Reliability of Local Activation Waves Features to Characterize Paroxysmal Atrial Fibrillation Substrate During Sinus Rhythm

Aikaterini Vraka, Fernando Hornero, Aurelio Quesada, Luca Faes, Raúl Alcaraz, José J Rieta

BioMIT.org, Electronic Engineering Department, Universitat Politecnica de Valencia, Valencia, Spain.

Background. Analysis of coronary sinus (CS) electrograms (EGMs) is vastly used for the extraction of information relative to the atrial fibrillation (AF) substrate even during sinus rhythm (SR). As the catheter consists of five dipoles (distal, mid-distal, medial, mid-proximal and proximal), results may vary upon the employed channel: myocardial contraction and bad contact are unavoidable factors affecting the recording. This work assesses which CS channels are the most reliable in catching unaltered information of AF dynamics in SR to characterize the atrial substrate.

Methods. Twenty-eight multichannel bipolar CS recordings in SR of patients undergoing catheter ablation of paroxysmal AF with 60-300 seconds in length were analyzed. Local activation waves (LAWs) were detected and main features obtained: duration, amplitude, area and correlation between dominant morphologies of each channel. Kruskal-Wallis analysis was used for multichannel comparison, while Mann-Whitney U-test was recruited for analysis in pairs of channels and the comparison between each one and the remaining channels, using Bonferroni correction. Median values were calculated.

Results. The distal channel showed the lowest amplitude and area values ($p_{\max} < 0.0100$), a trend for longer duration ($p = 0.0280$) and the lowest LAWs correlation with the other channels ($82.84 - 88.31\%$). Medial channel showed the highest area and amplitude values ($p_{\max} < 0.0200$) and a trend for shorter LAW duration ($p = 0.0341$). Difference between distal and medial channel was 14 ms in duration ($p = 0.0071$) and 1.4 mV in peak-to-peak amplitude ($p = 0.0019$). Mid-proximal channel also showed a trend for high amplitude and area ($p_{\max} < 0.0700$) and medial and proximal channels a trend for different duration, amplitude and area values ($p_{\max} < 0.0800$). Mid-proximal LAWs showed the highest correlation with adjacent channels, being 96.27% and 94.53% with proximal and medial channels, respectively.

Conclusions. Extreme channels may not achieve perfect contact with the tissue, presenting the highest alterations in LAWs features. Recordings of medial and mid-proximal channels appear to be more reliable and their analysis is recommended for more robust results to characterize AF substrate during SR.