Bipolar ablation of high-risk posteroseptal accessory pathway: Back to the future

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Introduction

Radiofrequency catheter ablation (RFCA) of accessory pathways (AP) is a well-established method of treatment of patients with Wolff-Parkinson-White syndrome. APs with effective refractory period ≤250 ms are considered at high risk of sudden cardiac death; thus RFCA of these pathways is highly recommended.[1] The main goal of conventional ablation is to terminate conduction through the AP, which is created by RF current. However, owing to variable anatomical and biophysical properties of targeted tissue, conventional RFCA can sometimes be insufficient to achieve an expected lesion depth, especially in some septal APs. Thus, some new approaches would be welcomed and bipolar RFCA (Bi-RFCA) can be an alternative. Nonetheless, despite promising initial clinical reports and case series, the use of Bi-RFCA is still limited mainly to septal ventricular tachycardias and outflow tract premature ventricular contractions.[2–6] We present a case when a single bipolar application led to elimination of high-risk refractory septal AP.

KEY TEACHING POINTS

- Bipolar radiofrequency catheter ablation (Bi-RFCA) of accessory pathways (AP) in Wolff-Parkinson-White syndrome was abandoned in the early 1990s
- New studies on Bi-RFCA show that it can overcome some limitations of the conventional unipolar approach.
- In cases of high-risk septal APs refractory to conventional ablation, Bi-RFCA can be feasible and effective.
- Future adaptation of new tools for Bi-RFCA, such as temperature monitoring, open-irrigated catheters, and contact force measurements, can additionally improve outcomes and reduce complications of this "new" emerging approach.

Case report

A 34-year-old man, after failed RFCA of posteroseptal AP, was referred for redo procedure. Electrophysiological study demonstrated a refractory period of AP of 210 ms with decremental properties. No retrograde conduction was present. During careful mapping of both sides of the posterior interventricular septum (IVS), no classic atrioventricular fusion on mapping catheter was observed. The earliest ventricular activation during preexcitation was noted on the left side of the posterior IVS with a second-best site on the right side of the IVS. No early activation in coronary sinus diverticulum/middle cardiac vein was recorded (Supplementary Figure 1). A conventional repetitive RFCA from both sides of the IVS led to temporary suppression of preexcitation with immediate recurrence after termination of RF delivery. Owing to the high-risk profile of the AP we ultimately decided to perform Bi-RFCA. Using the patent foramen ovale, an open-irrigated ablation catheter (AC; ThermoCool; Biosense Webster, Irvine, CA) was introduced to the site of earliest ventricular activation on the left side of the posterior IVS. A second conventional 4 mm nonirrigated AC (Triguy; APT Medical, Shenzen, China) was introduced to the second-best site, close to the proximal coronary sinus ostium. Using a bipolar ablation adapter (Futyma Box, formerly IndiCath; St. Joseph's Heart Rhythm Center Rzeszów, Poland), this catheter was connected to serve as an intracardiac return electrode (IRE) (Figure 1). A single bipolar application (40 W titrated up to 45 W at irrigation rates titrated from 2 mL/min to 30 mL/min), performed in IRE temperature-controlled mode, led to elimination of the AP in 11 seconds, preceded by progressive loss of preexcitation during RF delivery (Figure 1B).

KEYWORDS Bipolar ablation; Catheter ablation; High risk; Refractory accessory pathway; Wolff-Parkinson-White
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Conflict of Interest: Piotr Futyma declares 2 patent applications on bipolar ablation and creation of a bipolar ablation device. Piotr Kułakowski declares no conflict. **Address reprint requests and correspondence:** Dr Piotr Futyma, Invasive Cardiology Department, St. Joseph's Heart Rhythm Center, Anny Jagiellonki 17, 35-623, Rzeszów, Poland. E-mail address: piotr.futyma@gmail.com.

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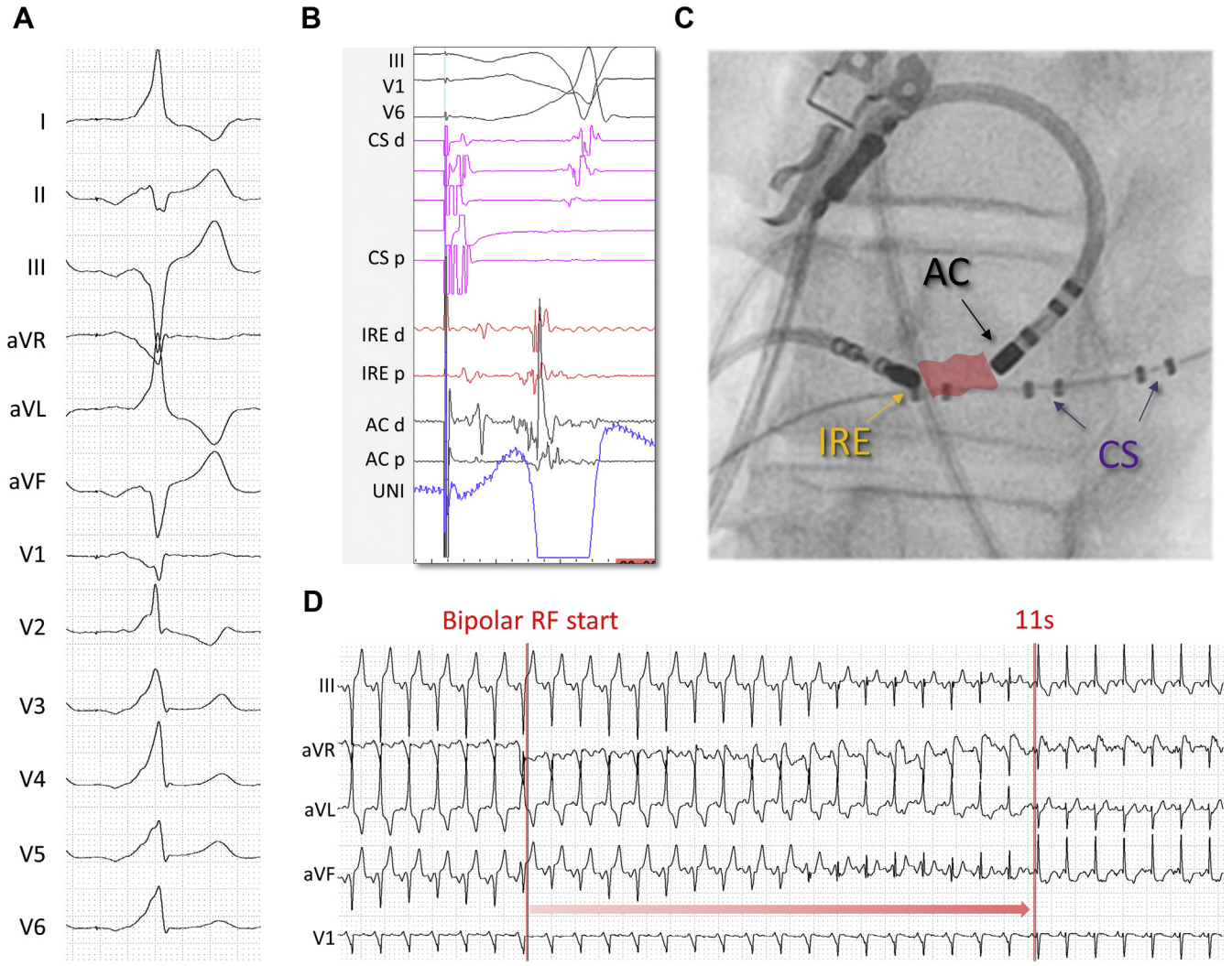

Figure 1 **A:** A 12-lead electrocardiogram of preexcitation recorded during atrial pacing. **B:** Intracardiac recordings from ablation catheter (AC) and intracardiac return electrode (IRE) at the site of bipolar ablation. **C:** Fluoroscopic image (left anterior oblique 30°) of bipolar ablation site. AC and IRE are located on both sides of posteroseptum, slightly above the level of coronary sinus (CS) ostium. **D:** Bipolar application (40 W titrated up to 45 W) led to elimination of the accessory pathway in 11 seconds, preceded by progressive loss of preexcitation during radiofrequency (RF) delivery. Bipolar RF catheter ablation (Bi-RFCA) was continued up to 120 seconds. Maximal temperature of IRE during Bi-RFCA was 46°C.

Bi-RFCA was continued up to 120 seconds. The maximal temperature of the IRE during Bi-RFCA was 46°C. No steam pop occurred and there was no complication during ablation. The patient remained symptom-free and there was no preexcitation recurrence during follow-up.

Discussion

Development of open-irrigated catheters and contact force sensors improved the quality of lesion formation and increased success rates. However, despite this technological progress in the field, conventional ablation of septal APs can sometimes be challenging.[7] Prolonged RFCA at high-power settings can lead to steam pop, which can be devastating. Cryoenergy can be useful; however, it has been implemented rather to minimize the risk of atrioventricular block and it is actually associated with higher recurrence rates when compared to standard RFCA.[8]

A bipolar approach can be one of the alternatives. Bi-RFCA has been used in the early 1990s in cases of septal APs refractory to conventional RFCA.[9] Notably, Bi-RFCA was initially introduced as a method of treatment as a first-line therapy of left-sided APs.[10] However, owing to technical limitations in these early days of RFCA and poor understanding of ablation biophysics, this approach was abandoned.

The bipolar approach was rediscovered in the last decade. Recent studies on Bi-RFCA showed that this approach can be safe and frequently more effective than conventional approach.[3–5,9,10] Optimal setup regarding connections, catheters, etc, for Bi-RFCA is still under discussion.[11–16] A broad spectrum of power settings used across published series (from 15 to 70 W) suggests flexibility of Bi-RFCA. Given the fact that nowadays this approach is limited to refractory arrhythmias, success rates oscillating around 75%–80% are

promising.[3,4,11,12] To date, published material suggests a rather good safety profile; however, some complications, such as atrioventricular block and pericardial effusion, have been reported.[2,12,14] Some complications may remain underestimated owing to limited availability of dedicated equipment,[15] and possible overheating of IRE has been recently reported.[11,16] During Bi-RFCA temperatures of AC and IRE correspond with heat of tissue in contact; thus careful tracking of temperature values may additionally improve lesion formation and, more importantly, prevent overheating. Such an approach can result in delivery of safe and stable bipolar applications even in the relative proximity of fragile anatomical structures such as the His bundle or coronary arteries.[4,11] In the presented case the temperature of the IRE was stable and did not exceed 46°C, so we were comfortable continuing bipolar application up to 120 seconds without problems. Thus, temperature data can additionally improve outcome of Bi-RFCA.

This case shows that bipolar ablation of posteroseptal APs at moderate powers (40–45 W), performed in the IRE temperature-controlled mode, can be safe and effective. Gradual disappearance of the delta wave during RF application may suggest that the pathway had a deep intramural location and this was the reason why previous unipolar ablations failed. In conclusion, Bi-RFCA should be considered in those high-risk Wolff-Parkinson-White patients with septal APs in whom conventional ablation fails.

Appendix

Supplementary data

Supplementary data associated with this article can be found in the online version at 10.1016/j.hrcr.2019.11.011.

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