Effect of abrupt preload reduction on left atrial and ventricular pressures in a multi-scale mathematical model of the cardiovascular system

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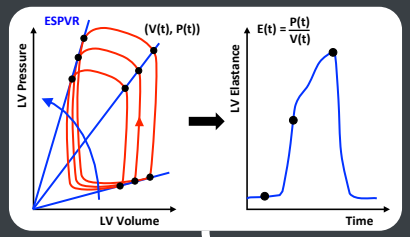
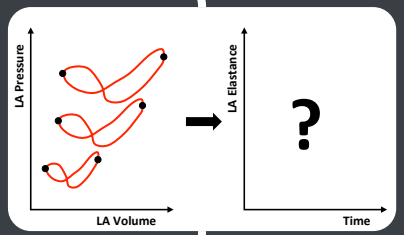
Purpose



The time-varying elastance theory is widely applied to the left ventricle.

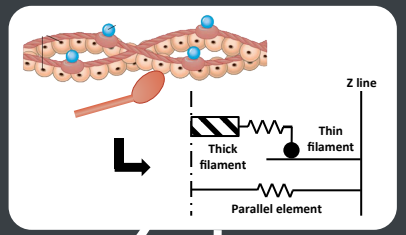
It is not sure if left atrial (LA) elastance is load-independent, which prevents its application.

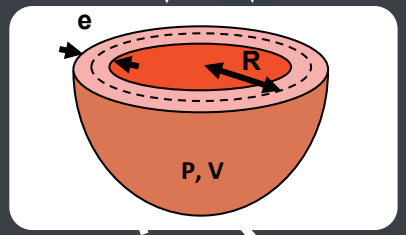


Left atrial behavior is difficult to reproduce *in silico*.

Methods

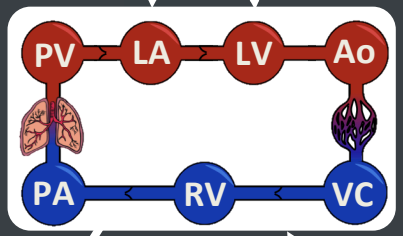
Computer model of one atrial and one ventricular sarcomere [1].

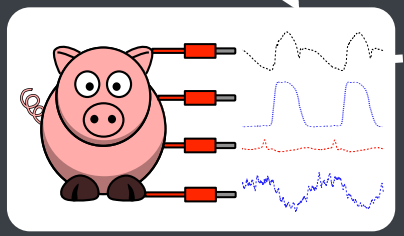




Simple geometrical model of the left atrium and ventricle

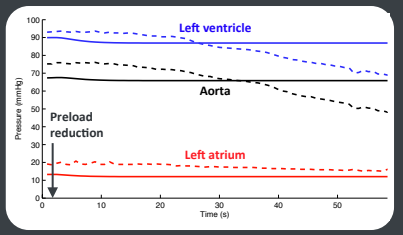
Computer model of the cardiovascular system





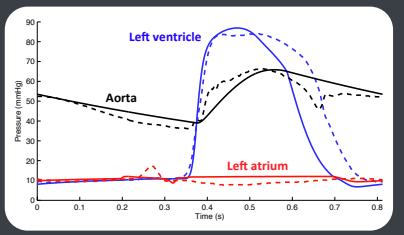
Adjustment of the model parameters to pig experimental data

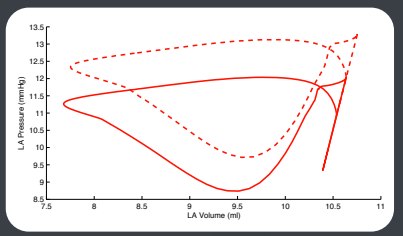
Results



Maximal measured (- -) and simulated (–) pressures during preload reduction

Measured and simulated pressures during one cardiac cycle





Simulated left atrial pressure-volume loops before (- -) and after (–) preload reduction

Conclusions

This model correctly accounts for LA behavior and responds to preload reduction experiments as physiologically expected.
It thus represents a valid substitute to the time-varying elastance method.

[1] Pironet, A., Dauby, P. C., Paeme, S., Kosta, S., Chase, J. G., & Desaive, T. (2013). Simulation of left atrial function using a multi-scale model of the cardiovascular system. *PLoS ONE*, *8*(6).

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The authors declare no competing interest.