

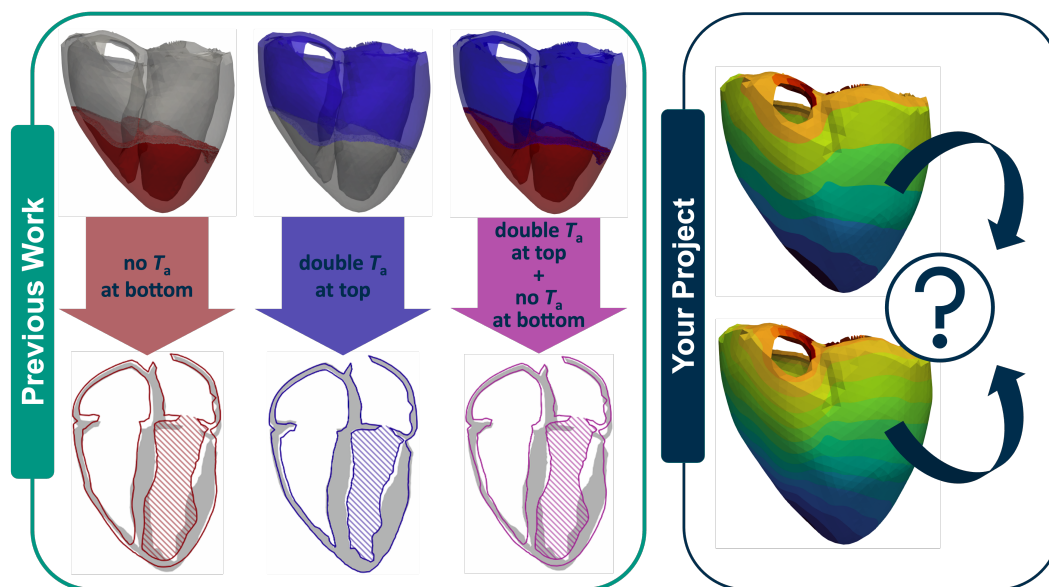
Investigating the Broken Heart Syndrome

Bachelor / Master thesis

Motivation

Takotsubo syndrome (TTS) is a reversible form of heart failure leading to regional ventricular contraction irregularities. It typically affects postmenopausal women following a stressful trigger, why it is also called the "Broken Heart Syndrome". The most common phenotype for TTS is characterized by a transient ballooning of the left ventricle during contraction. While the upper part of the ventricles constricts, the lower part barely moves, resulting in a balloon-like shape of the ventricle and a substantial loss in pump function.

The pathophysiology underlying Takotsubo syndrome remains largely unclear. Computational models of the heart can help to dissect and analyze mechanisms that could contribute to the typical ballooning pattern.



Student Project

In my previous work, I divided the ventricles horizontally into two parts and varied the contractile force (T_a) in both sections to reproduce the typical ballooning contraction pattern (s. Figure above). A stronger contraction in the upper ventricles combined with no contraction in the lower ventricles (violet results) most effectively mimicked the ballooning pattern. The separation of the ventricles in only two parts is not really physiological and was only meant as a proof of concept. Your project would be to divide the ventricles into smaller, finer regions to model a gradient in contractile force. As a possible addition, you could go upstream and test how the variation of calcium levels or other ionic currents influence the contractile force and therefore the contraction pattern. The results from those simulations can provide deeper insight into the underlying mechanisms of Takotsubo syndrome.

Notes

The thesis can be conducted in German or English.

Research Area

Computational Cardiac Modeling, Electromechanical Modeling, Whole Heart Simulations

Course of Studies

Computational Engineering, BME, ETIT or anything comparable...

Starting Date

September

Posted Date

19.08.2026

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