Single Reference Segmentation to Estimate T-Wave Alternans

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Introduction. Signal processing methods are essential for analyzing T-wave alternans (TWA), which is a risk predictor for sudden cardiac death. However, differentiating between high-frequency noise and repolarization information remains a challenging task and complicates TWA estimation, since T-wave variations are in the order of microvolts. To overcome this limitation, this work scrutinized the use of ECG imaging (ECGI) data for spatial-temporal analysis and estimation of TWA in both the torso and the epicardium. **Signal Processing Methods**. Firstly, the signals were detrended and high-frequency noise was eliminated. To segment the T-waves, a new method called the Single Reference Segmentation (SRS) is proposed, which assumes synchronous activity in all mesh points. Instead of segmenting T-waves based on the location of previous R-waves, SRS relies on the R-wave location in only one reference signal and it segments T-waves in that signal. The relative time positions where T-waves start and end are measured and used to segment the cardiac repolarization in the rest of the mesh points. After T-wave segmentation, even and odd templates are generated for each mesh point by averaging even and odd T-waves, respectively, and said templates are subsequently subtracted to estimate TWA. **Experiments and Results**. The ECGI database used in this work contains epicardium and torso ECGI data from eight patients with long QT syndrome and three control subjects provided by Rudy's Lab (Washington University in St. Louis). Experiments show the appropriate application of pre-processing steps and compare SRS to other methods in which T-wave segmentation depends on the location of R-waves in all mesh signals. **Conclusion**. The results with SRS showed noise reduction and marked spatial consistency in both epicardium and torso TWA estimates. More stable and coherent results were obtained with SRS, which also exhibited a tendency to regionalize TWA.

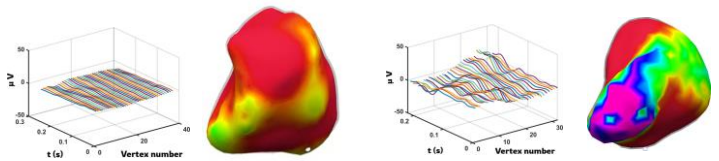

Figure1. TWA estimated by SRS in a control subject (left) and in a LQTS patient (right) epicardium meshes.