

Study of the Effect of Tissue Heterogeneity and Anisotropy in Atrial Fibrillation Based on a Human Atrial Model

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Atrial fibrillation (AF) is the most common cardiac arrhythmias in clinic, it is characterized by multiple waves of excitation coursing through myocardial tissue. AF disrupts the normal sinus rhythm and may arise from ectopic foci. In right atrium, there are many different conduction bundles which have different action potential morphology, and they provide a substrate for re-entrant activity during AF. Fibre orientation is important in electric propagation and maintaining AF, however, most previous simulation studies didn't consider the fibre orientation. In this paper we studied the effect of tissue heterogeneity and anisotropy on initiation and maintaining of AF based on a realistic human atrial model with fibre orientation and detailed conduction system. Two atrial cell models were used to simulate AF, the first one was based on the model developed by Courtemanche et al, the second one was an AF-induced electrical remodeling cell model which is based on Courtemanche et al and was modified to incorporate the experimental data measured by Bosch et al. Two pacing protocols were used to initiate AF, the first one was the cross-field protocol, and the second one was the ectopic focus stimulation. The results showed that tissue heterogeneity and anisotropy are important for AF, and in some cases AF is transient due to the lack of anisotropy. Another finding is that fiber orientation is very important in sustaining of re-entry waves. Furthermore, different pacing protocols influence the AF patterns, the cross-field protocol will get a more chaos re-entry waves than that of the ectopic focus stimulation method. This investigation suggests that a detail atrial anatomical model should be necessary for AF simulation.