

Atrioventricular nodal reentrant tachycardia and persistent left superior vena cava: A tough nut to crack. Successful ablation with transeptal approach



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Introduction

Atrioventricular nodal reentrant tachycardia (AVNRT) ablation presents a high success rate with the classical approach, with the ablation catheter positioned in the right posterior septal region. Persistent left superior vena cava (PLSVC), although rare, is the most common venous anomaly in the chest, with a prevalence of 0.3%–0.5% in the general population. Patients with PLSVC have a significantly enlarged coronary sinus (CS) ostium, and the location of the slow pathway and His bundle area may be displaced, making the procedure more difficult and increasing the risk of damage to the atrioventricular (AV) node during ablation.

Here we describe a patient with successful ablation of a typical AVNRT associated with PLSVC using the transeptal approach. Interestingly, the successful ablation site was on the ventricular aspect of the mitral annulus.

Case report

A 47-year-old woman without prior cardiovascular disease, with several episodes of paroxysmal supraventricular tachycardia refractory to drug treatment, was admitted for radiofrequency (RF) ablation.

The electrophysiological study was performed after 8 hours of fasting and under general anesthesia. Antiarrhythmic medication was suspended for at least 5 half-lives before the procedure. Triple puncture of the femoral vein was performed with 2 7F decapolar catheters positioned inside the CS and right chambers.

KEYWORDS Atrioventricular nodal reentrant tachycardia; Left-side atrioventricular nodal reentrant tachycardia; Muscular atrioventricular sandwich; Persistent left superior vena cava; Transeptal approach (Heart Rhythm Case Reports 2018;4:589–593)

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KEY TEACHING POINTS

- Patients with persistent left superior vena cava have a significantly enlarged coronary sinus ostium, and the location of the slow pathway and His bundle area may be displaced, making the atrioventricular nodal reentrant tachycardia (AVNRT) ablation more challenging and increasing the risks of damage to the atrioventricular node.
- The transeptal approach should be remembered and may be a simple, low-cost, and effective choice for the ablation in this situation.
- When a left-side AVNRT ablation is performed, it may be necessary to position the ablation catheter in the ventricular aspect of the mitral annulus to achieve successful slow pathway elimination.

Atrial pacing with extrastimuli showed dual AV node physiology and inducted the clinical tachycardia easily, with the earliest atrial activation seen at the His catheter with a His–atrial time of 30 ms (Figure 1A). During tachycardia, an atrial extrastimulus was delivered when the junction was refractory, with advancement of the next His potential in 15 ms by early engagement of the slow pathway (Supplemental Figure 1), confirming a common type (slow-fast) of AVNRT.

RF energy applications with a 4-mm catheter at the anatomic slow pathway area in the right atrium with a typical intracardiac electrogram (Figure 1B) and in the roof of the CS were unsuccessful despite the occurrence of a slow junctional rhythm.

Owing to the long duration of the procedure and difficulty in stabilizing the catheter near the CS ostium, we performed CS venography, and the presence of a PLSVC was observed (Figure 2A and B).

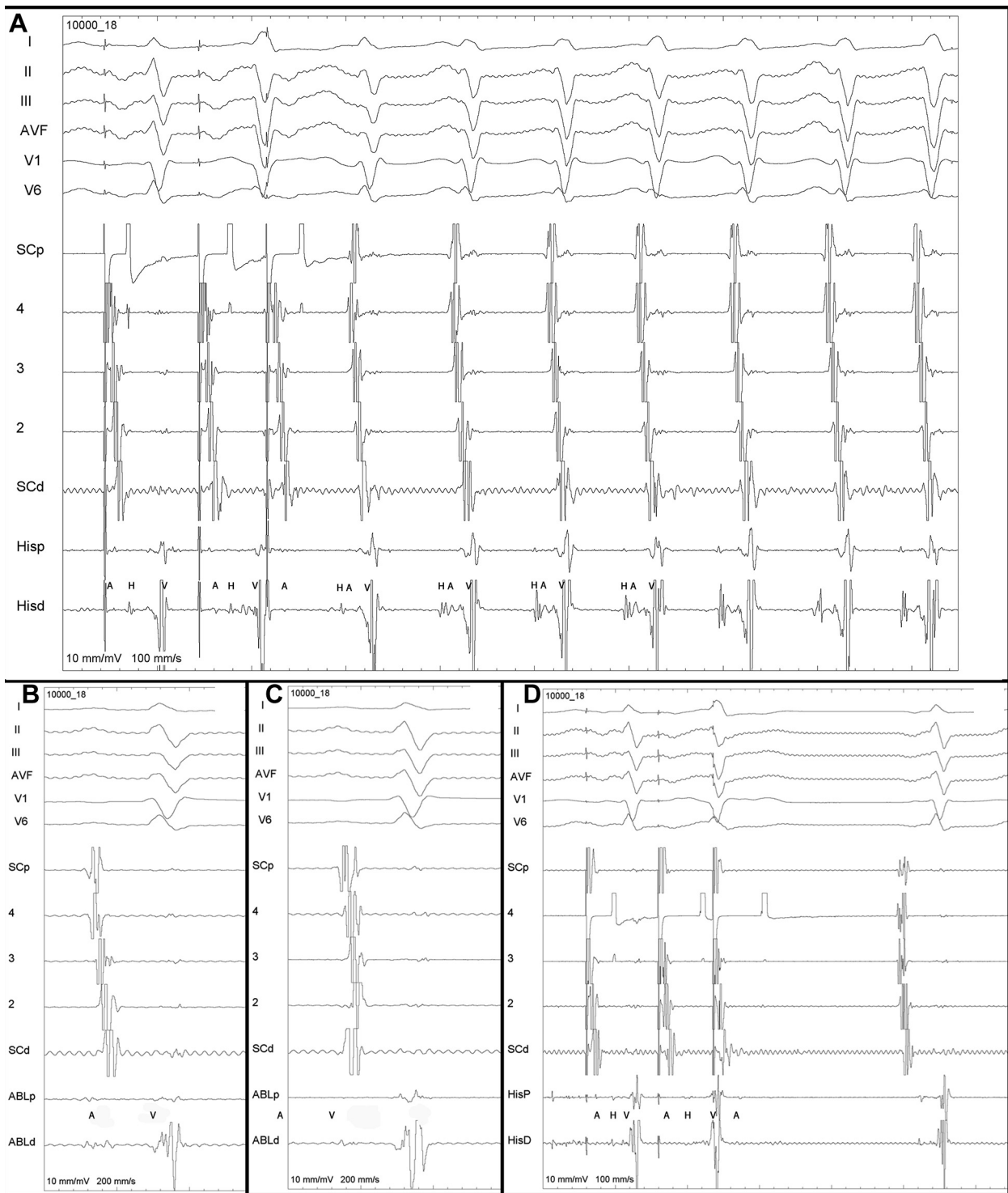


Figure 1 **A:** Atrial pacing with extrastimuli showed dual atrioventricular (AV) node physiology and induced the clinical tachycardia easily, with the earliest atrial activation seen at the His catheter with a His–atrial time of 30 ms. **B:** Ablation catheter positioned at the anatomic slow pathway area in the right atrium (unsuccessful target). **C:** Ablation catheter positioned after transseptal access with a far-field atrial signal followed by a large ventricular electrogram, suggesting the ventricular side of the mitral annulus (successful target). **D:** Atrial pacing with extrastimuli confirmed the slow pathway ablation. I, II, III, aVF, V₁, and V₆ indicate electrocardiography leads. A = atrial electrogram; Abl = Ablation catheter; d = distal; H = His electrogram; His = His area; p = proximal; SC = coronary sinus; V = ventricular electrogram.

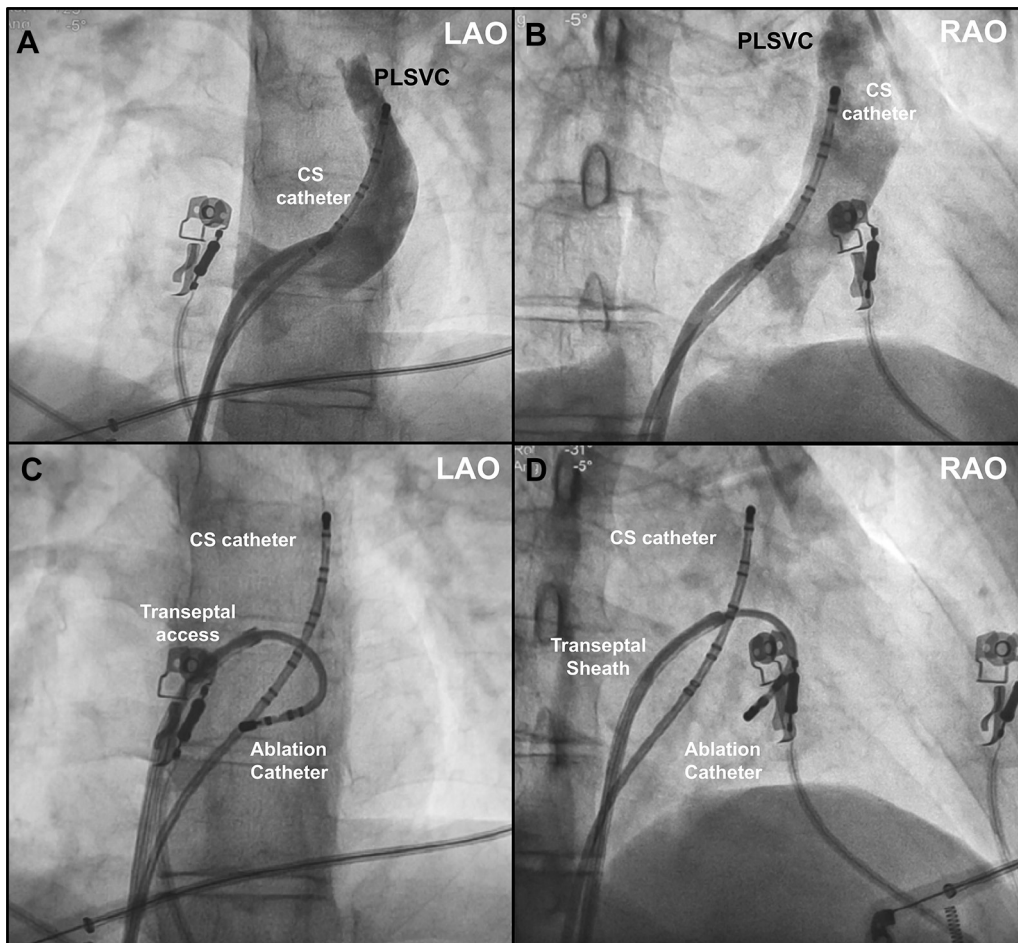


Figure 2 A, B: Coronary sinus (CS) venography in left anterior oblique (LAO; panel A) and right anterior oblique (RAO; panel B) fluoroscopy views showing persistent left superior vena cava (PLSVC). C, D: Position of the ablation catheter in the ventricular side of the mitral annulus at the posterior septal region through transeptal access (LAO: panel C; RAO: panel D).

We chose to perform transeptal puncture under fluoroscopy, and the catheter was positioned on the left posterior septal region (Figure 2C and D) with the intention of targeting left-sided slow pathway inputs and an AV ratio of 1:8. Several RF energy applications were performed, but tachycardia was still inducible. In a region where there was only a small far-field atrial potential and a large ventricular electrogram, suggesting the ventricular aspect of the mitral annulus (Figure 1C), RF pulses resulted in an accelerated junctional rhythm. The tachycardia was no longer inducible, and tests confirmed the slow pathway elimination (Figure 1D). The procedure was well tolerated, with no complications. During 5 months of follow-up, the patient has remained clinically free of symptoms, without medications.

Discussion

AVNRT ablation presents a high success rate with the classical approach, with the ablation catheter positioned in the right posterior septal region. However, in less than 1% of cases, the left approach may be necessary in cases when the right-sided slow pathway ablation has failed.¹ PLSVC,

although rare, is the most common venous anomaly in the chest, with a prevalence of 0.3%–0.5% in the general population and of 3% in patients with congenital heart defects. Usually, the left superior vena cava of the embryo involutes and becomes the ligament of Marshall in the mature heart.

As an isolated anomaly PLSVC is most often detected during thoracic surgery or cardiac catheterization.² It typically drains into the right atrium through the CS, which becomes dilated owing to volume overload. Patients with PLSVC have a significantly enlarged CS ostium, and the location of the slow pathway and His bundle area may be displaced, making the procedure more difficult and increasing the risk of damage to the AV node during ablation.^{3,4}

Owing to these difficulties, several approaches besides fluoroscopy have been suggested and reported, such as the use of 3-dimensional electroanatomic mapping,^{5,6} intracardiac echocardiography,⁷ and even a magnet navigation system,⁸ but to the best of our knowledge, this is the first case with the successful ablation of a typical AVNRT associated with PLSVC using the transeptal approach. This simple and low-cost strategy allowed for greater catheter stability and contact during the attempted mapping and ablation.

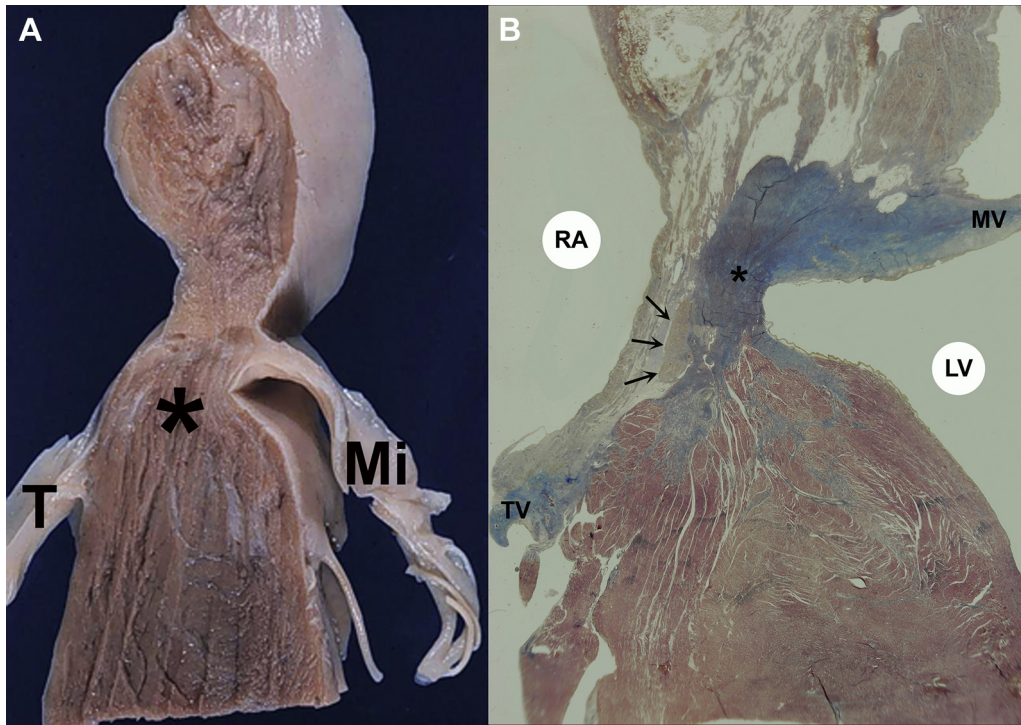


Figure 3 **A:** Longitudinal section through the posteroinferior septal part of the atrioventricular junction in a normal heart. Note the valvar offsetting, with the septal leaflet of the tricuspid valve (T) inserting toward the apex relative to the mitral valve (Mi). The asterisk shows the area of the so-called “muscular atrioventricular sandwich.” **B:** Photomicrography of the septal structures at the atrioventricular junction. Note the atrioventricular septum separating the right atrium (RA) from the left ventricle (LV). The atrioventricular node is marked with arrows. The fibrous body is marked with the asterisk. Masson’s trichrome. Original image from the Anatomy Lab of Heart Institute – Incor, São Paulo, Brazil. MV = mitral valve; TV = tricuspid valve.

Interestingly, as in the previous report by Green and colleagues,⁹ the successful ablation site was on the ventricular aspect of the mitral annulus. This region is accessed through the AV part of the cardiac septum, where the left ventricular inlet shares a close relationship with the right atrium and slow pathway location owing to the inferior displacement of the tricuspid valve relative to the mitral valve, known as valvar offsetting (illustrated in Figure 3). While some morphologists describe this part of the cardiac septum as the muscular portion of the AV septum, some others argue that the region is not a true septum, since it carries a layer of epicardial fibroadipose tissue with the artery originating in the U-turn of the dominant coronary artery responsible for irrigation of the AV node. The proposed name for this particular region is, according to such authors, “muscular atrioventricular sandwich.”¹⁰ We believe that this anatomic particularity must be considered for an adequate mapping of the slow pathway left inputs in all cases in which a left-side AVNRT ablation is necessary.

Conclusion

In cases where the classic AVNRT ablation approach fails, CS venography may diagnose PLSVC; and knowing the particularities of this association, the transeptal approach should be remembered and may be a simple, low-cost, and effective choice for the ablation of these arrhythmias. It

may also be necessary to position the ablation catheter in the ventricular aspect of the mitral annulus to achieve successful slow pathway elimination.

Appendix Supplementary data

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.hrcr.2018.09.004>.

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