Slow conduction regions as a valuable vectorcardiographic parameter for the non-invasive identification of atrial flutter types

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Atrial flutter (AFL) is the second most common atrial tachyarrhythmia, with an increasing prevalence nowadays. Accurate identification of the AFL type is not available before the ablation procedure. In this study we propose a vectorcardiographic (VCG) approach to characterize distinct AFL types in a non-invasive way.

Methods: We hypothesised that there is a higher similarity among the VCG loops described by the same AFL type and that a slow conduction region should be observable in the VCG loop, consistently with the re-entry mechanisms. Moreover, the location of the slow conduction region should play an important role for the identification of the AFL type. Firstly, surface atrial waves are isolated by the administration of adenosine during the electrophysiological (EP) study. After the averaging of subsequent atrial cycles, VCG is obtained from the inverse Dower's transform and then resampled. An archetype is then created for different AFL groups, from the averaging of AFL VCG loops from several patients. In this study we considered 4 different AFL groups: common and perimitral AFL types, both including clockwise and counterclockwise variants. The gold standard was the EP study. The velocity within the VCG trajectory allowed for the localization of slow regions. Finally, a correlation index for the comparison of two VCGs was defined from the mean correlation point-by-point of the vector described by the VCG loops. Each VCG loop was compared to each archetype.

Results: The proposed index was predominantly influenced by slow velocity regions, as they present a higher density of samples. Correlation was higher when comparing cases belonging to the same AFL group: 0.947 ± 0.021 for common and 0.859 ± 0.053 for perimitral, in contrast to 0.638 ± 0.110 when correlating VCG loops from different AFL groups. No relevant contrasts are highlighted between groups when evaluating the cycle length, the slow velocity percentage in time or the complexity of the loop, among other parameters.

Conclusions: The hypothesised bearing of the slow conduction regions when classifying AFLs was demonstrated and a new vantage point has been stablished for future research and improvement in the area of endeavour of diagnosis through physiological signals analysis. This non-invasive approach arises as a promising technique to identify the reentrant cause of AFL in advance of the EP procedure.