Abstract

Premature ventricular contraction (PVC) is one of the mechanisms that induce ventricular tachycardia and fibrillation. A way to cure PVC is to ablate the origin area with an endocardial catheter. But it can be difficult, and sometimes impossible, to localize this exit site accurately enough.

We propose a process to accelerate catheter ablation using an automatic method to guide the catheter towards the PVC origin. The proposed process is based on an iterative method, using the QRS complex integrals of the 8-lead ECG.

First, a single PVC beat is captured. Then we initiate our algorithm by stimulating the ventricles at four known locations and the paced ECGs are captured. Using the four paced beats a linear relation between the site of origin and the corresponding ECG is estimated. This relation is applied to the PVC ECG to provide a first prediction of the site of origin. Then a new pacing is applied as close as possible to the predicted site, the paced ECG is captured, and the linear relation is re-estimated. This is repeated until the predicted location appears to converge.

The method was tested using 7 realistic heart-torso models. For each model, 300 PVCs were randomly generated, 150 per ventricle, such that 50 were endocardial, 50 intramural and 50 epicardial. Thus we tested the method on 2100 target PVCs.

The four initial pacing sites were chosen manually to cover the widest possible area of the considered ventricle. For left ventricular targets the pacing sites were chosen in the left ventricle, the same for the right ventricle.

With 10 pacing sites, 95 % of the targets had been approximated with an accuracy better than 5 mm.

We conclude that although the convergence is sometimes erratic, the proposed method does converge to the origin, often within the radius of an ablation lesion.