Computer Simulation of Anterograde Accessory Pathway Conduction in Wolff-Parkinson-White Syndrome with a Simplified Model

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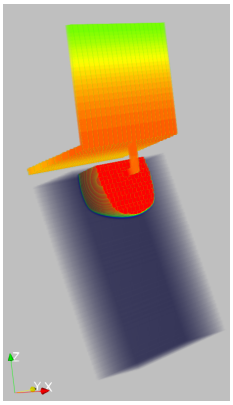
The underlying mechanism of Wolff-Parkinson-White (WPW) syndrome involves an accessory conduction pathway between the atria and ventricles. Since the accessory pathway cannot be visualized using clinical imaging modalities, WPW is usually diagnosed using an electrocardiogram. The treatment of WPW is radiofrequency catheter ablation. We have recently visualized the histological morphology of the accessory pathway in WPW using three-dimensional microscopic image reconstruction. However, the morphological and electrophysiological details of the accessory pathway remain unclear.

In this study, we performed computer simulations of anterograde accessory pathway conduction using a simplified model. Our simulation model consisted of a simplified atrial wall, a ventricular wall, and a myocardial bundle working as an accessory pathway, with myocardial bundles of various cross-section sizes. The action potentials of the atrial wall with the myocardial bundle and ventricular wall were represented by the Courtemanche and O'Hara-Rudy models, respectively. Conductivity was configured for each region. We then analyzed the success or failure of anterograde conduction.

When the cross-section size of the myocardial bundle was ≥ 0.60 mm, anterograde conduction occurred from the atrial wall to the ventricular wall via the accessory pathway. The conductivity of the ventricle promoted anterograde conduction. However, when the conductivity of the accessory pathway was increased, anterograde conduction was blocked. This anterograde conduction block may result from an increase in the electrotonic effect.

We revealed, theoretically, the relationship between bundle size and conductivity in anterograde conduction with a simplified model. Our findings provide new insights into the morphological and electrophysiological details of the accessory pathway.



Simulated anterograde accessory pathway conduction