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Radiofrequency ablation of a middle cardiac vein inserted accessory pathway resulting in posterolateral coronary artery occlusion: A case report

José Nunes de Alencar Neto*, Marina Vieira Nagahama, Saulo Rodrigo Ramalho de Moraes, Rafael Thiesen Magliari, Claudio Cirenza, Angelo Amato Vincenzo de Paola

Universidade Federal de São Paulo, Escola Paulista de Medicina, Hospital São Paulo, São Paulo, Brazil

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ABSTRACT

Introduction: Posteroseptal accessory pathways account for 34.5% of the total. Of these, 36% are located within the coronary sinus (CS). Its ablation requires technical alternatives to avoid damage to surrounding tissues, especially branches of the right coronary artery.
Case report: A 22-year-old man was referred for re-do ablation of an accessory left septal-septal (PSE) pathway. Inside the CS, a precocity of 25 ms was found in the region of the median cardiac vein (VCM) (Fig. 2, panel A). Radiofrequency (RF) was administered with a non-irrigated bidirectional catheter within this vessel with resolution of the pre-excitation after 5 seconds. Immediately after, the patient presented chest pain and revealed a ST segment elevation of 1 mm in the inferior leads of ECG. Coronary angiography showed occlusion of the middle third of the posterior ventricular branch of the right coronary artery, with no signs of thrombus or dissection. Arterial angioplasty was performed with a bare metal stent, followed by TIMI III distal flow. Retrograde aortic mapping was performed and a precocity of 20 ms was found in the PSE region. The RF was applied followed by loss of pre-excitation after 1.5 seconds of application.
Conclusion: This case demonstrates the risks involving delivering radiofrequency within the coronary sinus. We discuss some strategy that could help electrophysiologists in similar cases.

1. Introduction

Accessory pathways are distributed unevenly along the right and left atrioventricular valve annuli. The left-sided accessory pathways (AP) are most common and may be accessed by using the trans-septal approach or the retrograde aortic approach, or less commonly, from within the coronary sinus (CS), a location that some authors define as "epicardial". Posteroseptal APs represent 34.5% of total [1]. CS APs comprise 36% of posteroseptal APs (right or left) and its ablation require expertise and use of technical alternatives to avoid damage to surrounding tissues, specially branches of right coronary artery [2]. Few approaches techniques have proven to be successful. The aim of the present article is to report a serious complication related to radiofrequency ablation in the CS region and the outcomes of this complication.

1.1. Case report

A 22-year-old male was referred to Hospital São Paulo, Federal University of São Paulo, Brazil for ablation of Wolff-Parkinson-White (WPW) syndrome. He had a history of controlled systemic arterial hypertension, controlled asthma and cocaine use (abstened for 3 months). 12-lead electrocardiogram (ECG) in sinus rhythm evidenced ventricular suggestive of a left posterior or left posteroseptal (LPS) AP (Fig. 1. Panel A). Transthoracic echocardiogram demonstrated a structurally normal heart. He had a previous attempt of catheter ablation 13 months before in another medical center inside CS resulting in transient loss of preexcitation. He underwent a new electrophysiologic study (EPS) under conscious sedation. Uni and bipolar electrograms from CS, right atrium, His and right ventricle were recorded by a multi-channel polygraph

* Corresponding author. Borges Lagoa St, 1209. Apto 2613, Vila Clementino, São Paulo, Zip code: 04038-033, SP, Brazil.
E-mail address: josenunesalencar@usp.br (J.N. de Alencar Neto).
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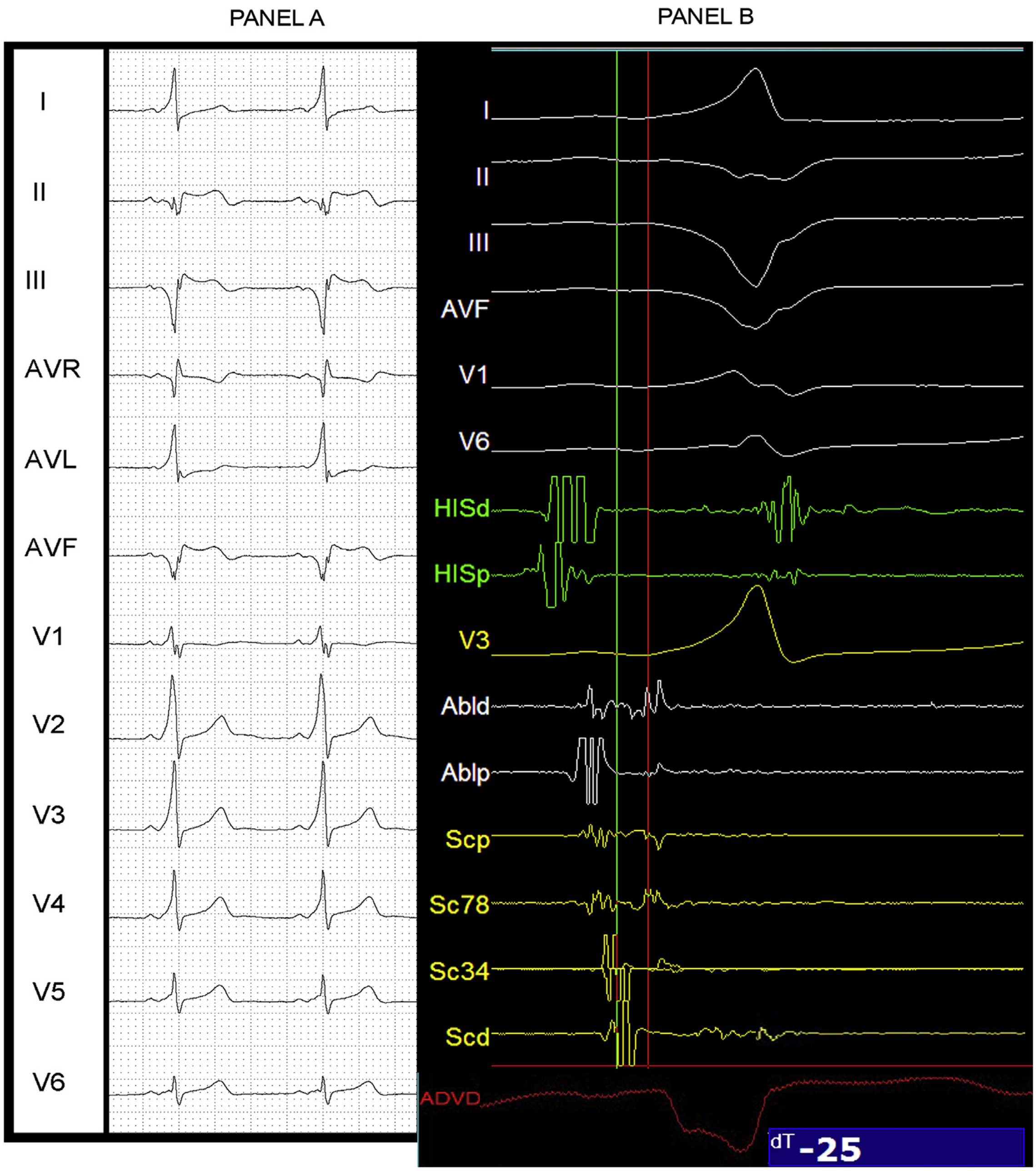

Fig. 1. Panel A: 12-lead ECG during sinus rhythm in beginning of EPS, evidencing ventricular preexcitation compatible with left posteroseptal accessory pathway. Panel B: Intracavitary electrograms with earliest ventricular activation during sinus rhythm of 25 ms and atrioventricular fusion in catheter inserted in coronary sinus (Abld and Ablp), in the region of MCV.

(EP-Tracer V1.079, Schwarzer Cardiotek) Initial intracavitary measures were: PA interval 22 ms, AH interval 70 ms and HV interval 0 ms. As suggested by previous EPS, we started by mapping CS region with a non-cooled-tip bidirectional catheter and fusion of atrial and ventricular potentials with earliest activation was found in the MCV region (Fig. 1, panel B). Unfractionated heparin was administered and radiofrequency energy was delivered within this vessel (duration of 60 seconds, energy of 30 W and temperature of 55 °C) with preexcitation disappearance at 5 seconds of application. Immediately after, the patient presented with chest pain and sweating without hemodynamic instability. Electrocardiogram revealed sinus rhythm, no preexcitation, and presence of a 1 mm ST segment elevation in inferior leads (Fig. 2, panel A). We performed urgent coronary angiography, with evidence of occlusion of the middle third of the posterolateral branch of the right coronary artery, without signs of intracoronary thrombus or dissection, and no alterations in the other coronary arteries (Fig. 3, panel A). Coronary sinus angiography showed stenosis of MCV (Fig. 3, panel B) Accessing femoral arterial puncture, balloon angioplasty was performed (Fig. 3, panels C and D) with immediate angiographic success and preexcitation recurrence soon after. The patient presented again with intense chest pain about 10 minutes after ballooning showing posterolateral artery re-occlusion. The patient received 300 mg of acetylsalicylic acid and 600 mg of clopidogrel and angioplasty of this artery was performed with a bare metal stent (Prokinetic 2.5 × 15 mm, Biotronik), followed by TIMI III distal flow, complete resolution of pain and ST segment normalization. Retrograde aortic mapping was performed and atrioventricular fusion

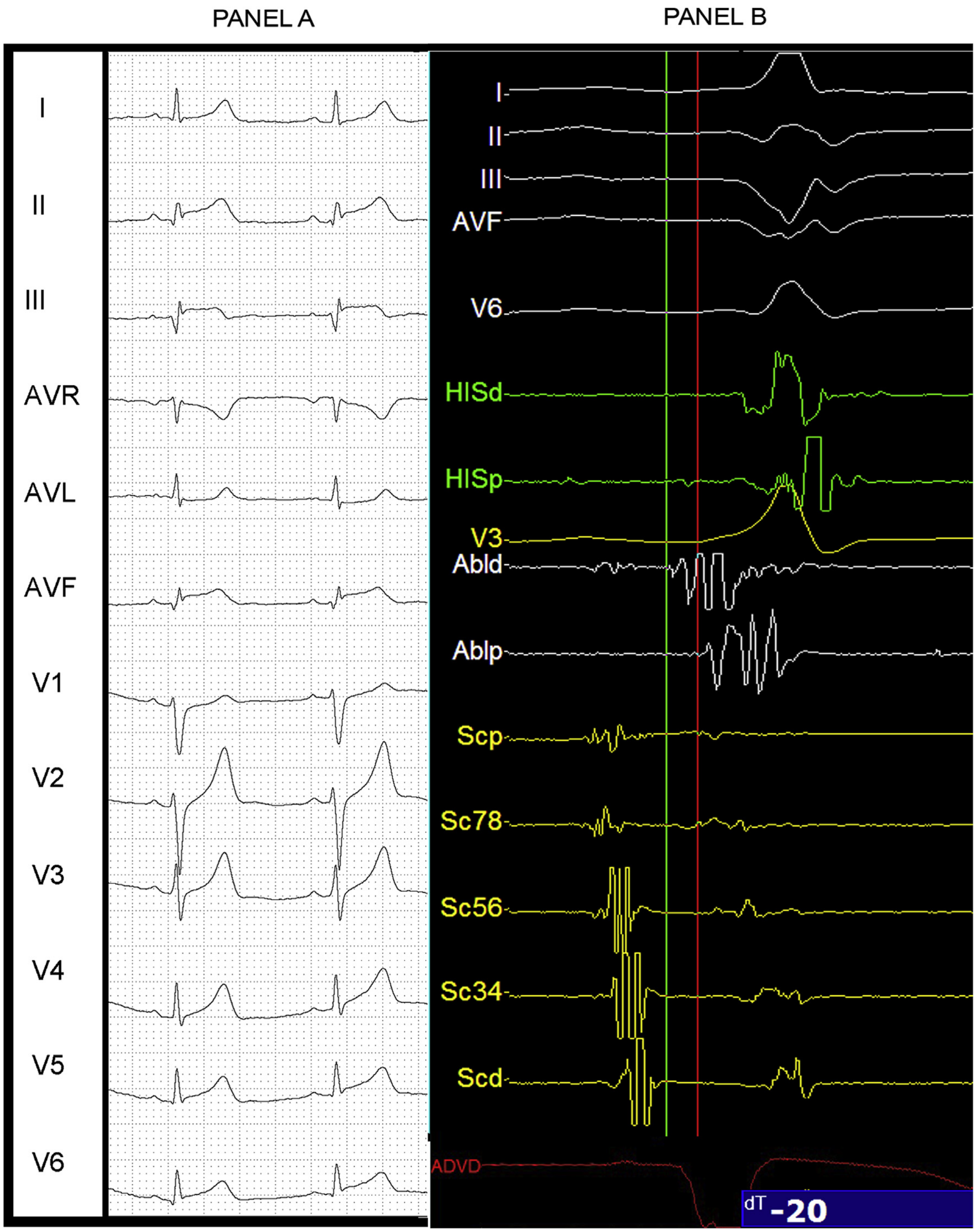

Fig. 2. Panel A: 12-lead ECG during sinus rhythm after first radiofrequency application, showing no signs of ventricular preexcitation, but with a 1 mm ST-segment elevation of inferior leads. Panel B: earliest ventricular activation of 20 ms during sinus rhythm at retro-aortic approach, in LPS region.

and AP potential were found in the LPS region (Fig. 2, panel B); radiofrequency was delivered (duration of 60 seconds, energy of 30W and temperature of 55 °C), followed by loss of preexcitation after 1.5 seconds of application. Adenosine was administered with occurrence of atrioventricular block without evidence of preexcitation. Final measured intracavitary records were: PA 26 ms, AH 90 ms and HV 45 ms. The procedure ended with success criteria. Troponin T peak value was of 26 times the reference value 48 h after ablation and echocardiogram showed no abnormalities. The patient kept hemodynamically stable and asymptomatic and remained hospitalized for observation for 3 days. There was no recurrence of preexcitation. Dual antiplatelet therapy was maintained.

2. Discussion

2.1. Coronary sinus and middle cardiac vein anatomy

The CS is the largest cardiac venous structure and is commonly

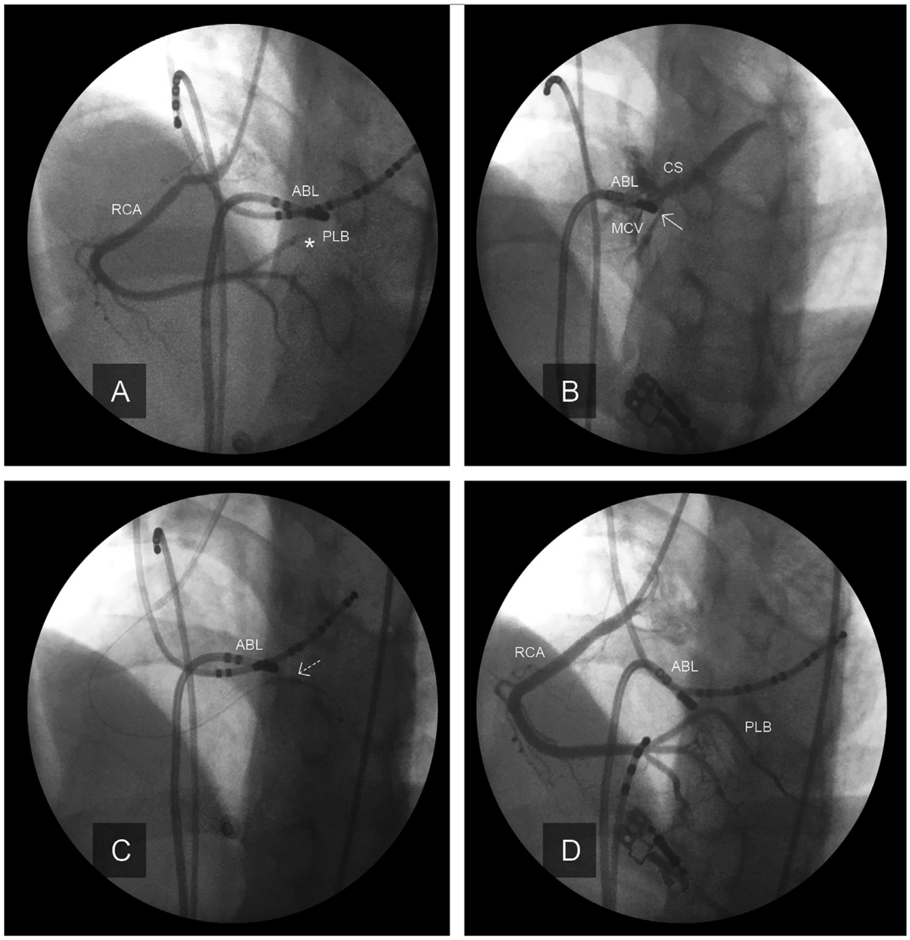

Fig. 3. Panel A: coronary angiography evidencing occlusion of the middle third of the posterolateral branch of the right coronary artery. Panel B: coronary sinus angiography evidencing stenosis of MCV. Panel C: balloon angioplasty of occluded artery. Panel D: immediate angiographic success followed by recurrence of chest pain (see text).

accessed for different cardiac procedures. The first vein is the anterior interventricular vein after turning laterally at the becomes the great cardiac vein (GCV) and drains the anterior wall of the left ventricle and the interventricular septum. GCV runs with a similar trajectory to left circumflex artery and after joining with left posterior lateral vein forms CS itself. The CS has two distinct systems of drainage: the left ventricular veins (usually in three) drain the left lateral wall, and the middle cardiac vein (MCV) or posterior interventricular vein drains the posterior aspect of the left ventricle. The CS ends in the endocardium of the right atrium in the coronary sinus ostium, a structure with 5–15 mm in diameter and is closely related to the MCV, which runs parallel to the posterior descending branch of the right coronary or circumflex artery and drains into the inferior aspect of the CS just proximal to its termination in a position very close to the posterolateral branch of the right coronary artery. Because of its proximity to the GCV and the fact that both of them share the same cloaca, the posterior ventricular vein may be misinterpreted as the GCV. Diverticula or aneurismal dilation of this vein may occur with or without associated arrhythmias [3–7].

2.2. Electrophysiological and electrocardiographic characteristics

Epicardial AP location may be the cause of 8% of difficult or failed AP ablations [8]. During antegrade accessory pathway conduction, the earliest ventricular activation is recorded from the middle cardiac vein, posterior cardiac vein or coronary sinus diverticulum, not in the endocardium. In 480 patients referred to electrophysiological lab for right or left posteroseptal ablation, a coronary sinus accessory pathway was found in 171 (36%) and 70% of these occur within a diverticulum or other venous anomaly [2].

According to Arruda's ECG algorithm, a MCV's AP ECG usually shows a negative delta wave in lead II concomitant to negative delta waves in leads III and aVF. When ruled out a left free wall AP, this study established a 100% sensitivity and specificity for this criteria [9]. In this case we had electrocardiographical evidence of LPS AP, but, since the previous EPS found earlier signals in MCV region, and we found a precocity of 66 ms, we decided to try a radiofrequency application in that region, that was successful after 5 seconds, but recurred soon after. Retrospectively, a left endocardial approach could be first considered because of a wide positive R wave in V1, with higher amplitude than the S wave. In contrast, when a negative QRS complex in V1 is present, a RPS or CS AP is predicted [10,11].

2.3. Ablation techniques

Radiofrequency current delivery within a vein is associated with certain risks, such as perforation leading to cardiac tamponade, stenosis or vessel occlusion. In our experience, catheter ablation within the CS must be delivered with the catheter pointing towards the ventricle, by maintaining a subtle counterclockwise torque. When a diverticulum is present, targeting its neck may be effective. An irrigated catheter is indicated when impedance or temperature limit RF application. To avoid damage to the vein and the contiguous structures, application of low energy (20–30 W) is recommended, targeting a temperature of 55 °C to 60 °C for 30–60 seconds. The low power may lead to an increase in the number of recurrences [12]. RF energy delivery must be stopped if impedance rises to >130–140 Ω [13]. When earliest VA is more than 15 mm within the CS, a left sided endocardial approach should be considered [10]. Reasonable options for CS ablation are: 1) cryoablation with low thrombogenic potential l [14] and smaller risk of coronary artery lesion [15]; 2) The percutaneous epicardial approach, that may be the only option for successful percutaneous ablation [16] when there is endocardial inaccessibility, difficulties in cannulation of the CS secondary to stenosis due to previous ablation or congenital heart disease. 3) Angiographic definition of coronary sinus and coronary arteries may be helpful to avoid the complication presented in this paper, since a 2 mm proximity between the coronary and venous systems is a contraindication to RF delivery. Its performance, however, is not routine in many centers [17].

In our case, radiofrequency was first delivered in vein lumen, resulting in transitory loss of pre-excitation and was associated with posterolateral right coronary artery occlusion. Following coronary artery ballooning, there was immediate recurrence of pre-excitation, possibly related to a transitory ischemic effect. The protocol for coronary injury is coronary stenting [18], but, due to the rarity of this complication, this recommendation is based on the experience of a few cases. Since our patient was a young healthy man, we decided to attempt ballooning, which was unsuccessful, leading the team to perform coronary artery stenting.

3. Conclusions

This case demonstrates the feasibility of a septal endocardial and intravenous approach for a epicardial AP, and the risk involving the applications of radiofrequency energy within the CS, mainly because of the vicinity with posterolateral and descendent posterior coronary artery. The earliest electrograms must be interpreted with caution. A wide positive R wave, with higher amplitude than S wave in V1 and an earliest VA recorded more than 15 mm within the CS are betters predictors of success with a left sided endocardial approach. When RF delivery is indicated within the CS itself, a low energy (20–30 W) must be applied and the catheter must point towards the ventricle. An irrigated catheter is indicated when impedance or temperature limit the application. Previous angiographic definition of coronary and venous system may be useful to avoid vessel damage.

Conflict of interest

There is no conflict of interest to disclose

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