Open chest ablation of a right anterior epicardial accessory pathway

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Introduction

Wolff-Parkinson-White (WPW) syndrome is a cardiac conduction disease characterized by one or more accessory pathways (APs) that predispose patients to recurrent tachyarrhythmias that may result in sudden cardiac death.[1] The 2019 European Society of Cardiology guidelines for the management of supraventricular arrhythmias recommend electrophysiological study with catheter ablation as the treatment of choice in symptomatic patients.[2] However, standard endocardial ablation can be challenging, especially in cases of epicardial or intramural localization of the pathway.[3,4]

Case report

A 17-year-old, otherwise healthy boy was diagnosed with WPW syndrome. His electrocardiogram showed typical preexcitation (Figure 1). He had been suffering from several episodes of palpitations and 1 syncopal episode during cycling. His smartwatch showed heart rates of 180–200 bpm during palpitations. He was referred to our center for electrophysiological study and ablation of an AP. Echocardiography and cardiac magnetic resonance imaging revealed slightly impaired left ventricular ejection fraction (biplane ejection fraction 49%), absence of fibrosis, and a normal anatomy.

Electrophysiological study for assumed right-sided anteroseptal AP initially was performed using a 3-dimensional (3D) cardiac mapping system (EnSite™ NavX™, St. Jude Medical, St. Paul, MN). Earliest ventricular activation (–33 ms) was documented at the anterior portion of the tricuspid annulus (Figure 2A). Pacing maneuvers showed accessory pathway effective refractory period $\leq$270 ms and incremental atrial pacing 210 ms. Nonsustained only antidromic atrioventricular (AV) reentrant tachycardia could be induced by sensed S3 extrastimuli. However, the ablation procedure was not successful despite use of a long sheath for stabilization of the ablation catheter and ablation with an irrigated catheter. The delta wave showed no change. Only antidromic, nonsustained AV reentrant tachycardia could be induced. Therefore, it was not possible to map the atrial insertion of the AP. The patient was scheduled for re-ablation a few months later using the CARTO® 3 System Version 7 (Biosense Webster, Diamond Bar, CA), high-density mapping (PENTARAY® NAV ECO catheter, Biosense Webster), and jugular venous access. Earliest ventricular activation was recorded at the same site as that during the first procedure; however, radiofrequency (RF) ablation again was not successful, and the delta wave was unchanged. Therefore, mapping of the noncoronary sinus using a retrograde approach was conducted even though the activation map had shown earliest activation anterolaterally. During the mapping procedure, the catheter accidentally fell into the right coronary artery (RCA) and revealed sharp and very early ventricular signal fused with atrial activation about 15–20 mm distally to the ostium of the RCA directly opposite the putative right atrial appendage (RAA) (Figures 2B and

KEY TEACHING POINTS

- If standard endocardial ablation is not successful, the examiner should initiate further diagnostic steps to locate an epicardial location of accessory pathways.
- Further diagnostic steps must be coordinated meticulously between participating specialties to yield maximum diagnostic output, such as merging computed tomographic and mapping scans.
- Open chest ablation is an alternative, safe therapeutic approach, especially in cases of epicardial accessory pathways close to the coronary artery given the risk of coronary injury during epicardial ablation.

KEYWORDS Ablation; Arrhythmia surgery; Epicardial accessory pathway; Myocardial bridge; Wolff-Parkinson-White syndrome
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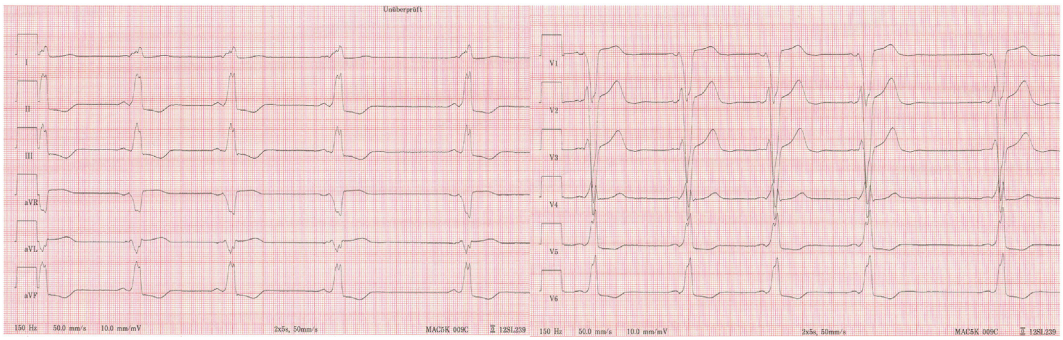

Figure 1 Initial 12-lead electrocardiographic tracings (50 mm/s) showing a short PQ interval as well as a broad QRS complex with preexcitation due to a right-sided anteroseptal accessory pathway (Wolff-Parkinson-White syndrome).

3B; blue spot/green arrow). The activation map of the RCA and aortic root was completed without further ablation. In addition, because there were RAA to right ventricle (RV) APs, we attempted unsuccessfully to reach the spot of earliest activation via the RAA. To confirm a suspected epicardial AP and to plan the next therapeutic step, contrast-enhanced computed tomographic (CT) scan of the heart with 3D reconstruction was performed. The scan revealed myocardial tissue crossing the RCA (Figure 3D), which matched up exactly with earliest ventricular activation and was verified by merging the 3D CT scan and the CARTO® map of the RCA and aortic root (Figures 3A and 3B).

Because epicardial ablation near the coronary artery is associated with a high risk of coronary injury, a surgical approach was chosen.[5–8] After inferior partial sternotomy, the aortic root and right AV groove were exposed, and simple epicardial mapping was performed by positioning a decapolar catheter in the right AV sulcus. The earliest ventricular activation was used by the surgeon to navigate during careful preparation of the myocardial bridge spanning the RCA from the right atrium to the RV. The RAA as revealed was shorter than usual and not near the AP. The myocardial bridge was lifted approximately 1 mm over the RCA (Figure 3C). A very short electrocautery impulse interrupted the AP conduction (Figure 2B). The complete myocardial bridge was dissected. As expected, programmed stimulation via temporary epicardial electrodes showed decremental retrograde conduction and no recurrence of preexcitation during incremental atrial pacing. The postoperative course was uneventful. ECG at 9-month follow-up showed sinus rhythm without preexcitation. The patient is asymptomatic and in good clinical condition, and the slight left ventricular dysfunction has resolved.

Discussion

Before RF catheter ablation became the treatment of choice for patients having APs (success rate approximately 95%),[4,9] therapeutic mainstays were pharmacologic therapy and, as techniques improved, mapping with surgical treatment, which is a markedly more invasive approach than the current standard endocardial ablation procedure.[10] Yet, standard endocardial ablation can be challenging, especially in cases of epicardial or intramural localization of the AP.[3,4] Therefore, alternative approaches have been proposed, including epicardial access through the epicardial venous system or percutaneous catheterization of the pericardial space.[4] Only a few cases have reported use of a surgical

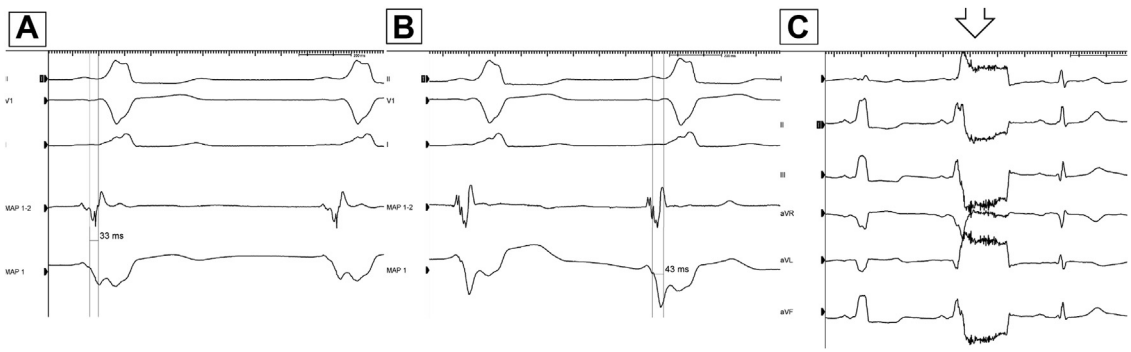

Figure 2 **A:** Earliest activation (33 ms before surface electrocardiogram [ECG]) during mapping of the tricuspid annulus. **B:** Recordings during mapping of the right coronary artery showing surface ECG leads I, II, and V1, as well as intracardiac ECG recordings from the mapping catheter (MAP 1: unipolar recording; MAP 1-2: bipolar recording). Earliest ventricular activation can be seen in the bipolar recording of MAP 1-2, which shows activation 43 ms before surface ECG recordings. **C:** ECG recordings during surgery for myocardial bridge showing the moment of electrocautery impulse at the site of the accessory pathway *(arrow)*. Loss of delta wave on the surface ECG leads can be seen, comparing the QRS complex on the left to that on the right (before and after dissection).

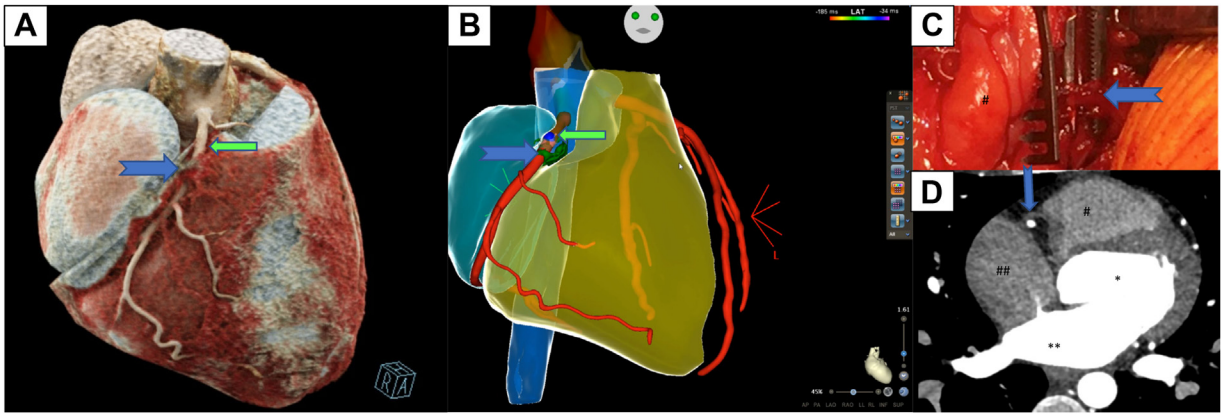

Figure 3 Three-dimensional reconstruction of cardiac computed tomographic (CT) scan **(A)** and result of merged CT scan and CARTO mapping of the right coronary artery (RCA) and aortic root **(B)** showing the myocardial bridge crossing the RCA and the earliest ventricular activation, respectively. **C:** Accessory pathway (AP) and surgical situs before AP dissection as viewed from the patient's head with the right ventricle on the **left. D:** Cross-sectional CT scan of the myocardial bridge. *Blue arrow* indicates myocardial bridge with accessory pathway. *Green arrow* indicates earliest ventricular activation. *Left ventricle; **left atrium; #right ventricle; ##right atrium.

approach including sternotomy. These cases of epicardial mapping/ablation reported left posterior or postero-paraseptal pathways.[4] Furthermore, recent case reports describe quite well APs connecting right or left atrial appendage and right or left ventricle, respectively. These also have been reported to be difficult, if possible at all, to ablate from the endocardium.[11,12] For that reason, an epicardial AP was the most likely differential diagnosis. However, surgery revealed first a short RAA that was not close to the AP and second a myocardial bridge containing the AP as diagnosed before CT scan. The myocardial bridge could be surgically dissected in a pointed and precise manner. This contrasts with RAA-RV APs, which tend to require more extensive surgical dissection of the RAA to interrupt AP conduction. To our knowledge, this is the first case of open chest surgical ablation of a right anterior to anterolateral epicardial AP. Because RF ablation or cryoablation near the coronary arteries can lead to serious complications such as acute coronary syndrome, extreme caution is necessary.[5–8,13]

Conclusion

The current case shows that epicardial ablation using open chest mapping and ablation may be successful in cases of right anterior APs. Importantly, balancing the risk of coronary injury during ablation against the procedural risk of a surgical approach remains crucial.

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