INFN FERRARA
Istituto Nazionale di Fisica Nucleare
Sezione di Ferrara

University of Ferrara
Department of Physics and Earth Sciences

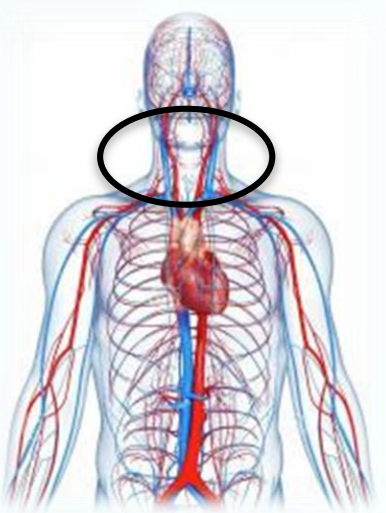
UNIVERSITY OF FERRARA - ITALY
Vascular Diseases Center

A multiscale model for the simulation of cerebral and extracerebral blood flows and pressures in humans

Dott. Giacomo Gadda

31-05-2019

Model features



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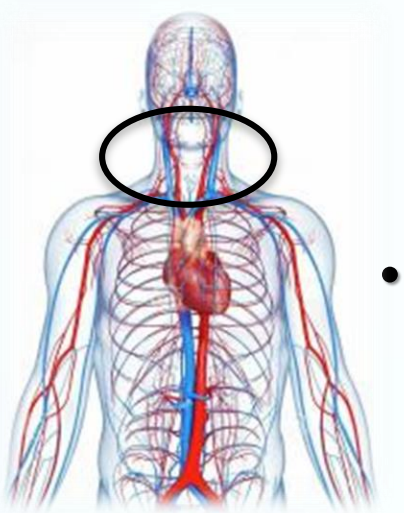
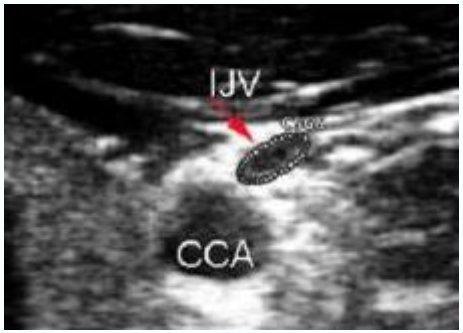
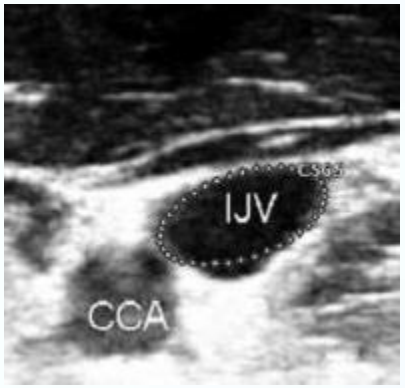


- **POSTURE**





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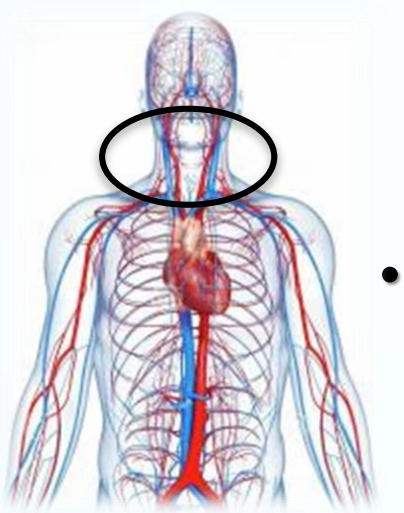
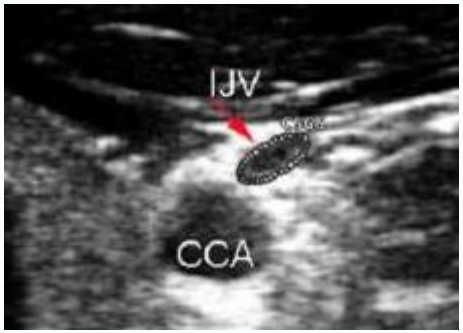
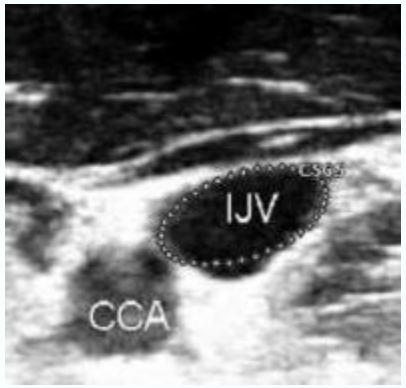
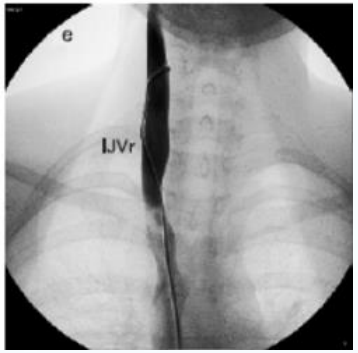






- **POSTURE**

- **STENOSIS**



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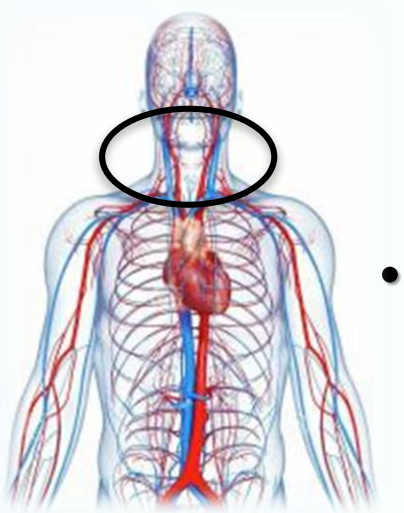

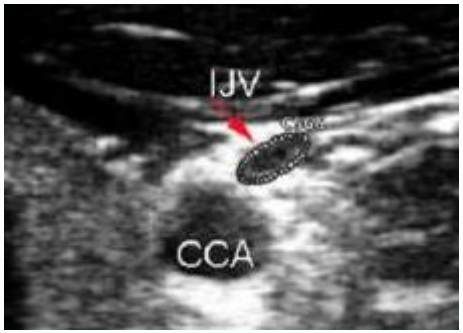

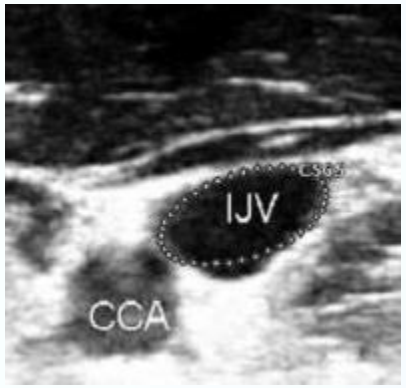

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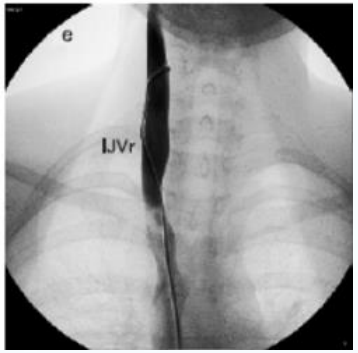
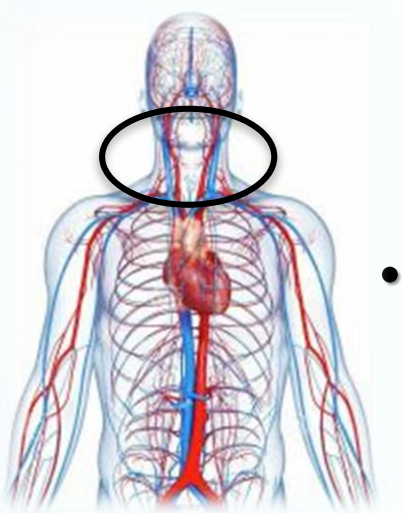
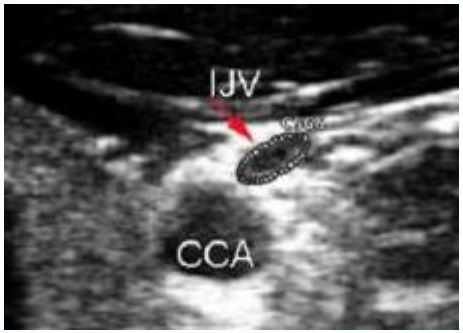


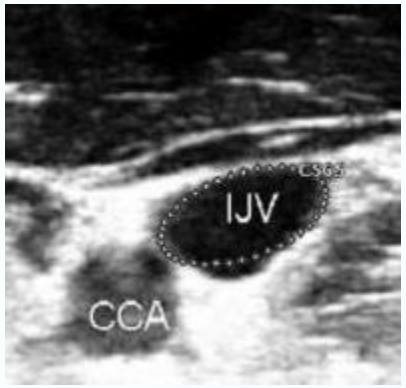
- **STENOSIS**

- **BREATHING**

Model features







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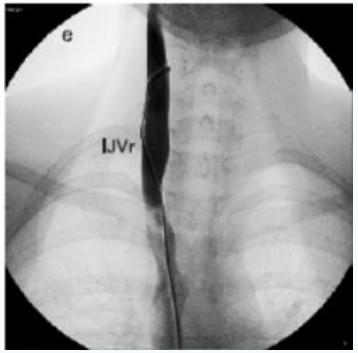
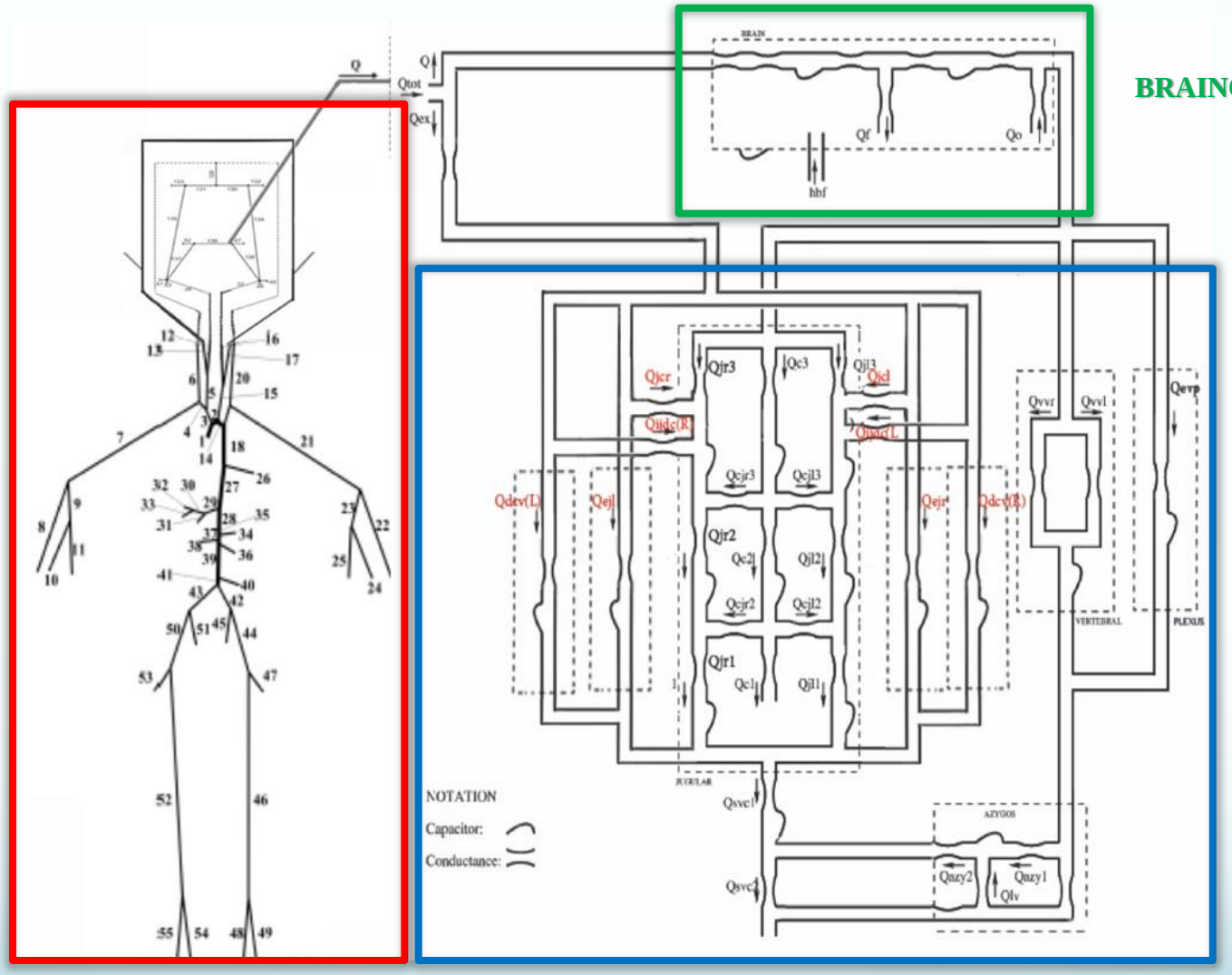


- **STENOSIS**

- **BREATHING**

- **PaCO2 PRESSURE**

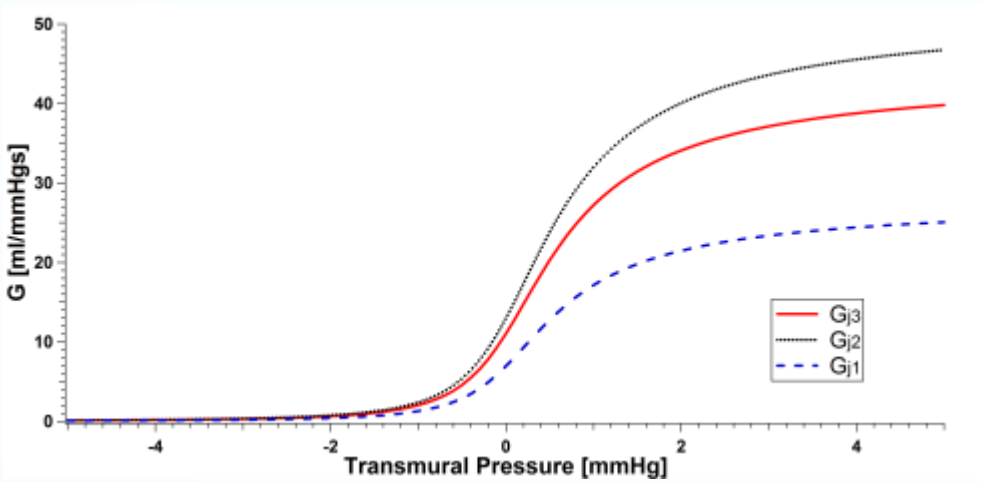
Scheme of the model

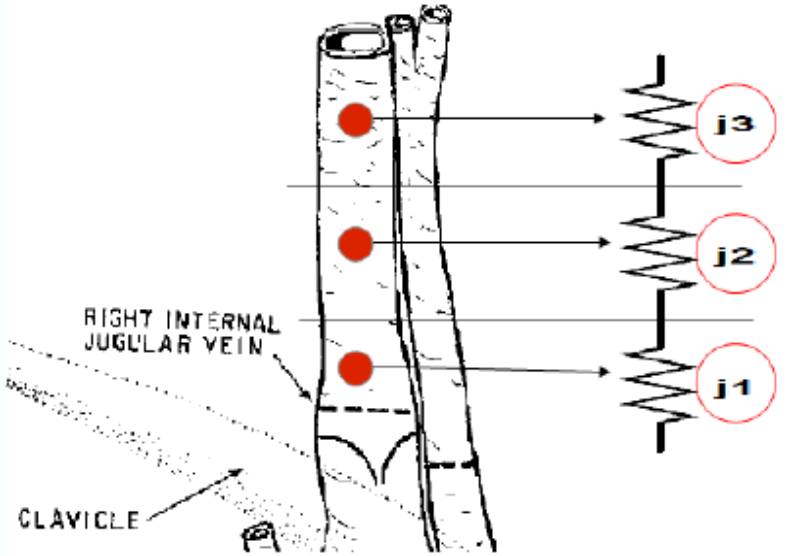


Gadda et al. *AM J Physiol* – 2015
Gadda et al. *AJNR* – 2016
Gadda et al. *Eur J Appl Physiol* – 2018

Gadda et al. *Conf Proc IEEE* – 2015
Gadda et al. *Conf Proc RTSI* – 2016

Posture modelling

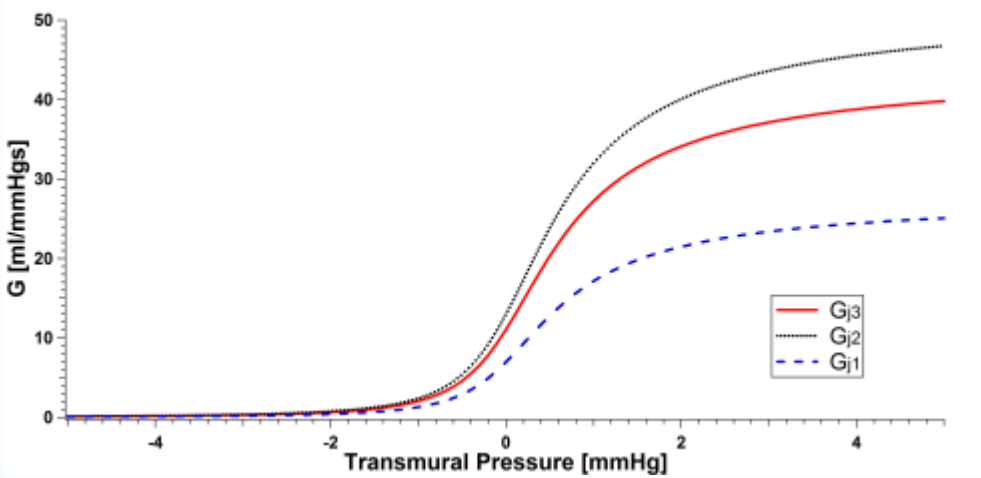


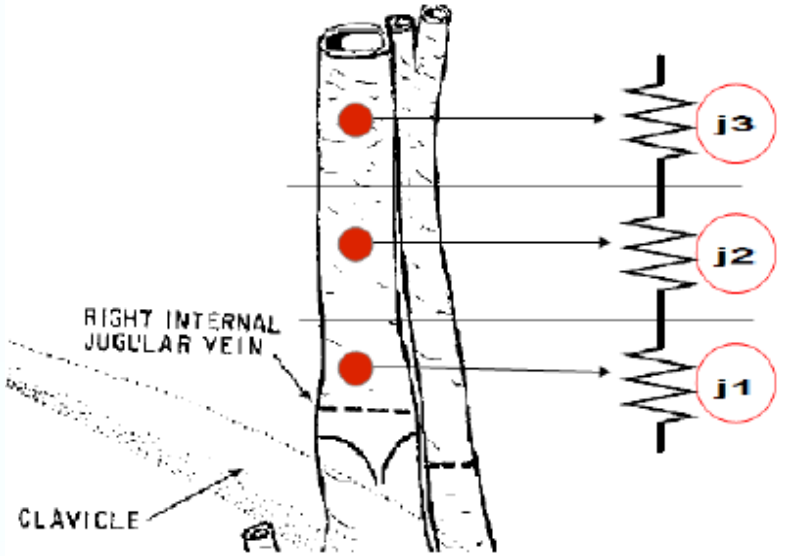


$$G_x = k_x\left(1 + \left(\frac{2}{\pi}\right)\tan^{-1}\left(\frac{P_{x\,int} - P_{x\,ext}}{A}\right)\right)^2$$

Gadda et al. *AM J Physiol* – 2015

Posture modelling





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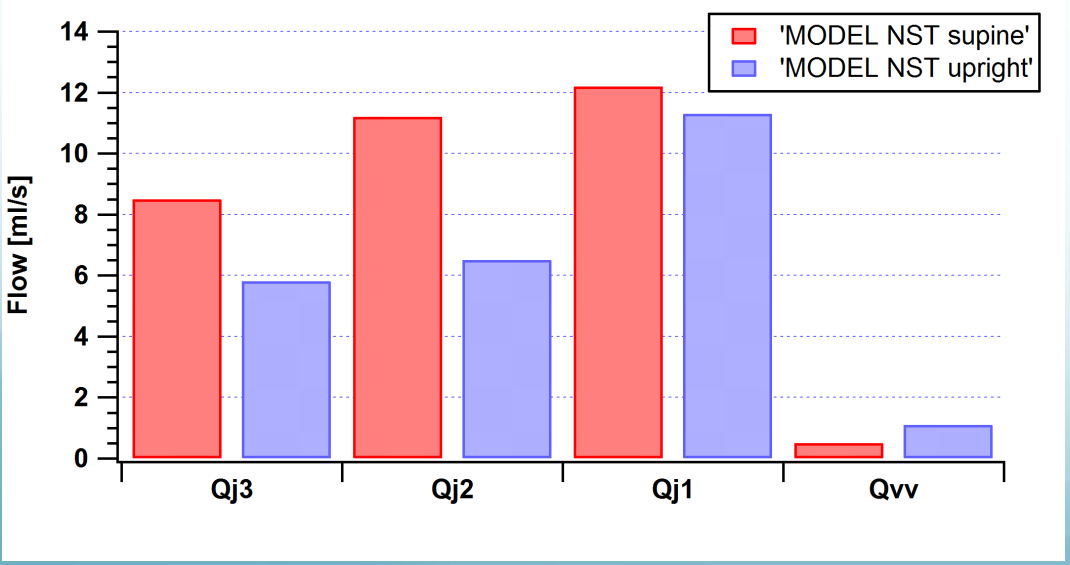
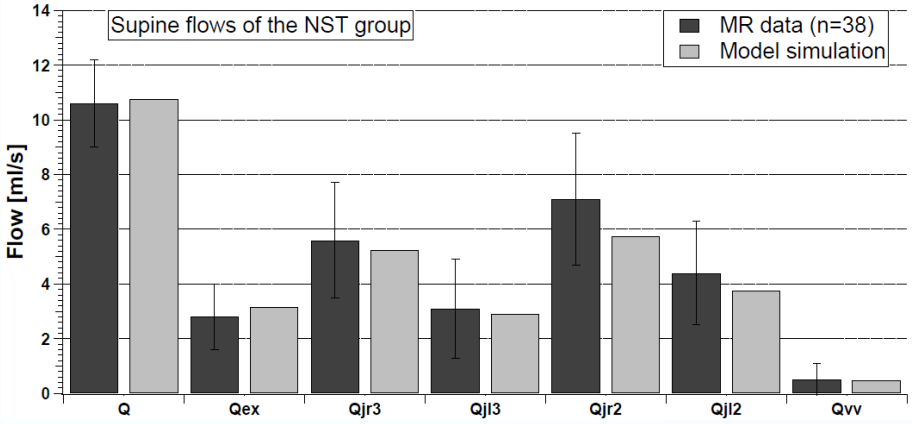


US	supine	upright	variation
Qj3	6.0±2.6	4.1±2.0	-32%
Qj2	8.9±3.4	5.2±3.3	-42%
Qj1	22.0±10.3	20.4±12.5	-7%
Qvv	1.1±0.7	2.3±1.2	+109%

Every flow Q_x is reported in ml/s

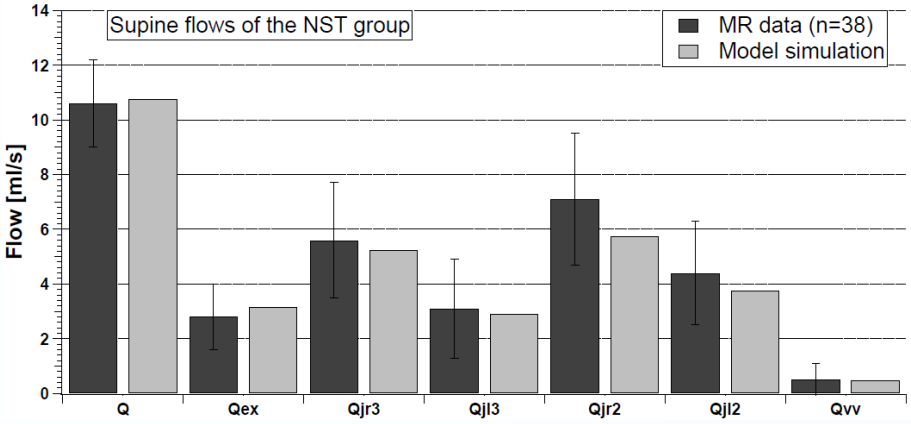
Gadda et al. *AJNR 2016*

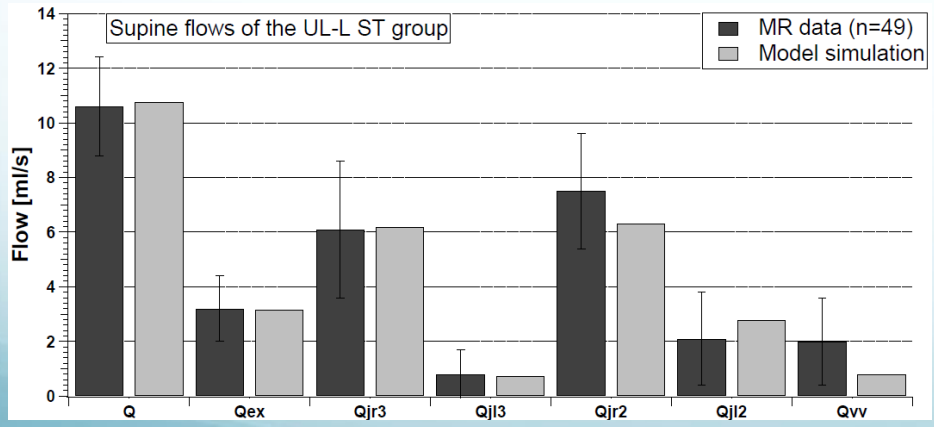
Stenosis modelling

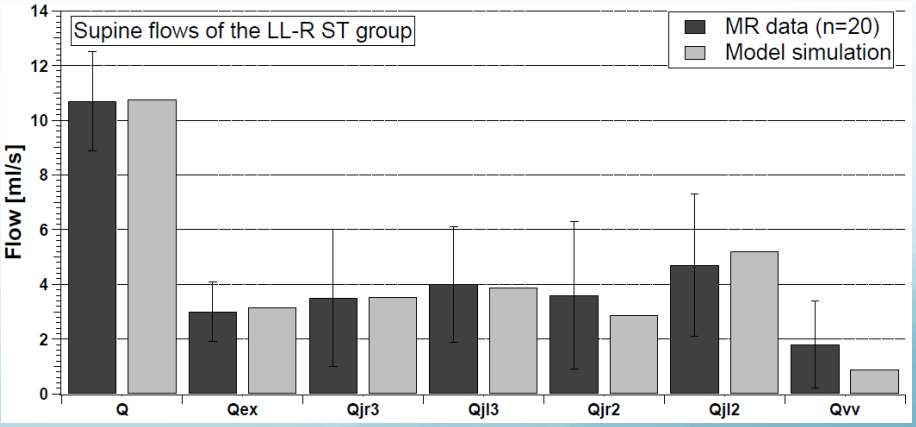


Gadda et al. *AJNR 2016*

Stenosis modelling

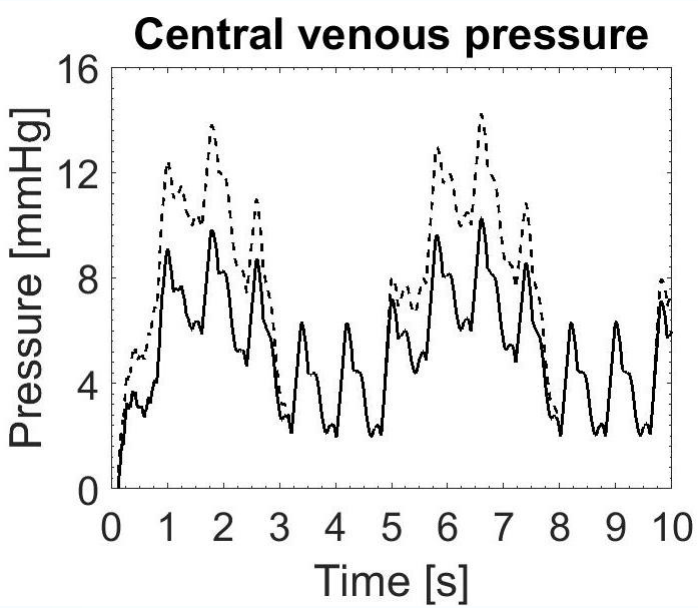






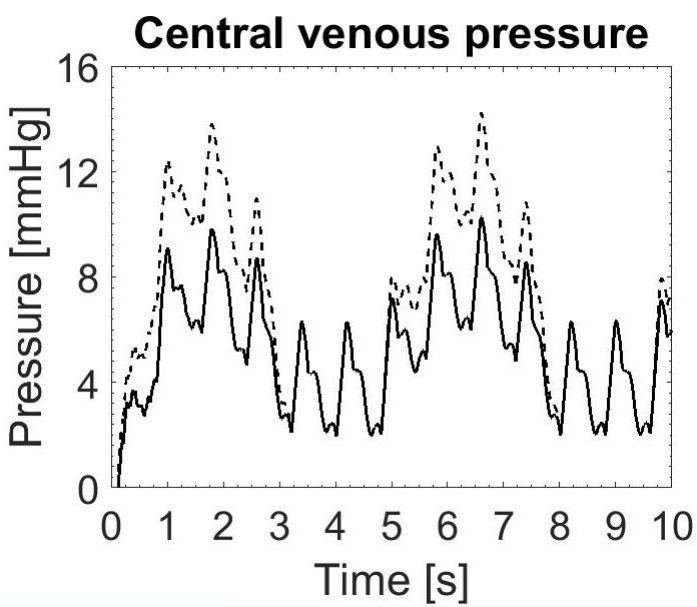
Gadda et al. *AJNR 2016*

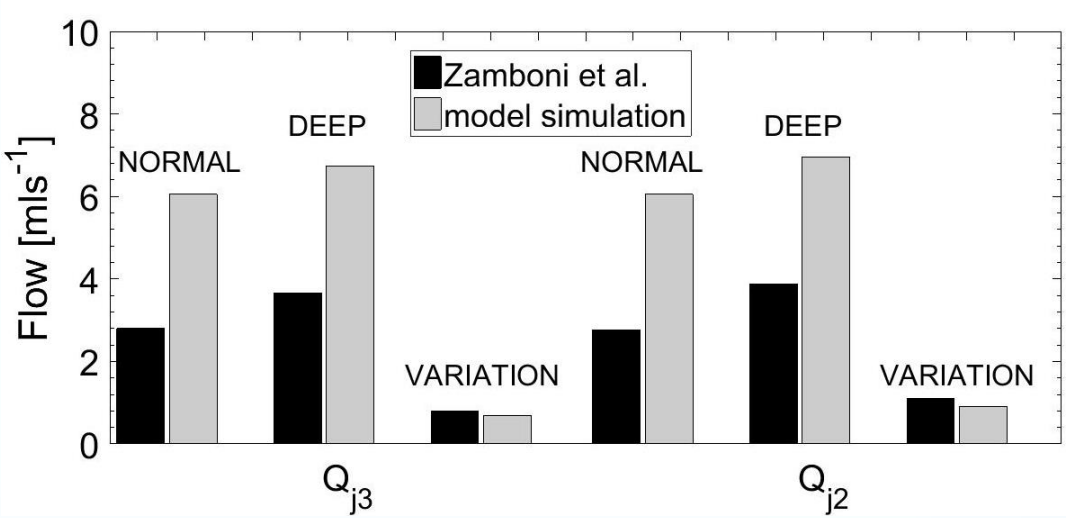
Pressure modelling



Gadda et al. *Eur J Appl Physiol 2018*

Pressure modelling





Gadda et al. *Eur J Appl Physiol 2018*

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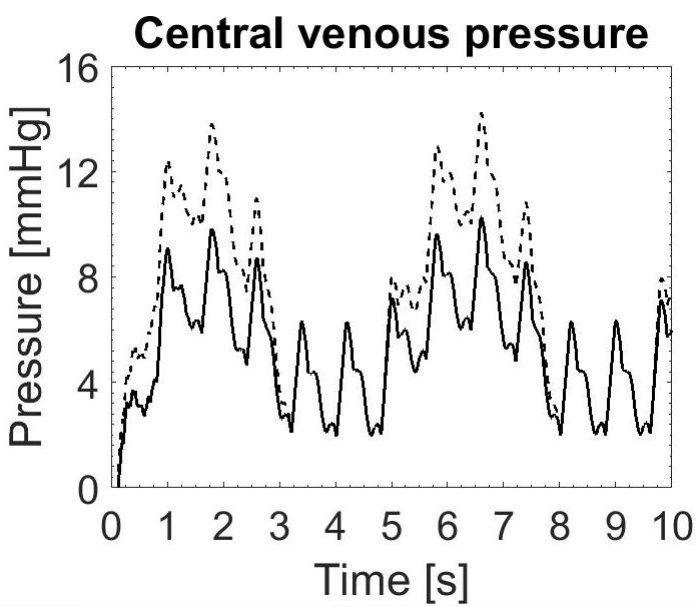
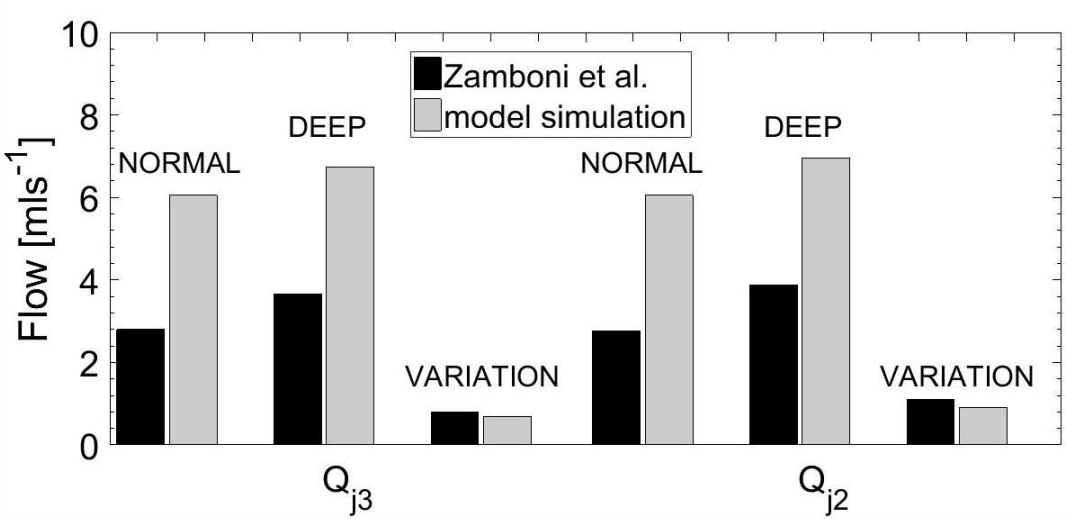
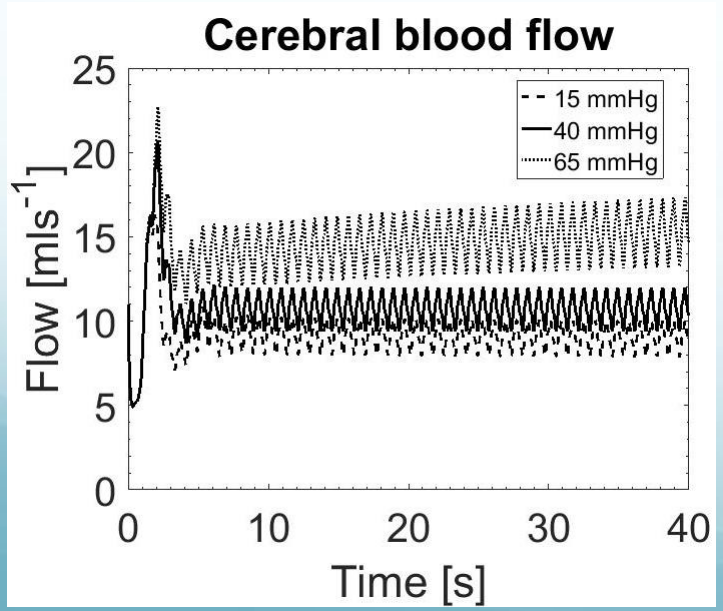
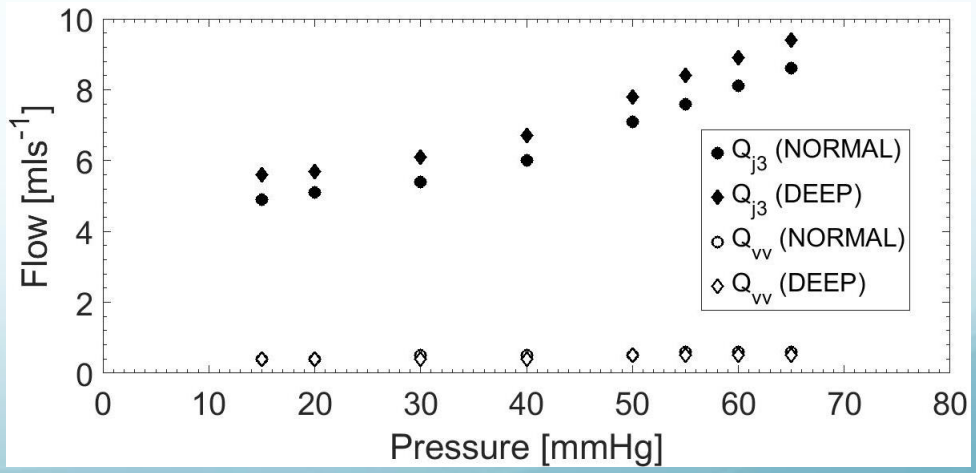


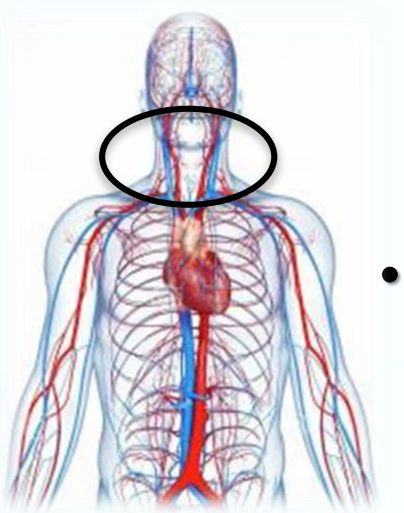


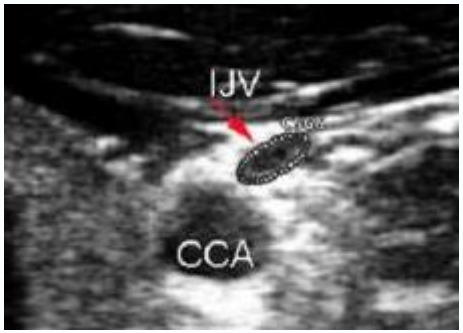


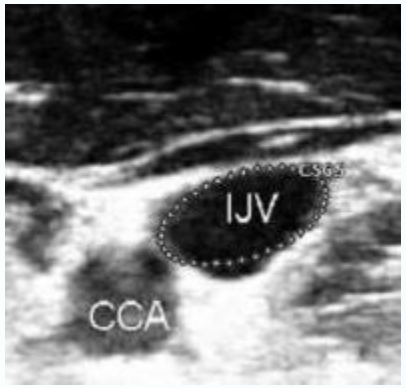


Gadda et al. *Eur J Appl Physiol 2018*

Model features







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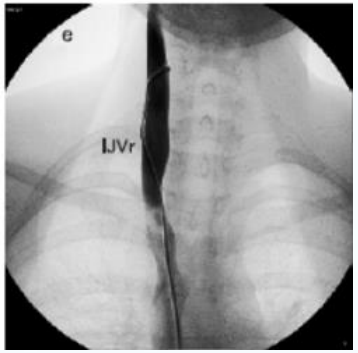
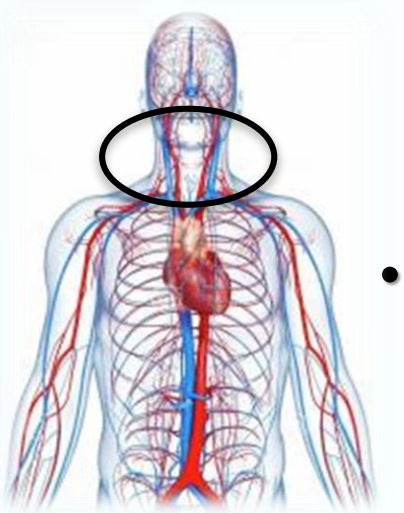


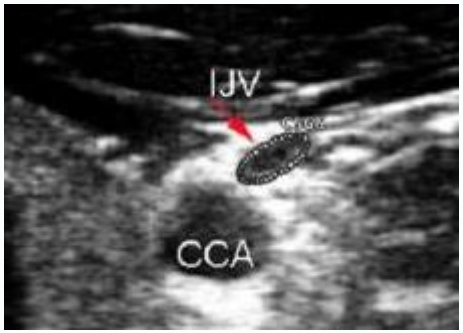
- **STENOSIS**

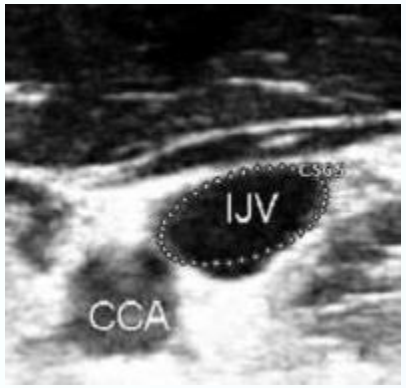
- **BREATHING**

- **PaCO2 pressure**

Model features







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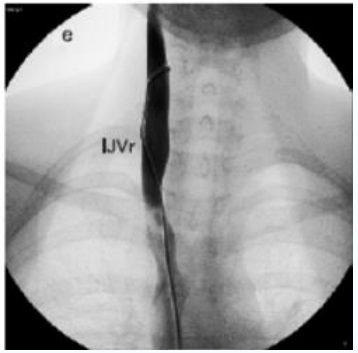
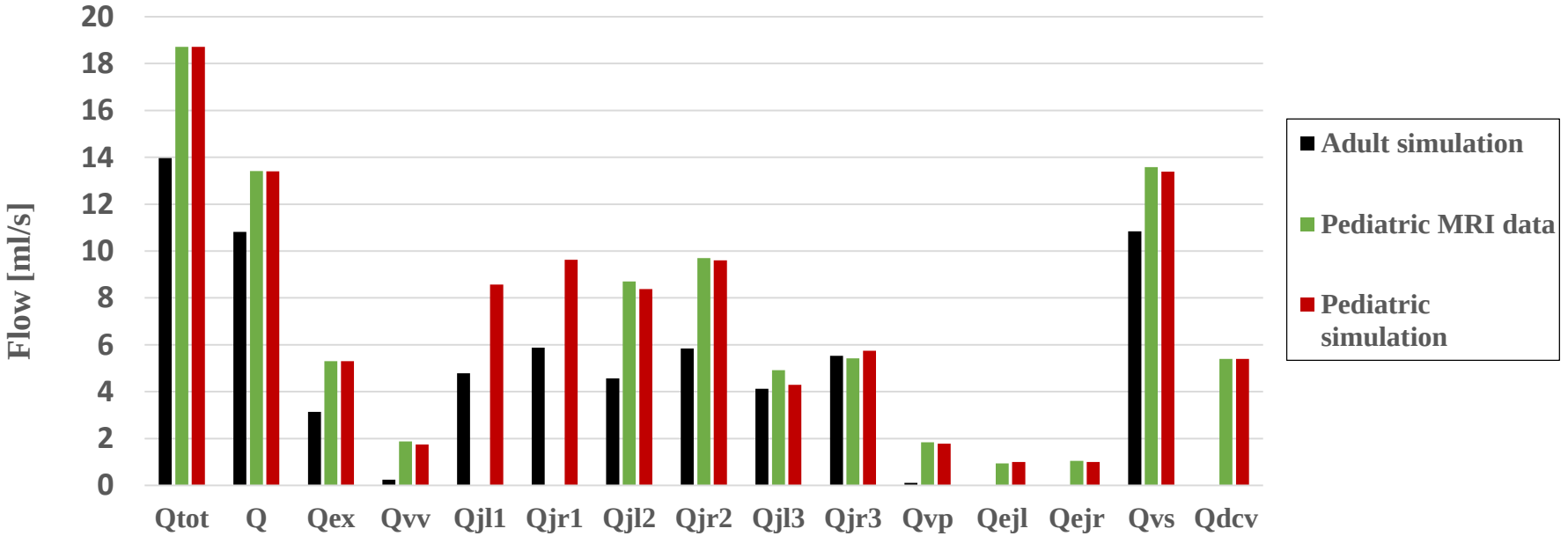
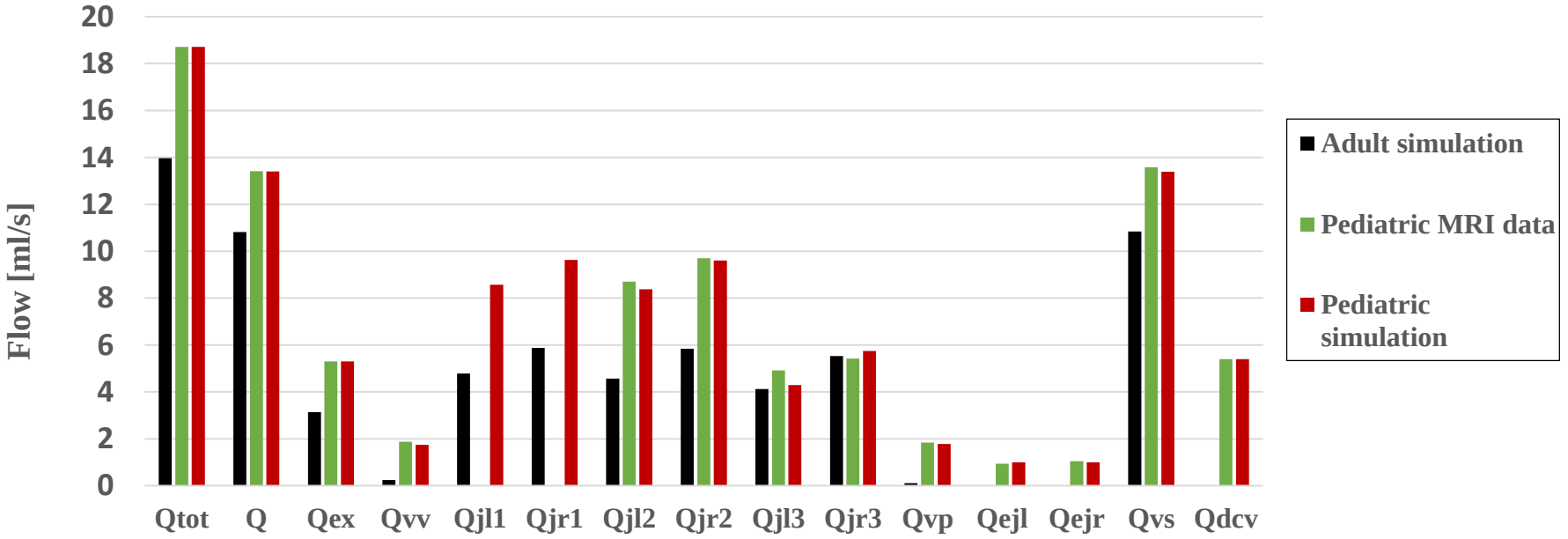


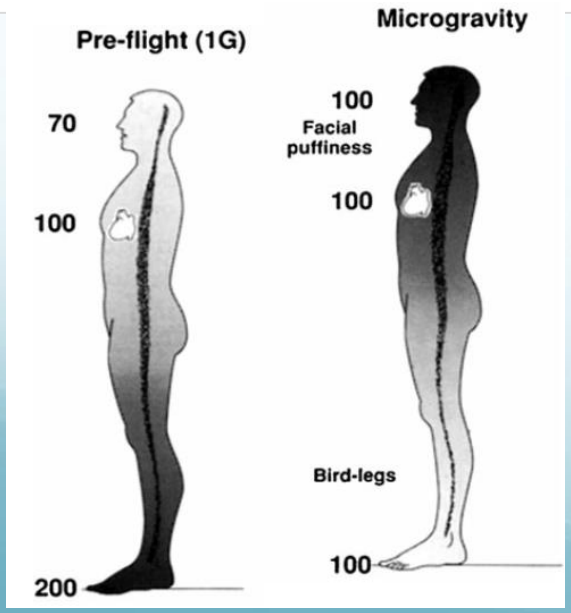
- **STENOSIS**
- **BREATHING**
- **PaCO2 pressure**
- **AGING**
- **MICROGRAVITY**

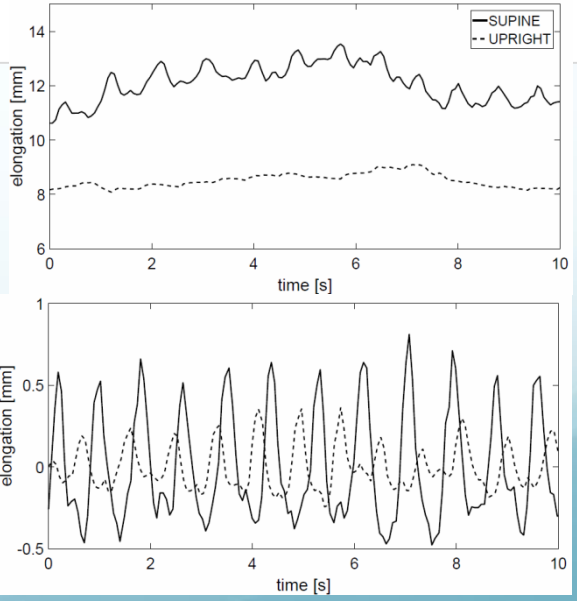
Future developments



Future developments







Taibi et al. *Sens Actuators A Phys* 2018 Taibi et al. *Physiol Meas* 2017

Thanks for your attention

Aging modelling