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COMPUTATIONAL MODELING OF CARDIAC FIBROSIS: A MULTISCALE, MULTIPHYSICS CHALLENGE

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MINISYMPOSIUM

Cardiac fibrosis is a form of structural remodeling connected to various cardiac pathologies and diseases. It impacts cardiac function directly and indirectly through various pathways. On the electrophysiological side, it leads to reduced conductivity and deranged cellular excitability, increasing the risk of atrial and ventricular arrhythmia; mechanically, it reduces contractility and increases matrix stiffness, impairing pump function; hemodynamically, it leads to reduced blood flow and increased thrombogenesis risk. Cardiac fibrosis is manifested across many spatial and temporal scales, and computational models can be immensely useful in exploring its complex, multiphysics pathophysiological consequences.

This minisymposium aims to bring together computational researchers working on projects focusing on the impact of cardiac fibrosis. It allows for the exchange of recent advances achieved through modeling and simulation across multiple scales (e.g., myofilament dynamics, electromechanical feedback mechanisms, cell-matrix interaction, alterations in tissue-level mechanical properties, organ-level multiphysics modeling). Use of previously published or new experimental or clinical data in these models is expected to yield additional insights and guide computational research toward the most interesting new questions, spanning multiple physiological scales. For example, the impact of cell structure or calcium dynamics can be studied at the cell and tissue levels, while areas of interest at the organ level include personalization of models or incorporation of data from novel clinical imaging modalities. Multiscale modeling focus areas include challenges related to numerical stability and model validation, verification, and uncertainty quantification. This is a highly multidisciplinary field, requiring expertise on many levels. A critical aim of this minisymposium is to promote the unification of these disparate and often siloed research teams.