Brugada or Early Repolarization in V_1 V_2 V_3. Can VCG Aspects Differentiate the Localization of ECG Manifestations ?

C. A. Pastore, N. Samesima, H. G. Pereira Filho

Heart Institute (InCor) – Electrocardiology Clinical Unit - University of São Paulo Medical School Hospital
ecg_pastore@incor.usp.br

Abstract. *Electrocardiographic aspects in Brugada syndrome (BrS) and early repolarization (ER) may confuse the diagnosis, especially when located in the anteroseptal region of the rest-ECG (V1-V3). Vectorcardiography (VCG) is useful to differentiate the two situations, both through visual characteristics of vector loops and quantification of certain measurements. The objective of this study was to define BrS and ER characteristic and distinctive patterns, using aspects of QRS complex loops and ST segments. SÂJ-point of vectorcardiographic loops in the horizontal plane (HP) of 29 BrS patients and 30 individuals with ER were analyzed. J-point resulting vector was obtained by the non- coincidence between QRS complex onset and end. We measured and compared the angle of this resulting vector in PH between groups. Non-paired t-test and ROC curve were used, with* $P \leq 0.05$. *Men age was* 47 ± 15 *vs* 38 ± 14 *y.o.* ($p = 0.02$), *66% vs 90% male* ($p = 0.03$); *QRS duration was* 101.6 ± 10.2 *vs* 94.9 ± 12.5*ms* ($p = 0.03$); *mean SÂJ-point was* $103.4^o \pm 18.9^o$ *vs* $54.5^o \pm 16.3^o$ ($p < 0.0001$), *BrS vs ERS, respectively. SÂJ-point* $> 75^o$ *cut-off value as obtained by ROC curve better identified BrS, with 96.6 % sensitivity and 93.3 % specificity. SÂJ-point* $>75°$, *as assessed by vectorcardiography can differentiate between the Brugada syndrome and early repolarization with high sensitivity and specificity.*

Keywords. Vectorcardiography, Differential diagnosis, J-point, Early repolarization, Brugada syndrome

1. Introduction

Many experts have published scientific contributions about the relationship between early repolarization (ER) and the Brugada syndrome (BrS) [1-4]. The two electrocardiographic patterns, which are sometimes linked to sudden cardiac death, share similar features, such as patients' ages, gender, influence of parasympathetic tonus, family inheritance. Both situations show J-point and ST-segment alterations, which are critical for determining the phenotype and prognosis. ECG characteristics and electrical changes induced by drugs or heart rate can highlight the subgroup of individuals who are at greater risk. In what refers to the electrophysiological mechanisms involved, there is heated discussion over a common substrate (augmented Ito channels) in different locations of the ventricles, as an explanation for the electrical phenomena which are found and for the worse evolution.

Most cases of ER and BrS have clearly distinct ECGs. However, some of them share similar features, especially when the ECG findings are located in the anteroseptal region of the rest ECG (V1-V3). They can frequently lead to a difficult formulation of diagnosis, but an extra help could be obtained from an old method, the vectorcardiogram (VCG). Analysis of the VCG makes it possible to differentiate between these particular syndromes expressions, both from qualitative and quantitative characteristics of the QRS and J point/ST segment loops. Therefore, we conducted our study aiming to define electro/vectorcardiographic patterns of differential diagnoses.

This study sought to characterize and distinguish the changes in the QRS complex, J-point, ST-segment and T-wave, which we observed using the vectorcardiographic loops of the VCG as a tool, in individuals with electrocardiographic diagnosis of early repolarization and Brugada syndrome.

2. Material and Methods

Study subjects
All the study subjects underwent 12-lead electrocardiography and vectorcardiography examinations.

- 30 individuals with diagnosis of ERs were selected according to the ECG pattern described in the literature: presence of notch or final slowing of the QRS complex, J-point elevation, either with or without ST-segment elevation.
- 29 individuals with diagnosis of type I (n – 22) or type II (n – 7) Brugada syndrome were also selected.

Methodology
SÂJ-point of vectorcardiographic loops, obtained in the horizontal plane (HP) of BrS patients and individuals with ER were analyzed. The J-point resulting vector was obtained by the non-coincidence between the QRS complex onset point and its end (Fig. 2). We measured the angle of this resulting vector in the HP and compared its value between groups. Non-paired t-test and the ROC curve were used, with $P \leq 0.05$ significance level.

3. Results

Men age was 47 ± 15 vs 38 ± 14 y.o. (p = 0.02), 66% vs 90% male (p = 0.03); QRS duration was 101.6 ± 10.2 vs 94.9 ± 12.5ms (p = 0.03); mean SÂJ-point was 103.4 ± 18.9° vs 54.5 ± 16.3° (p < 0.0001), BrS vs ERS, respectively. SÂJ-point > 75° cut-off value as obtained by ROC curve better identified BrS, with 96.6 % sensitivity and 93.3 % specificity (Fig. 1).

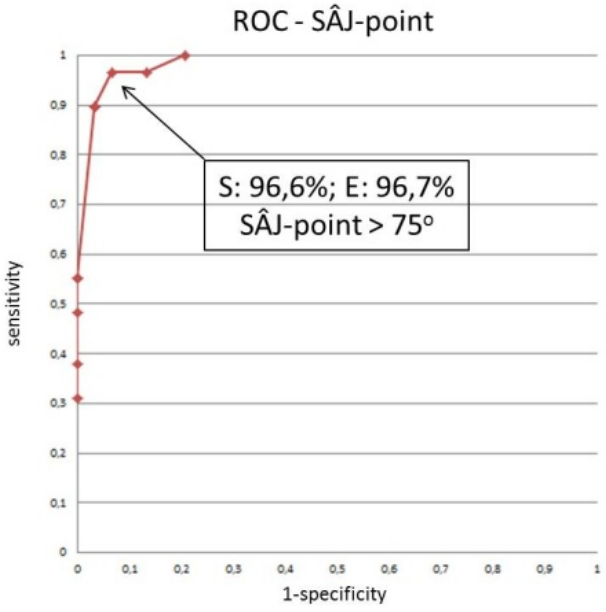

Fig. 1. SÂJ-point > 75° cut-off value obtained by ROC curve.

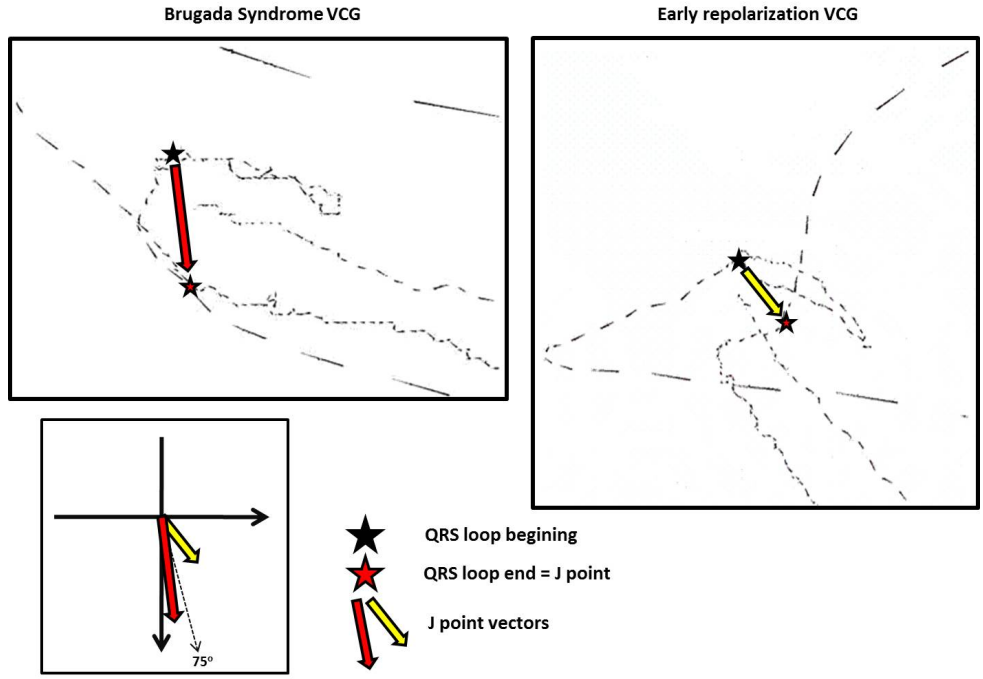

Fig. 2. Determination of the J-point resulting vector by the non-coincidence between the QRS complex onset point and its end.

4. Discussion

The electrocardiogram presents some limitations when the electrical phenomena occur concomitantly, especially if this happens in the precordial leads (V1, V2, V3). When it happens with some patterns of Brugada syndrome and a few early repolarization cases, they become differential diagnoses. It occurs frequently in some other disorders, like Wolff-Parkinson-White syndrome, anteromedial fascicular block, right bundle-branch block, right ventricular hypertrophy, lateral (formerly dorsal) myocardial infarction and dystrophies, as a result of an overlapping of ECG patterns in this region.

The spatial vectorcardiographic configuration can improve the 12-lead electrocardiogram sensitivity in order to clarify similar, but absolutely distinct, electrical phenomena. Our study was designed to compare some electrical aspects of patients with early repolarization and Brugada Syndrome using the vectorcardiogram. Initially, a qualitative J-point/ST segment analysis seemed to be a useful tool to differentiate both. A fish-hook shape of J-point/ST segment, as well as "nose" profile in Brugada, could distinguish the two syndromes. Besides, the left posterior or right anterior J-point/ST segment position could be used to determine an ER or a BrS case, respectively. In the present study, our intention was to quantify our previous findings. We measured and compared the angle of the vector generated by the non-coincidence between onset and end of the QRS loop (SÂJ-point) in the horizontal plane. The observation that such vector is oriented forward and rightward in the Brugada syndrome, with a mean value of 103.4 degrees, is in sharp contrast with the leftward and lateral orientation, and mean 54.5 degrees in the early repolarization ($p < 0.0001$). The cutpoint of SÂJ-point $> 75°$ obtained in the ROC curve plotting could identify the Brugada syndrome with 96.6 % sensitivity and 93.3 % specificity.

The differential patterns of vectorcardiographic loops, mainly displayed in the horizontal plane, between the Brugada syndrome with anterior and rightward orientation giving it the aspect of a "nose" in the presence of end-conduction delay, and the early repolarization with

its configuration as a “fishhook” and end-conduction delay oriented to the left and posteriorly, are very clearly evidenced.

Therefore, the presence of the J vector in the two contexts, although similarly generated, shows different angles in the horizontal plane, with a neat separation between the two situations as described above. The vectorcardiographic findings can make it easier to perform the ECG analysis, by creating patterns of different aspects, thus helping to make the correct diagnosis.

References

[1] Osborn JJ. Experimental hypothermia: respiratory and blood pH changes in relation to cardiac function. *American Journal of Physiology* 1953; 175: 389-398.

[2] Gussak I, Antzelevitch C. Early repolarization syndrome: clinical characteristics and possible cellular and ionic mechanisms. *Journal of Electrocardiology* 2000; 33(4): 299-309.

[3] Haissaguerre M, Derval N, Sacher F, et al. Sudden cardiac arrest associated with early repolarization. *The New England Journal of Medicine* 2008; 358(19): 2016-2023.

[4] Pérez-Riera AR, Ferreira Filho C, Abreu LC, Ferreira C, Yanowitz FG, Femenia F, et al. Do patients with electrocardiographic Brugada type 1 pattern have associated right bundle branch block? A comparative vectorcardiographic study. *Europace* 2012; 14(6): 889–897.