

Assignment 1 - CBoTH: Simulation of bioelectric activity in the heart during myocardial ischemia: effects of acidosis

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Model The following results have been obtained through the Ten Tusscher model (*ten Tusscher KH, Noble D, Noble PJ, Panfilov AV. A model for human ventricular tissue. Am J Physiol Heart Circ Physiol. 2004 Apr;286(4):H1573-89. doi: 10.1152/ajpheart.00794.2003*) in MATLAB, aiming to evaluate the pro-arrhythmic effects of ischemic-induced acidosis.

Parameters In order to simulate the condition of acidosis, the three currents of I_{Na} , I_{CaL} and I_{NaCa} have been progressively and linearly decreased during the course of the first 15 minutes of Phase 1A of ischemia. This operation has been performed by setting a multiplication factor that linearly decreases from 1 over time, reaching at 15 minutes the value of 0.5 for I_{Na} and I_{CaL} and 0.1 for I_{NaCa} . The simulation has been performed 10 times (once for each of the first 10 minutes of Phase 1A), with a preconditioning of 600s followed by 75 stimuli for each simulation.

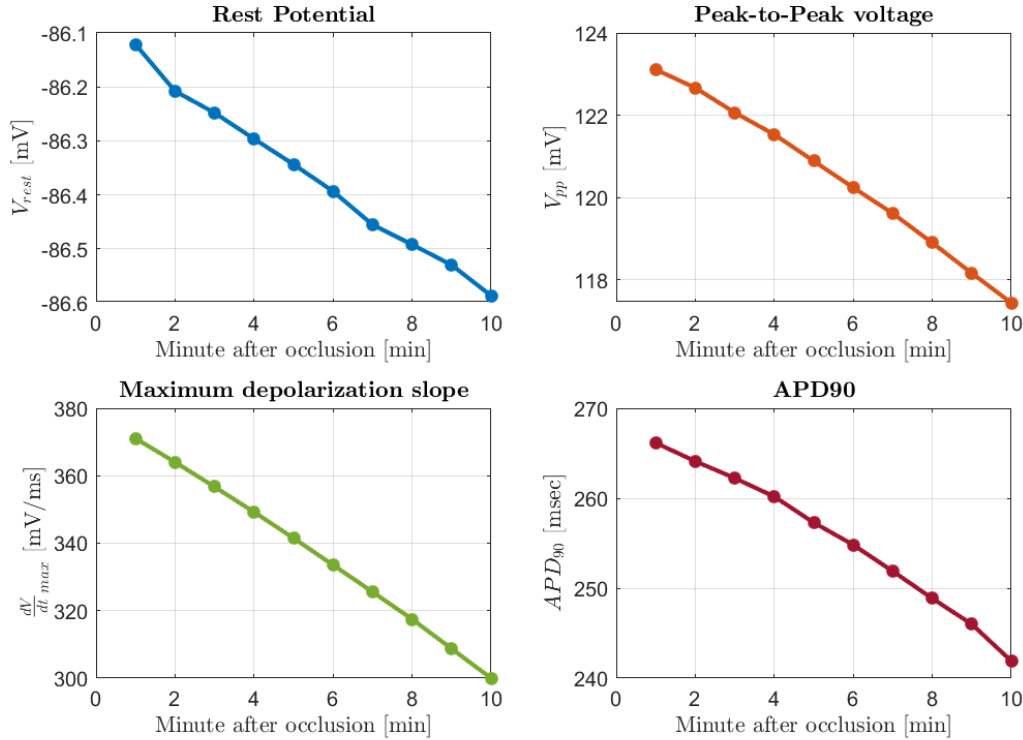


Figure 1: Time evolution of the biomarkers evaluated in Phase 1A of myocardial ischemia under the effect of acidosis

Discussion All of the biomarkers taken in consideration show a consistent decrease over time. In Phase 1A of ischemia, therefore, the decrease of rest potential shifts the action potential downwards; also, a reduction in V_{pp} lowers the peak value. The depolarization slope also decreases, meaning the action potential reaches its peak values later. The most influential factor for ischemic-induced cardiac arrhythmias is the reduction of the APD90 biomarker. The decrease over time of such value shows that it takes less time for the cardiomyocyte to "relax" to its rest potential. In conclusion, the reduction of APD90 and the consequential increased triangularity of the action potential is a signal that **acidosis in cardiomyocytes could have a pro-arrhythmic effect**.

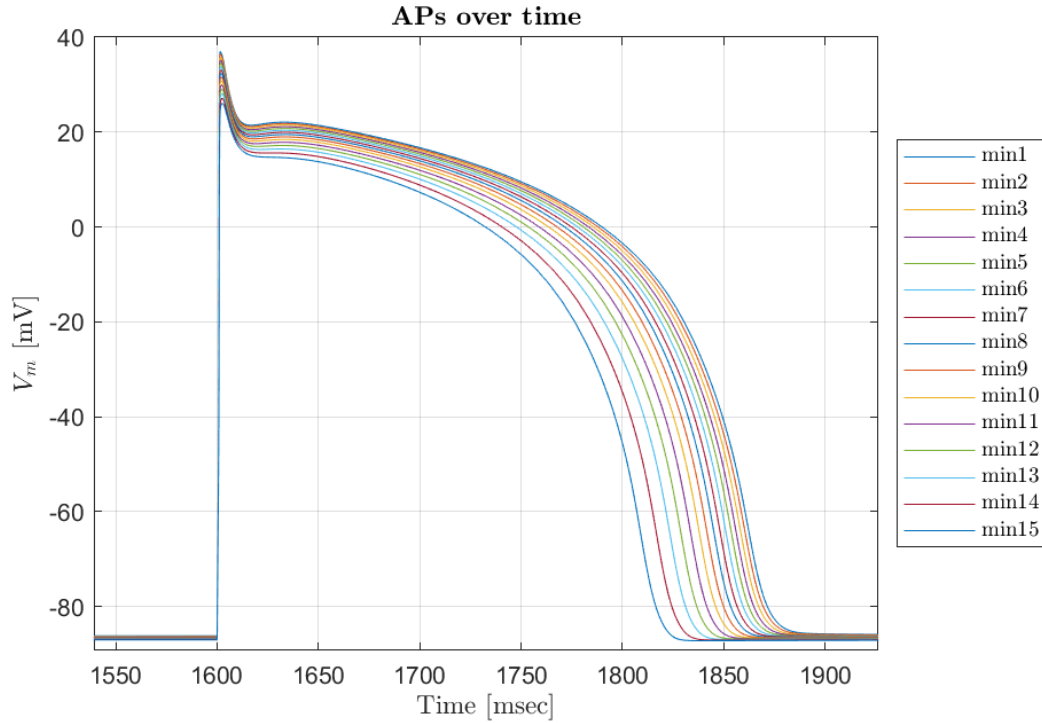


Figure 2: *The action potential in a cardiomyocyte in the first 10 minutes after an ischemic event*