The Effect of Variation of Myocardium Wall Thickness on the Evolution of Ischemic Heart Wall Stress and Movement: A Computational Modelling

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Abstract:
Myocardial infarction (MI) is the common cause of heart failure, which happens following a myocardial ischemia. Left ventricular (LV) remodeling has been associated with the long-term outcomes following MI. The infarct region is growing and becoming stiffen over time as a result of remodeling, causing the LV to weaken and dilate. However, the evolution of the infarct growth starting from the shortage of the oxygen supply have not been extensively studied, thus further work involving a complete cardiac cycle is required to study the progressive effect of ischemic changes on both active and passive myocardial behaviors. This work aims to investigate the motion of the ischemic myocardial wall in a complete cardiac cycle using a 3D electro-chemical mechanical coupled mathematical model. The study on how the shortage of oxygen and different wall thickness affects the ischemic myocardium wall motion over time will also be examined. The finding shows a reduction in strain value at the early systole, which suggests a progressive stiffening of ischemic myocardium that contributes to the increase of the peak wall stress over time. Peak wall stress is an important determinant of myocardial oxygen consumption. Reduction of the wall thickness will increase the occurrence of the peak systolic wall stress.

Keywords: Myocardial infarction; Wall movement; LV remodeling; Ischemic heart

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