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Mitochondrial Calcium Handling and the Interstitial Cells of Cajal

The Interstitial Cells of Cajal (ICC) generate pacemaking signals controlling contractions of surrounding smooth muscle tissue in the gastrointestinal tract. The mechanism by which they generate these signals is not well known, although calcium (Ca^{2+}) transport between the endoplasmic reticulum (ER) and mitochondria (MT) is shown to be crucial. Precisely how their interaction influences pacemaking signaling is not clear, yet a better understanding of the MT modulation of cytosolic Ca^{2+} may provide insights into the pacemaking mechanism. We thus aim to extend our previous ICC Ca^{2+} modeling efforts to include recent experimental data and updated models of MT Ca^{2+} transporters to facilitate exploration of the ER-MT Ca^{2+} handling dynamic. Using our own customized unstructured finite element solver written in MATLAB, our resulting spatio-temporal model further studies impact of variant spatial distributions of MT Ca^{2+} transporters and MT themselves. This study also gives insights into the overall role of MT in modulating cytosolic Ca^{2+} signals, crucial to behavior of other cellular mechanisms ranging from cardiac cell contraction to neurotransmitter release.