

A bumped atrial tachycardia due to guidewire manipulation in the vein of Marshall before ethanol infusion



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Introduction

Catheter ablation has become a cornerstone of atrial fibrillation (AF) management. Pulmonary vein isolation is the recommended procedure for paroxysmal AF.¹ For persistent AF and atrial flutters linear lesions in the left atrium are also frequently required.¹ The mitral line generally connects the posterior mitral annulus to the left inferior pulmonary vein. It is, however, challenging to obtain mitral isthmus (MI) block.² The vein of Marshall (VOM) runs along the posterior mitral annulus and is suspected to be implicated in the genesis and maintenance of AF and atrial tachycardias.³ Ethanol infusion within the VOM has been reported to help in obtaining acute MI block.⁴ We present a case where the mitral line was quickly successfully blocked owing to a mechanical bump within the VOM after several conventional endocardial and epicardial ablation attempts.

Case report

A 76-year-old man was admitted for ablation of a recurrent atrial tachycardia (AT) following 3 previous procedures for persistent AF. Pulmonary vein isolation was performed at the index procedure. During the second ablation procedure planned for AF recurrence, 2 pulmonary veins were reconnected. Isolation of these veins directly led to a double loop left AT that was terminated with a roofline and a posterior MI line. Bidirectional block was obtained for both lines; the mitral line, however, needed endocardial and epicardial ablation into the coronary sinus (CS) to achieve block. In addition, a cavotricuspid isthmus block was also performed. A third procedure showed a perimitral flutter (PMF), which again required both endocardial and epicardial applications to achieve MI block. During follow-up, the patient presented with syncope and a documented AT, for which a fourth ablation procedure was performed.

KEYWORDS Atrial tachycardia; Atrial fibrillation; Ethanol infusion; Perimitral flutter; Mitral isthmus; Vein of Marshall (Heart Rhythm Case Reports 2020;6:219–221)

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KEY TEACHING POINTS

- Owing to its anatomical path along the mitral isthmus, the vein of Marshall (VOM) can be part of the ablation strategy in recurrent perimitral flutter.
- Ablation within the coronary sinus and the VOM with a radiofrequency catheter to block the mitral isthmus can be achieved, but manipulation of such catheters in this area can be challenging. Ethanol infusion in the VOM can help to obtain mitral isthmus block.
- Mitral isthmus block can be assessed with left atrial appendage pacing.

The ablation procedure was carried out under general anesthesia. After 3 femoral venous punctures, a decapolar catheter was introduced inside the CS, showing an AT with a cycle length of 220 ms and distal-to-proximal activation along the CS suggesting PMF. After a transeptal puncture, a PentaRay mapping catheter was used to create a 3-dimensional electroanatomical map of the left atrium using the CARTO 3 mapping software (Version 7, Biosense Webster, Diamond Bar, CA). After confirmation of a PMF, the line of block along the MI appeared to be incomplete. Despite radiofrequency applications, both endocardially and within the CS, the AT did not stop, nor was the circuit changed. Residual epicardial conduction was therefore suspected (Figure 1).

Considering the location of breakthrough at the posterior MI line, despite acute block over the MI in each of the previous procedures and the absence of modification of the circuit following the last radiofrequency applications, an alternative approach was used to target the VOM-CS junction: namely, direct ethanol infusion inside the VOM.

After cannulating the CS with a guiding catheter (IMA 6F; Medtronic, Dublin, Ireland) over a steerable sheath (Agilis; Abbott, Minneapolis, MN), an angiogram revealed a thin VOM at the level of the electrical gap shown on the CARTO

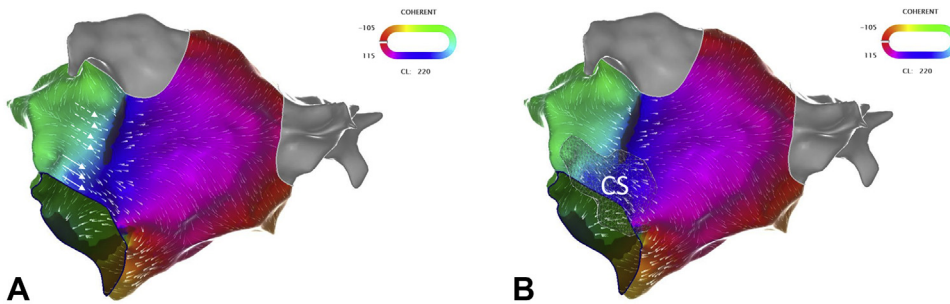


Figure 1 **A:** High-density mapping confirming a perimitral flutter with cycle length of 220 ms. Line of block (*dotted arrows*) and epicardial breakthrough at the level of coronary sinus (CS) (*plain arrows*). **B:** CS location in mesh overlay right on the location of the incomplete line of block.

map (**Figure 1B**). A guidewire (Marvell; Boston Scientific, Marlborough, MA) was inserted through an over-the-wire balloon and advanced into the ostium of the VOM (**Figure 2A**).

This manipulation resulted in AT termination (**Figure 3A**). Pacing maneuvers showed a bidirectional block of the mitral line (**Figure 3B**), confirming a mechanical bump of the PMF critical isthmus, located within the VOM. Thereafter, the balloon was inflated at the ostium of the vein and contrast was injected to confirm its occlusion (**Figure 2B**). Only then, alcohol was injected as previously described (3 injections of 3 mL of 98% ethanol).⁵ After 20 minutes of waiting time, the bilateral MI block remained, and no AT could be induced using atrial stimulation.

After 6 months of follow-up, the patient is still free of any arrhythmia or syncope.

Discussion

Left atrial linear lesions are one of the main techniques described in the ablation of persistent AF and left AT. However, obtaining bidirectional block following linear ablation of the MI remains challenging, with reported success rates from 32% to 92%.^{6–8} Furthermore, incomplete lines of block are proarrhythmic and linked with an increased risk of AT recurrence to up to 4 times,⁹ mainly presenting as PMF rather than AF.¹⁰ In case of PMF, one of the main anatomical targets is the posterior MI, connecting the left

inferior pulmonary vein with the mitral annulus. Bidirectional block may require not only endocardial lesions but also epicardial applications within the CS.¹¹ This can be harmful, as the CS is located close to the circumflex coronary artery, although coronary injuries are barely reported.¹² On the other hand, the VOM runs along the posterior MI, making it an ideal target for ablation, as it can act as an epicardial bridge in maintaining left atrial arrhythmias.³ Manipulating and ablating inside the CS with an irrigated catheter can be challenging, even more so in the VOM, which is a very thin structure. Ethanol infusion in the VOM was recently described as a technique that can help to achieve acute MI block by leading to the ablation of the vein itself, and its intrinsic and neighboring myocardial electrical activity.⁴

Our case describes the key role of the VOM as a conducting structure responsible for recurrent PMF. In this case, mechanical bump of the VOM resulted in AT termination. Ethanol injection inside this vein should be considered in resistant mitral lines.

Conclusion

The challenging aspect of this case lies within the recurrence of PMF despite repeatedly obtained acute block at each of the previous endocardial and epicardial procedures. This case supports the concept of epicardial breakthrough at the level of the VOM as well as the usability of local ethanol injection to achieve acute MI block.

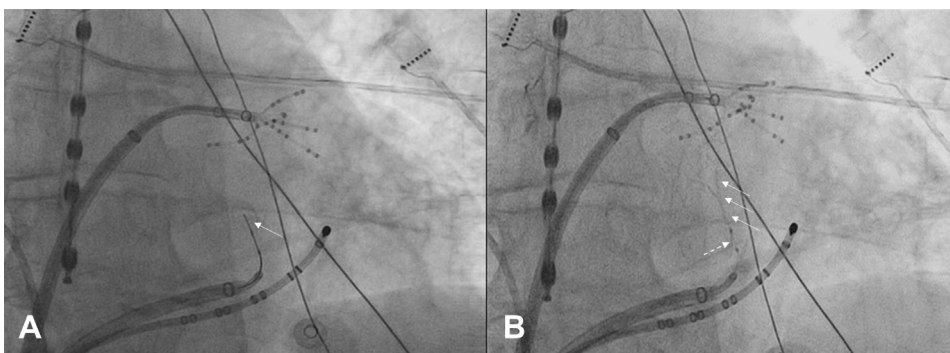


Figure 2 **A:** Fluoroscopic image of the cannulated coronary sinus with a guidewire in the vein of Marshall (VOM) (*plain arrow*). **B:** Selective contrast injection in the VOM (3 *plain arrows*) occluded with a balloon (*dotted arrow*) at its ostium.

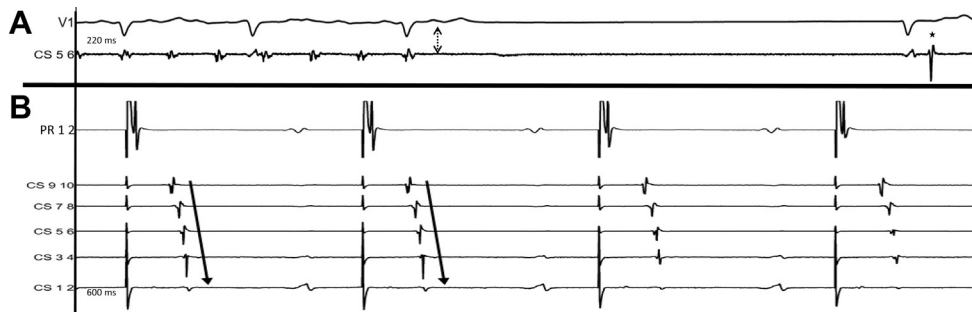


Figure 3 **A:** Lead V₁ and tracing from CS 5/6 showing an atrial tachycardia (AT) with a cycle length of 220 ms. The double arrow points at the AT termination and the star indicate the junctional beat before sinus rhythm is restored. **B:** Intracardiac tracings showing pacing beats from the left appendage with the PentaRay (Biosense Webster, Diamond Bar, CA) (PR 12) and proximal-to-distal propagation along the CS indicating block over the mitral isthmus line.

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