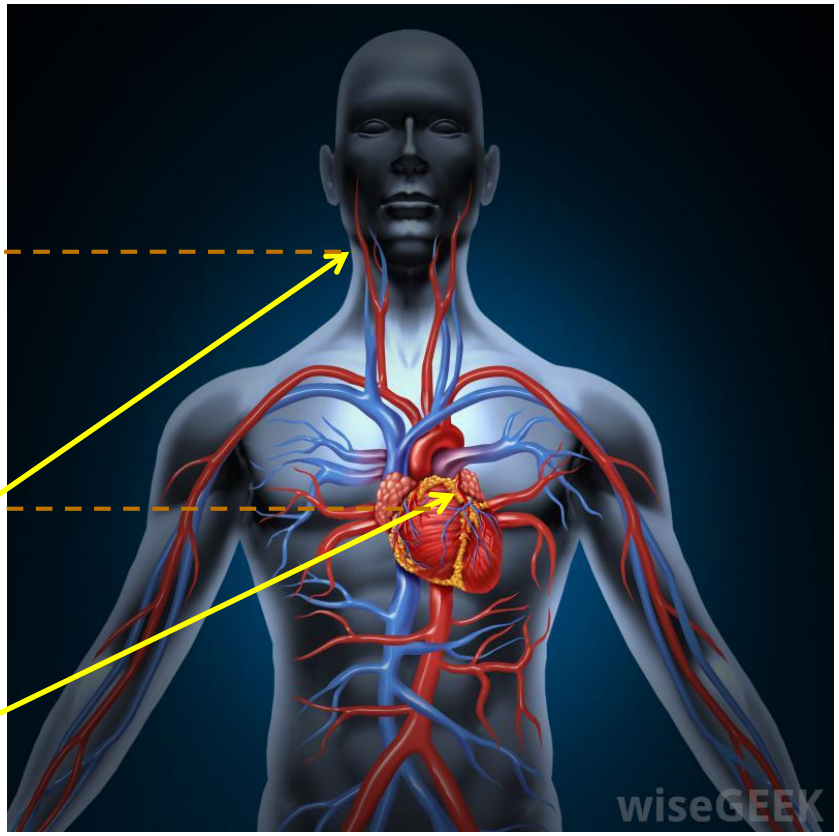


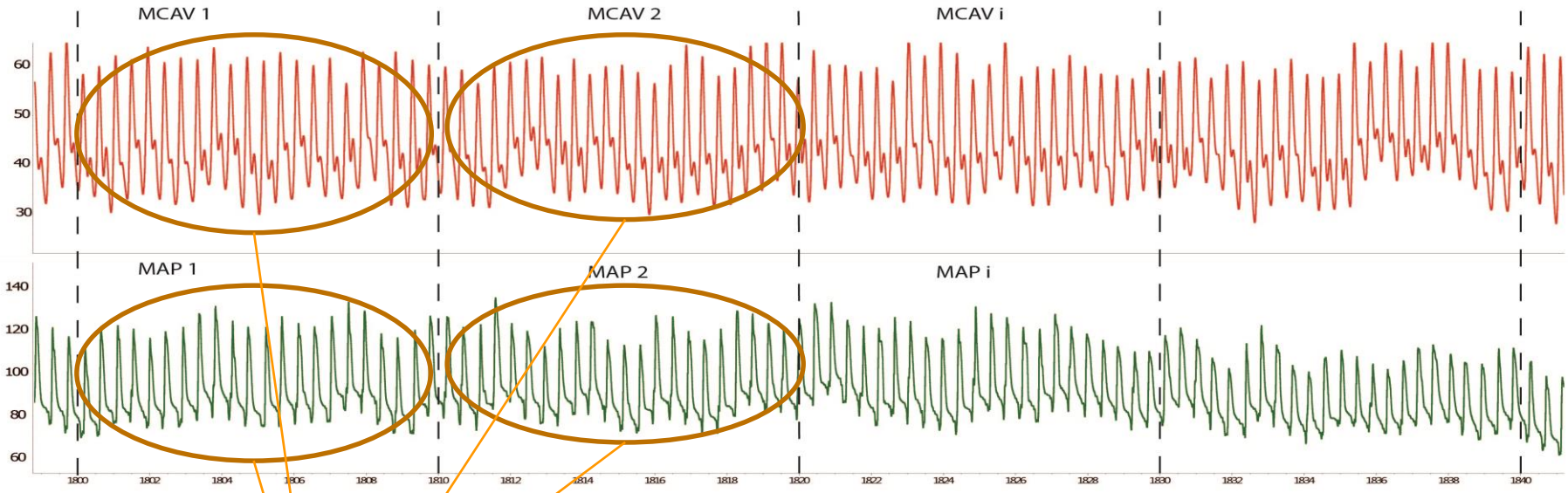


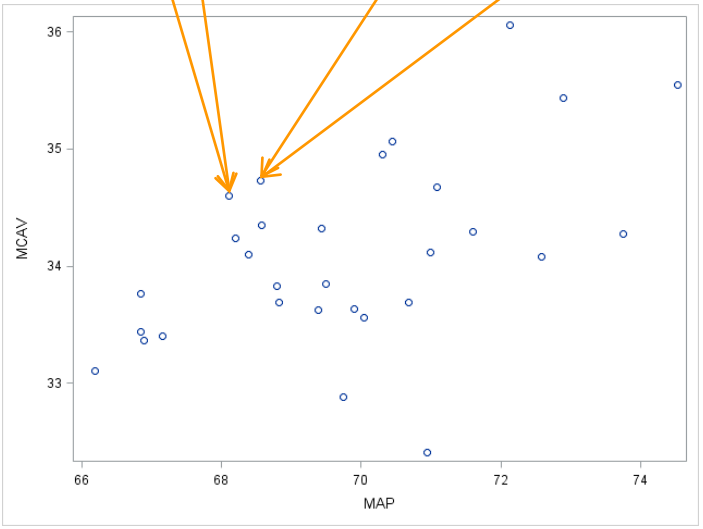
Mean 30 cm

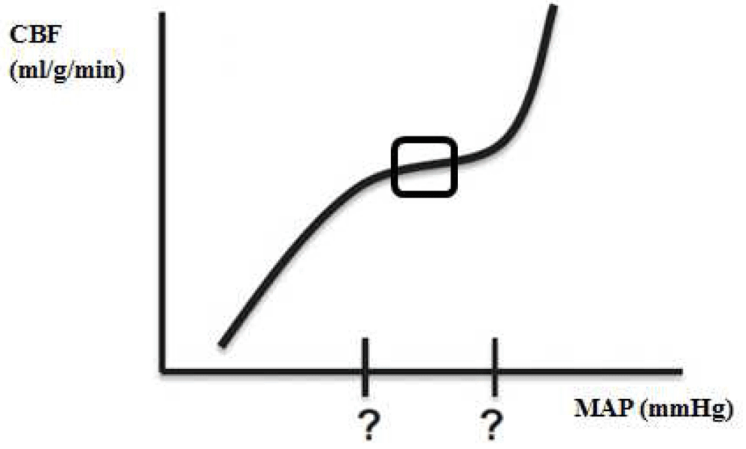


$$CPP_e = MAP_{heart\ level} - 30\ cm \times 0.7\ \frac{mmHg}{cm} \times \sin(tilt\ angle)$$

Cerebral autoregulation Mx







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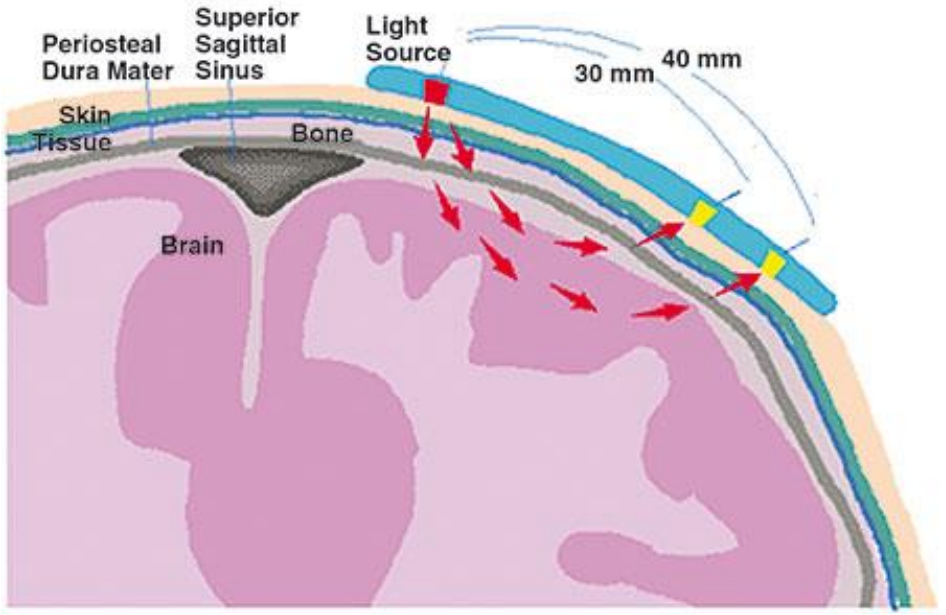
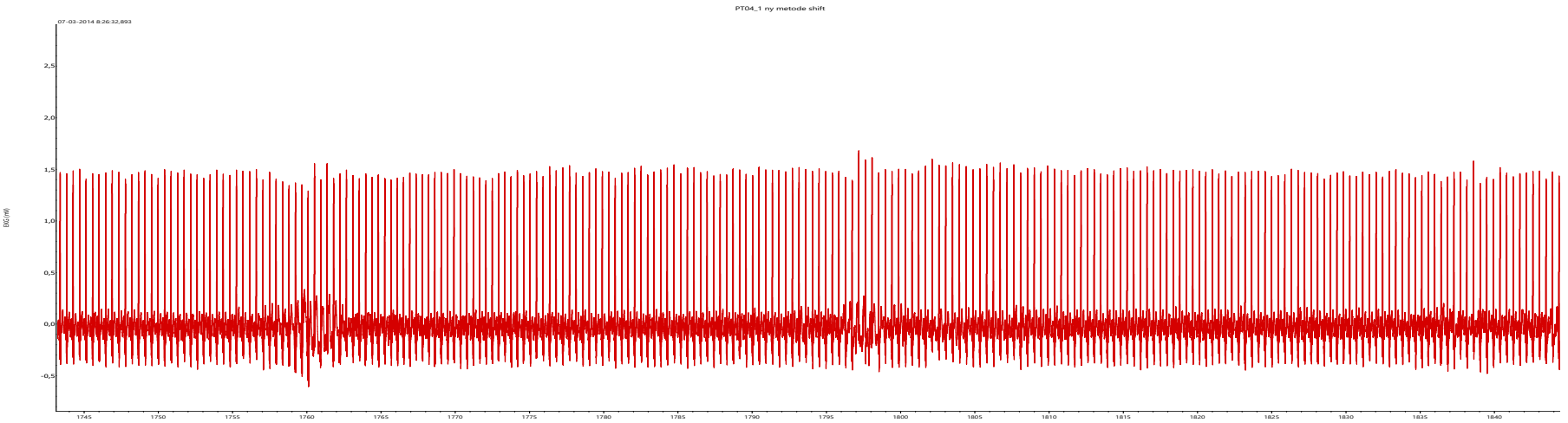
Near Infrared Spectroscopy

- Relationship between deoxy- and oxygenated hemoglobin



Baroreflex



- LF 0.04-0.15 Hz *sympathetic activity*
- HF 0.16-0.35 Hz *parasympathetic activity*

Results

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Table 1. Subject characteristics.

	Patients (n = 14)	Healthy controls (n = 15)
Age [years] (IQR)	64 (49–69)	31 (27–59)
Male sex (%)	7 (50)	7 (47)
Traumatic brain injury (%)	8 (57)	
Cerebral haemorrhage (%)	5 (36)	
Anoxic brain damage (%)	1 (7)	
GCS (IQR)	9 (8; 13)	
MCS (%)	11 (79)	
EFA (IQR)	31 (20; 45)	
FIM (IQR)	18 (18; 18)	
Days since injury (SD)	41 ± 12	
Days in ICU (SD)	26 ± 9	

Results

Table 2. Central and cerebral hemodynamics.

	Baseline [a]	HUT 30° [a]	HUT 60° [a]	HUT 80° [b]	HUT0 [a]	Post-tilt [c]
MAP [mmHg]						
PT	96 (3)*	92 (3)	87 (4) †	93 (4) †	84 (5) †	97 (4)
HC	79 (3)*	77 (4)	79 (4)	82 (4)	92 (4)	80 (3)
HR [beats/min]						
PT	95 (4)*	99 (5)	103 (5)	113 (8)	110 (7)	97 (5)
HC	62 (2)*	69 (3)	71 (3)	76 (4)	82 (3)	61 (3)
CPP_e [mmHg]						
PT	96 (3)*	82 (3)	70 (4) †	72 (4) †	65 (4) †	97 (4)
HC	79 (3)*	66 (4)	61 (4)	62 (4)	73 (3)	80 (3)
MCA Vmean [cm/s]						
PT	43 (3)*	40 (3)	35 (3)	36 (4)	36 (3)	41 (3)
HC	64 (3)*	64 (2)	60 (3)	56 (3)	55 (3)	60 (3)
$rScO_2$ [%]						
PT	65 (2)	64 (3)	61 (3)	63 (2)	57 (3) †	63 (3) †
HC	70 (2)	70 (2)	69 (2)	67 (2)	68 (2)	75 (2)

Results

Table 3. Flow index (Mx).

	Baseline (300 s)	HUT (300 s)	Post-tilt (300 s)
Mxa			
PT	0.04 (0.07)*	0.35 (0.09) †	-0.02 (0.06)
HC	0.35 (0.07)*	-0.15 (0.10)	0.39 (0.08)
Mxc			
PT	0.04 (0.07)*	0.50 (0.09) †	-0.02 (0.06)
HC	0.35 (0.07)*	0.28 (0.07)	0.39 (0.08)

Results

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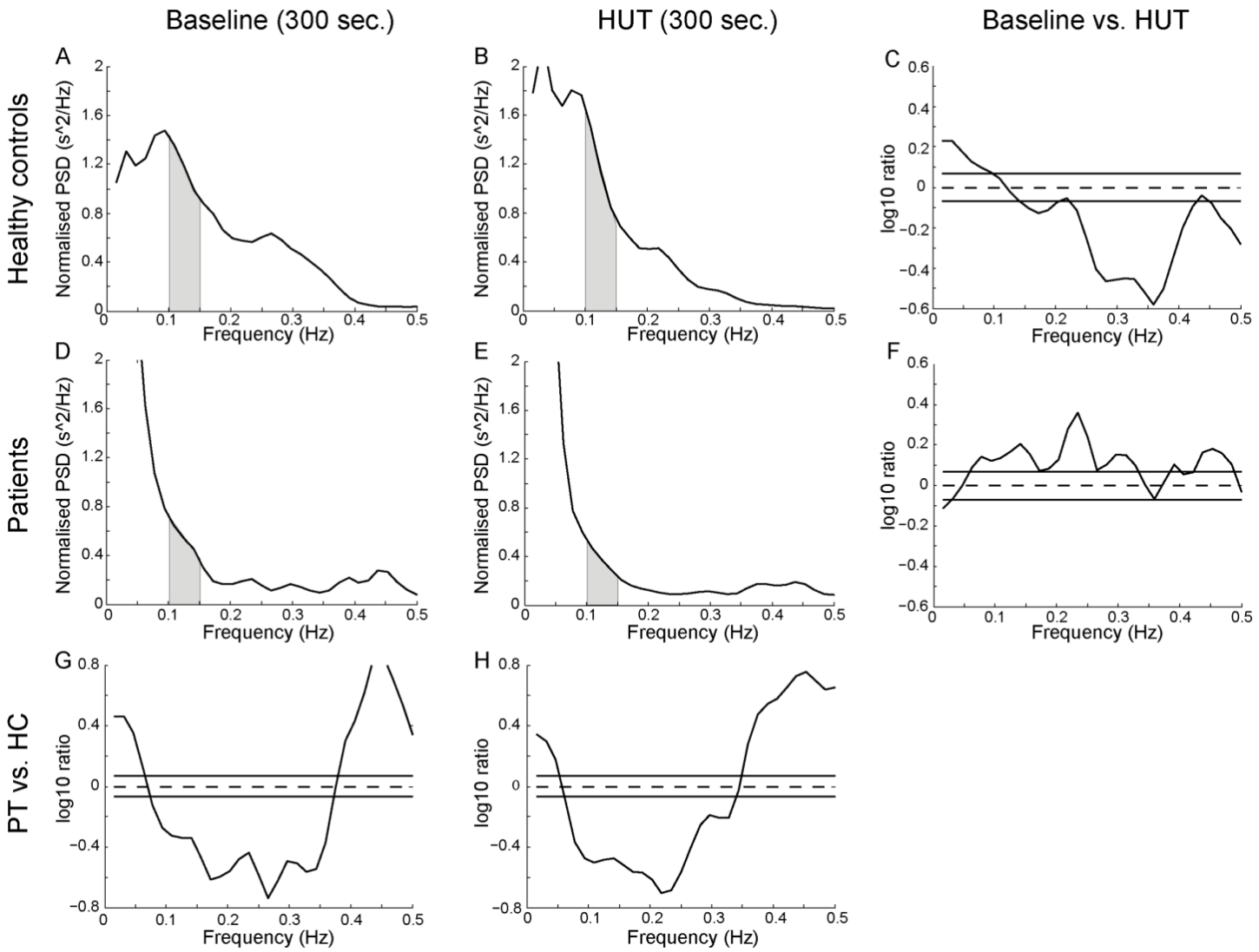

Discussion

- Investigating cerebral autoregulation of blood flow using HUT
- Impaired cerebral autoregulation in severe traumatic brain injury
- Immobilisation or brain injury?

Conclusion

- Impaired cerebral autoregulation during HUT

- 40 days after ABI

Questions

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