Analysis of Heterogeneous Cardiac Pacemaker Tissue Models and Traveling Wave Dynamics

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PII: S0022-5193(18)30459-4
DOI: https://doi.org/10.1016/j.jtbi.2018.09.023
Reference: YJTBI 9632

To appear in: *Journal of Theoretical Biology*

Received date: 12 March 2018
Revised date: 12 September 2018
Accepted date: 20 September 2018

Please cite this article as: Cheng Ly, Seth H. Weinberg, Analysis of Heterogeneous Cardiac Pacemaker Tissue Models and Traveling Wave Dynamics, *Journal of Theoretical Biology* (2018), doi: https://doi.org/10.1016/j.jtbi.2018.09.023

Highlights

- We adapted a realistic biophysical cardiac pacemaker model (Severi et al., 2012) that accounts for both calcium handling and perturbations to the funny current, to model other pacemaker cell types.
- We develop sinoatrial node (SAN) network models based on Severi et al., analyzed rich spatio-temporal dynamics in these large-scale biophysical model with reduced phase models, and found that generally these models do not have central wave generation as a stable solution, which is surprising given the biophysical realism in these models, but are nevertheless consistent with prior experiments that sever the surrounding atrium.
- In addition to capturing (network) tissue frequency of traveling waves and stability, we focus on the duration of transient dynamics, because in our class of models, central wave generation (center-to- peripheral electrical wave propagation that is thought to be the physiological activation pattern in the SAN) can only happen transiently.
- The implications of our results are that in order to have central wave generation based on biophysically realistic models (Severi et al), it must occur transiently in a standalone SAN model; incorporating the atrium and/or fibrous tissue coupling may also promote central wave generation and is thus an important issue we will investigate in the future.