

# Interaction of Pacemakers as a Generating Mechanism of Atrial Fibrillation

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Although known and studied since the last century the underlying mechanisms of atrial fibrillation (AF), the most common arrhythmia of the heart, are still under discussion. Understanding the mechanisms responsible for the onset of fibrillation periods is important for the therapy of AF. We study the interaction of wavefronts emanating from different pacemakers located in separated regions as a new mechanism for the generation of AF. One pacemaker represents the natural pacemaker of the atrium, the sinus node, and the second one is a self-excitatory perturbation pacemaker like an ectopic foci or microreentrant circuit, as is often found in the left atrium of AF patients. The regions of the two pacemakers are connected by a small bridge only. Our calculations are based on the model of Bueno-Orovio et al. with a specific adaption of parameters to the electrophysiology of the atria. To check how far the mechanism is specific for the electrophysiological conditions in the atria, we compare our findings also with corresponding results from the solution of the generic FitzHugh-Nagumo equations. For certain frequency ratios of the two pacemakers irregular excitation patterns are observed, characterized by wavebreaks and a broadened frequency distribution compared to the undisturbed case. The strength of the irregularity is quantified in terms of a Shannon entropy of the frequency distribution and synchronization measures. Particularly interesting is the fact that the strength of the irregularity is determined by the frequency of the natural pacemaker, representing the sinus node. This may be an explanation why AF is typically intermittent at its beginning.