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A dynamical mechanism for generation of arrhythmogenic early afterdepolarizations in cardiac myocytes

Roberto Barrio[1], **Jorge Alberto Jover-Galtier**[1], **M. Ángeles Martínez**[1], **Ana Mayora-Cebollero**[1], **Sergio Serrano**[1], **Rubén Vigara**[1],

SUMMARY

Early Afterdepolarizations (EADs), which are voltage oscillations in cardiac action potential during the repolarization phase, are linked to the appearance of cardiac arrhythmias and other heart conditions. In this presentation we analyze the dynamical mechanisms underlying the formation of arrhythmogenic early afterdepolarizations (EADs) in two mathematical models of cardiac cellular electrophysiology: a biophysically detailed model of a ventricular myocyte with a large number of state variables (which allow a more faithful reproduction of experimental observations) and a low dimensional model, more suitable for theoretical analysis. Based on a comparison of the two models, with detailed bifurcation analysis using continuation techniques in the simple model and numerical explorations in the complex model, we propose a conjectured scheme involving a hysteresis mechanism with the creation of alternans and EADs in the unstable branch. This theoretical scheme fits well with electrophysiological experimental data on EAD generation and hysteresis phenomena [1, 2, 3].

Keywords: Cardiac dynamics, bifurcations

AMS Classification: 34C60, 92B05

References

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[1]Departmento de Matemática Aplicada, IUMA
Universidad de Zaragoza
email: rbarrio@unizar.es