

Stability of Bipolar and Unipolar Endocardial Electrograms

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Background: Implantable Cardioverter Defibrillators (ICDs) are widely used for sudden cardiac death prevention. In most ICD algorithms, decision making includes a morphological analysis of the unipolar and/or bipolar EGMs. The principle of such algorithms is to create a normal template by averaging normal sinus rhythm heartbeats, for comparison to each arrhythmic heartbeat. The present study addresses two major issues: (i) the stability of unipolar and bipolar EGMs with respect to the posture of the patient, and (ii) the temporal evolution of the EGM shapes.

Method: A total of 140 unipolar (RVcoil-Can) and 140 bipolar (ring-tip) 10-second EGMs were recorded by ICDs (Paradym, Sorin Group) during sinus rhythm. For 23 patients (67 ± 12.5 years, 73% men), recordings were performed in different positions (supine, prone, left and right lateral, sitting, standing). EGMs were recorded 3 ± 3 days after implant and 2 ± 1 months later (early evolution) in a subgroup of 5 patients, 10 ± 6 months and 6 ± 1 months later (late and long-term changes) in a subgroup of 8 patients. EGMs similarities are measured by the correlation coefficient on a time window of 160 ms centered on each ventricular depolarization peak.

Results: Three (resp. 2) consecutive heartbeats suffice to create a normal template for unipolar signal (resp. bipolar) ($p < 0.01$). The correlation between bipolar EGMs in a given position (0.96 ± 0.06) is not statistically different from the correlation between EGMs in different positions (0.95 ± 0.06). Conversely, unipolar EGMs are affected by position changes (0.98 ± 0.04 vs. 0.97 ± 0.05). However the correlation coefficient being very high, EGMs are very similar. As expected, the time changes of unipolar and bipolar EGMs are significant during the first post-implant month (bip: 0.80 ± 0.27 , uni: 0.92 ± 0.05), and very small after a few months (bip: 0.98 ± 0.02 , uni: 0.94 ± 0.07).

Conclusion: The above results are significant in view of the design of a statistically solid template updating procedure for morphological algorithms in ICDs.