Use of the Inverse Solution Guidance Algorithm method for RF ablation catheter guidance

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Abstract

We previously introduced the Inverse Solution Guidance Algorithm (ISGA) methodology using a Single Equivalent Moving Dipole model of cardiac electrical activity to localize both the exit site of a re-entrant circuit and the tip of a radiofrequency (RF) ablation catheter. The purpose of this study was to investigate the use of ISGA for ablation catheter guidance in an animal model. Ventricular tachycardia (VT) was simulated by rapid ventricular pacing at a target site in eleven Yorkshire swine. The ablation target was established using three different techniques: a pacing lead placed into the ventricular wall at the mid-myocardial level (Type-1), an intracardiac mapping catheter (Type-2), and an RF ablation catheter placed at a random position on the endocardial surface (Type-3). In each experiment, one operator placed the catheter/pacing lead at the target location, while another used the ISGA system to manipulate the RF ablation catheter starting from a random ventricular location to locate the target. The average localization error of the RF ablation catheter tip was 0.31 ± 0.08 cm. After analyzing ˜35 cardiac cycles of simulated VT, the ISGA system's accuracy in locating the target was 0.4 cm after 4 catheter movements in the Type-1 experiment, 0.48 cm after 6 movements in the Type-2 experiment, and 0.67 cm after 7 movements in the Type-3 experiment. We demonstrated the feasibility of using the ISGA method to guide an ablation catheter to the origin of a VT focus by analyzing a few beats of body surface potentials without electro-anatomic mapping.

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