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T-wave width as an index for quantification of ventricular repolarization dispersion: Evaluation in an isolated rabbit heart model

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Abstract

This study examined the significance of ECG-derived indexes in quantifying ventricular repolarization dispersion (VRD) given its value as a risk marker for severe myocardial arrhythmia. Multilead ECG recordings from an isolated rabbit heart model, including control and globally increased VRD (IVRD) beats, were studied. The IVRD was induced by supplying d-Sotalol (DS) or premature ventricular stimulation (PVS). ECG indexes came from (a) the absolute ECG summation signal, from which we obtained the amplitude and area of the T-wave, and the T-wave width (T_W), which we consider as IVRD indexes, and (b) the Singular Value Decomposition (SVD) of the ECG, from which the θ_{PT} (angle between the first SVD principal axis and the repolarization axis), T-wave residuum (T_{WR}), T-wave morphology dispersion (T_{MD}), unnormalized T_{MD} (UT_{MD}), and θ_{RT} (the angle between the depolarization and the repolarization vectors) were estimated as IVRD indexes. Results were compared with the classical QT-based VRD indexes (σ_{QT_e}, standard deviation of QT end). The main results are T_W: 78.0 ± 10.3 vs. 133.6 ± 29.6 ms, for control vs. IVRD generated using DS, $p < 0.005$ and 95.2 ± 7.9 vs. 118.5 ± 15.7 ms when PVS was used, $p < 0.007$; σ_{QT_e}: gives 6.5 ± 1.4 vs. 11.6 ± 1.9 ms, for DS $p < 0.007$ and 7.6 ± 2.2 vs. 13.0 ± 3.4 ms for PVS, $p < 0.007$; respectively. θ_{PT}: $35 \pm 51°$ vs. $117 \pm 49°$, $p < 0.009$ in DS. We concluded that globally induced IVRD is well reflected by the T_W parameter, being the most sensitive of the studied ones. The IVRD can also be quantified by using the θ_{PT} index.

Keywords: Electrocardiography; T-wave; SVD; Repolarization heterogeneity; Arrhythmia