

Spectral Analysis of Intracardiac Electrograms After PQRST Removal

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Aims. To investigate power spectral density (PSD) of intracardiac electrograms (EGM) after digital elimination of PQRST waves. The idea is that, outside PQRST waves, EGM should reveal heart muscle activity during its resting condition.

Methods. EGMs are recorded from implantable cardioverter defibrillators (ICD) recipients in two cases: (i) when the ICDs recognizes the onset of a spontaneous ventricular tachyarrhythmia (VT) episode, and (ii) at the Hospital for periodic follow-up to test ICD device reliability, with the patient resting in supine position. In the first case, basal rhythm preceding VT-onset is investigated, in the second a 60-seconds EGM duration is considered. EGM analysis consists of: (i) R peaks recognition using an automatic algorithm; (ii) substitution of the QRS wave with a fixed duration smooth function (ramp) connecting samples before and after QRS complex; (iii) filtering of the new signal using a third order butterworth digital bandpass filter with passband between 40 and 110 Hz (to eliminate P and T waves); (iv) computation and inspection of the filtered signal PSD.

Results. Qualitatively the following different patterns have been observed during the analysis: (i) unimodal pattern, with a PSD peak in the 40-60 Hz frequency range (similar pattern is observed in muscle contraction); (ii) more interestingly, bimodal and 3-modal patterns are observed in some cases. Power line interference was limited in most EGMs; similarly flat PSD patterns indicating that the signal PSD is typical of a gaussian noise are seldom observed.

Conclusion. This observational study, based on EGMs retrieved from ICD implanted in cardiac patients, indicates that PSD analysis of EGM during diastole (neglecting as much as possible PQRST waves), exhibit different patterns in different patients and in the two different cardiac activities of resting and pre-VT onset.