A Comparison of the Bidomain and EMI Models in Refractory Cardiac Tissue

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The simulation of cardiac activity is classically carried out using the bidomain model, a system of partial differential equations that models the diffusion of electrical impulses through tissue. Although the bidomain model has proven beneficial for several applications, in other situations, it may obscure critical details of heart function due to the model's homogenization of individual cells. The extracellular-membrane-intracellular (EMI) model is a recently developed representation of cardiac conduction that addresses this limitation. It models cardiac cells individually, thereby offering the potential for greater physiological accuracy than bidomain simulations. In order to explore the benefits of one model over the other, this talk looks at the performance of the bidomain and EMI models in the context of a pacing study often employed in pacemaker design. The relative refractory periods of the two tissue models are compared through the use of strength-interval curves. The curves are then compared against experimental data, and it is found that one model's portrayal of refractory tissue is more similar to physical heart tissue than the other. These results hold implications for future pacemaker simulation studies and improve our understanding of the two models' roles in relation to one another.