Optimal ECG leads for atrial fibrillation characterization and prediction of ablation outcome

Francesco Acquati, Anna McCann, Etienne Pruvot, Jean-Marc Vesin, Adrian Luca*

Swiss Federal Institute of Technology, Lausanne; Lausanne University Hospital, Switzerland

Aims. Previous studies have shown that not all surface ECG leads yield relevant information regarding the level of atrial fibrillation (AF) organization. This study aims at identifying the optimal subset of ECG leads for prediction of persistent AF (peAF) termination by catheter ablation.

Methods. In 40 consecutive patients (61±8 y, sustained AF 19±11 m), pulmonary vein isolation and left atrium ablation were performed until peAF termination or cardioversion. 30-sec ECG epochs (63±20.6 epochs per patient) devoid of QRST were recorded before ablation. Adaptive harmonic frequency tracking schemes were applied on atrial ECG to compute the variance of the phase difference (APD) between the AF dominant frequency and its first harmonic, the adaptive organization index (AOI) defined as the ratio between the power of the extracted components and the total power of the signal, and the instantaneous AF frequency (IF) defined as the central frequency of the adaptive band pass filter. The features were estimated on all 12 ECG leads (V6b was placed on the patient’s back) and then fed into a KNN classifier.

Results. peAF was terminated within the LA in 70% (LT-left terminated) of the patients, while 30% (NLT – not left terminated) were not. The figures show that the classification model reached a maximum accuracy of discriminating between LT and NLT subgroups for two features (mean_IF and mean_AOI) computed on nine leads V1, V5, V6, V4, II, V2, aVR, I, III (total average accuracy 95.75% [95.25 – 96.25%]).

Conclusion. Lead V1 is the most relevant ECG lead for the assessment of AF organization. Combining several precordial leads may significantly improve prediction of catheter ablation outcome.