

Time Variability of Fibrillatory Waves Energy Predicts Long-Term Outcome of Atrial Fibrillation Concomitant Surgical Ablation

Juan Ródenas, Pilar Escribano, Miguel Martínez-Iniesta, Manuel García, Fernando Hornero, José J Rieta, Raúl Alcaraz

Research Group in Electronic, Biomedical and Telecommunication Engineering, University of Castilla-La Mancha Cuenca, Spain

Background and Aim. Surgical ablation is the most effective procedure to terminate atrial fibrillation (AF) in patients requiring concomitant open-heart surgery. However, considering the extra stress that ablation provokes to patient's heart, which often lead to major side effects, together with the anticipation of antiarrhythmic therapeutical decisions, the possibility of preoperatively predict long-term failure of AF surgical ablation is a clinical challenge. The present work introduces a novel algorithm to anticipate surgical ablation long-term outcome by just analyzing the preoperative surface ECG.

Methods. The method firstly extracted the fibrillatory waves from standard surface lead V1 by adaptive QRST cancellation. The resulting signal was segmented into 1 s-length intervals and wavelet energy was computed sement-wise. Finally, the coefficient of variation of the wavelet energy, obtained for the 7th scale (CVWE7), was computed as the ratio between standard deviation and mean. 7th scale was selected to cover the typical AF frequency range (4~8 Hz). The well-established dominant atrial frequency (DAF) and fibrillatory waves amplitude (FWA) were also computed as a reference. 30 s-length preoperative ECGs from 53 persistent AF patients undergoing concomitant open-heart surgery were analyzed. After one year of follow-up, 30 patients maintained sinus rhythm (SR) and the remaining 23 relapsed to AF.

Results. The proposed CVWE7 was the only metric exhibiting statistically significant differences between groups of patients. The index also provided values of sensitivity, specificity, and accuracy between 10 and 20% better than DAF and FWA (see table below).

Conclusions. Time variability of fibrillatory waves energy has proven to be a promising predictor of AF ablation outcome, outperforming DAF and FWA, as well as other common clinical parameters traditionally employed in long-term outcome prediction of concomitant surgical ablation of AF.

Index	SR group	AF group	<i>p</i> -value	Se (%)	Sp(%)	Acc(%)
CVWE7	0.203 ± 0.077	0.266±0.071	0.003	80	65	74
DAF	6.10±1.40 Hz	6.70±0.90 Hz	0.060	63	52	58
FWA	48.70± 17.80 μ V _{pp}	44.70± 22.70 μ V _{pp}	0.201	59	46	53