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Dynamics of "Discordant Alternans" in Cardiac Tissue

by

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ABSTRACT

It is known since early last century that the duration of cardiac electrical excitation, and concomitantly the strength of contraction, can alternate from beat to beat at fast pacing rate. Recent optical experiments have revealed that these alternans can be spatially "concordant", meaning that all cells in some imaged region of cardiac tissue alternate in phase, or "discordant", meaning that cells in two adjacent regions of tissue alternate out of phase, with the latter occuring at faster pacing rate. Moreover, these experiments have demonstrated that discordant alternans can be a dangerous precursor to ventricular fibrillation. This talk will present numerical and analytical results that shed light on the origin of this phenomenon. The most interesting conclusion is that the initiation and evolution of discordant alternans can be understood in terms of a Ginzburg-Landau type equation that is ubiquitous in physics and biology for the description of front motion. In the present context, this equation governs the evolution of phase kinks that separate regions of tissue alternating out of phase, and predicts their motion in terms of pacing rate and experimentally measurable electrophysiological tissue properties.