Simulation Study of Effect of Antiarrhythmic Drugs on Ventricular Rate during Atrial Fibrillation

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Background: Atrial fibrillation (AF) is the most common cardiac arrhythmia. Rate control to limit conduction from the atrium to the ventricle during AF is one of the important treatments clinically. However, the ionic basis underlying the rate control is not clear. In this study, we have investigated the effect of antiarrhythmic drugs on ventricular rate using mathematical model.

Methods: We constructed one-dimensional model for rabbit with two conduction pathways from the atrium to the bundle of His. To simulate AF, the string of atrial cells was stimulated randomly. Ca²⁺ antagonists are known effective in rate control in patients with AF. To simulate this, Ca²⁺ current was decreased. Effect of Na⁺ channel blocker that is not always used clinically was also simulated.

Results: When Ca²⁺ current was partially blocked during AF, excitation rate in a slow pathway was decreased resulting in slow ventricular rate. When the Na⁺ current was partially suppressed, rate in the slow pathway was not changed, but decreased in a fast pathway. As a result, ventricular rate was also decreased.

Conclusion: Although antiarrhythmic drugs for blocking either Na⁺ and Ca²⁺ currents could control ventricular response by modulating atrioventricular conduction, there are two different mechanisms to control ventricular rate during AF.

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