Superior approach facilitated by atrial septoplasty in a case of persistent atrial fibrillation ablation with inferior vena caval obstruction

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Introduction

Catheter ablation is widely used in treating atrial fibrillation (AF) and other tachyarrhythmias originating from the left atrium (LA).[1,2] Transseptal puncture to access the LA has traditionally been performed via the inferior transfemoral venous approach. Inferior vena cava (IVC) obstruction, either congenital or acquired, is a rare condition that can make inferior access impossible.[3]

A small number of cases have been reported of patients with IVC obstruction undergoing LA ablation, superior access from puncture of a jugular, subclavian, or axillary vein being the most popular strategy.[4] Alternative nonsurgical routes to the LA include using a femoral approach through azygos or hemiazygos vein, retrograde approach through the aorta, or transhepatic approach.[4] Even when the IVC is normal, transseptal access can be challenging and although a variety of sheaths, guidewires, and radiofrequency (RF)-powered transseptal needles are available, atrial balloon septoplasty (ABS) is occasionally required.[5,6] We present a case of persistent AF ablation performed from a superior approach, where ABS was used as a stepwise bailout strategy, to facilitate access into the LA.

KEY TEACHING POINTS

- In atrial fibrillation patients with inferior vena caval obstruction, pulmonary vein isolation using a superior transseptal access via the superior vena cava can be difficult, but achievable.
- When standard transseptal techniques are ineffective and high resistance is encountered at the transseptal site, atrial balloon septoplasty should be considered.
- Adequate septostomy dilation can provide an access for the ablation catheter to pass to the left atrium, even when the deflectable sheath cannot be advanced across the septum.

Case report

A 47-year-old female patient with a history of hypertension and symptomatic paroxysmal AF that recently progressed to persistent was referred for catheter ablation. The baseline echo showed a normal LA size, with LA diameter of 37 mm on parasternal long-axis view, and a good biventricular function. During the first pulmonary vein isolation (PVI) attempt, a diagnostic catheter via the right femoral vein was unable to access the right atrium (RA). Computed tomography revealed a congenital IVC obstruction and an enlarged azygos/hemiazygos system draining into the superior vena cava (SVC) and the left subclavian vein, respectively.

A second attempt with a superior approach was performed, under general anesthesia with transesophageal echocardiogram (TEE) guidance. A decapolar deflectable catheter was advanced into the coronary sinus via the right internal jugular vein. The left axillary vein was accessed with an 8F short sheath and upsized to a 14F steerable sheath (Agilis 40 cm length; St Jude Medical, St Paul, MN), which was advanced to the RA and deflected to engage the interatrial septum.

After failed attempts to reach in to the LA using an NRG RF transseptal needle (NRG-71-Curve 1, 71 cm; Baylis Medical Inc, UK), a 0.025-inch pigtail wire (ProTrack; Baylis Medical Inc, Montreal, Canada) was advanced to the tip of the dilator pointing toward the septum, as visualized by the TEE, and RF energy (10 watts for 2 seconds) was delivered at the edge of the needle (Figure 1). Having verified the crossing of the interatrial septum using the TEE, fluoroscopy, and the LA pressure waveform, heparin was administered to achieve a target activated clotting time of >300 seconds. We then attempted to advance the dilator into the LA but

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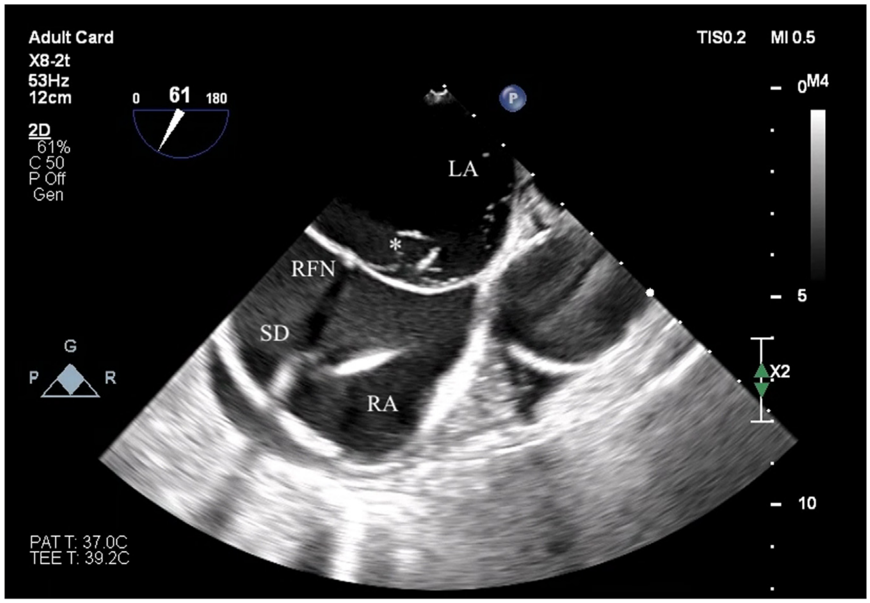

Figure 1 Transesophageal echocardiogram: aortic valve short-axis view, 60°. Delivery of radiofrequency (RF) energy at the tip of the RF needle to gain into the left atrium (LA). *: delivery of RF energy. RA = right atrium; RFN = tip of the radiofrequency needle; SD = sheath dilator.

encountered very firm resistance. Multiple attempts using different wires, including a 0.035-inch stiff guidewire (180 cm Super Stiff Guidewire; Abbott Medical, Maidenhead, Berkshire, England) failed to permit the advancement of the sheath into the LA.

At this point, an ABS was considered. The guidewire was placed in the left superior pulmonary vein (LSPV) and a 0.035-inch dilatation catheter (Advance 35LP Low-Profile PTA Balloon Dilatation Catheter; Cook Medical, Limerick, Ireland) was advanced over the wire and positioned across the septum, guided by the fluoroscopy and the TEE. The balloon (nominal diameter 7 mm, length 20 mm; Platform-14 Ltd, Stroud, UK) was fully inflated 3 consecutive times under continuous fluoroscopic and direct TEE visualization, to achieve an adequate septostomy dilation (Figure 2A and 2B). Then, the balloon was deflated and withdrawn and a J-tip guidewire was advanced into the LSPV. Despite the significant septal dilation, the steerable septal sheath could not be advanced in the LA over the guidewire, probably because of angulation. Instead, we allowed the sheath to remain in the RA, directed toward the septum, and advanced the ablation catheter through the dilated septostomy site into the LA. A 3-dimensional electroanatomic map of the LA and the PVs was created and PV isolation was successfully performed with an open-irrigated mapping and ablation catheter (QDOT MICRO Bi-directional D-F curve; Biosense Webster, Irvine, CA) (Figure 3). No acute or late complications occurred. No significant iatrogenic atrial septal defect was detected on the TEE after the procedure. The patient was discharged home the following day with oral dronedarone and omeprazole prescribed for 2 months; an allergic reaction to amiodarone had been previously recorded. She remains asymptomatic on bisoprolol 6 months postprocedure.

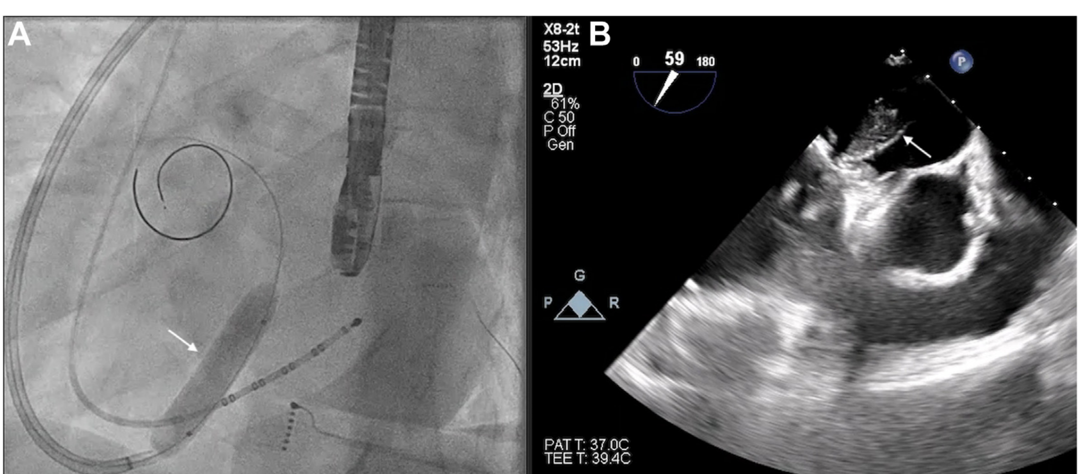

Figure 2 Atrial balloon septoplasty. **A:** Fluoroscopic (left anterior oblique 30°) and **B:** transesophageal echocardiogram view of the fully inflated balloon (*arrow*) to achieve an adequate septostomy dilation.

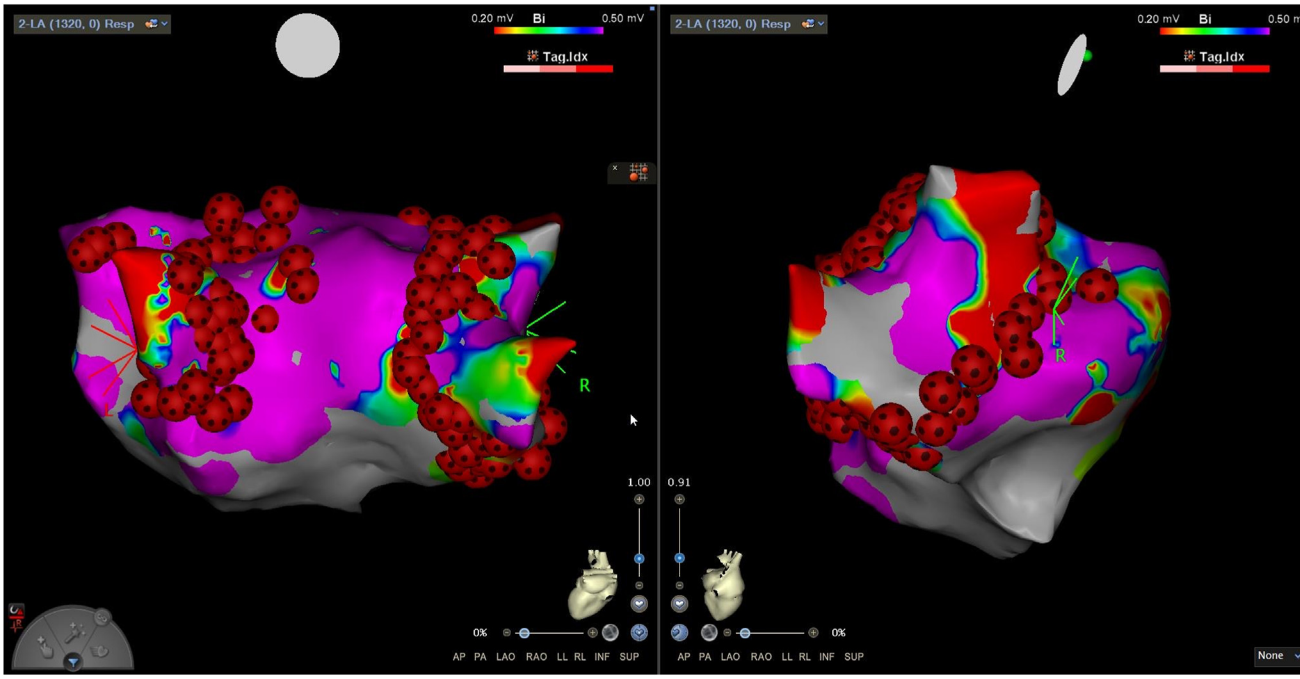

Figure 3 CARTO mapping system: posterior-anterior view (left) and right lateral view (right). A 3-D electroanatomic map of the left atrium and the pulmonary veins using the QDOT MICRO ablation catheter (Biosense Webster). The red dots represent ablation lesions with ablation index target values of 450 for the anterior segments and 350 for the posterior segments.

Discussion

A superior transseptal approach for PVI has been previously described in AF cases with an anomalous IVC-RA venous system.[4] Other uncommon challenges that make transseptal access more difficult include septal resistance owing to scarring or thickening, and additional strategies including bailout ABS are needed. To the best of our knowledge, this is the first report in which superior access via the left subclavian vein and SVC was combined with ABS to perform a catheter ablation in a patient with persistent AF and IVC obstruction.

Although atrial balloon septoplasty has previously been reported, its application has primarily been transfemoral. Rarely has it been used via the superior approach; the geometry is unfavorable owing to the angulations generated by the vasculature and the approach is unfamiliar to most operators. Our case has demonstrated the feasibility and effectiveness of ABS via the left subclavian access.

Congenital IVC obstruction is a rare condition with a known prevalence of 0.15% in the general population.[3] As the number of patients undergoing AF ablation increases, more cases are being encountered. Most IVC obstructions are clinically silent and totally unknown to the operator.[7] Congenital IVC obstruction is usually present in the context of other congenital heart conditions and lateralization anomalies, which makes access into the LA even more difficult.[4,8] Among the available methods, transseptal access via a superior approach is the strategy most frequently used to access the LA when the IVC is obstructed,[4] but the catheters, sheaths, wires, and needles traditionally used for transseptal puncture have been designed for the inferior approach. Additional tools are required, including deflectable sheaths, RF needles or wires, and intracardiac or transesophageal ultrasound.[9] In the largest series of AF ablations performed via the SVC, Liang and colleagues[10] reported safe and successful advancement of the transseptal sheath into the LA in all 15 patients. In all cases a deflectable sheath (Agilis EPI sheath in 10 patients and SupraCross sheath in 5 patients) was used with a powered tool (an NRG RF-tip transseptal needle in the first 4 cases and an RF in 11 patients).

In a large majority of left-sided ablation cases, the transseptal puncture is straightforward and safe. Septal scarring owing to prior ablation, surgery, or disease can make access into the LA difficult but can be achieved by dilating with progressively larger-diameter dilators and the use of an extra-stiff guidewire; ABS should also be considered. In the largest series to date, Wang and colleagues[5] noted that ABS with a soft-headed angioplasty guidewire and a short noncompliant balloon (15 mm in length and 4.0 or 5.0 mm in diameter) facilitated the LA access in all 20 AF cases with challenging transseptal punctures. In another series of 15 patients with previously failed transseptal puncture, access into the LA was achieved with a noncompliant balloon (diameter 4–10 mm) that was advanced over a stiff wire deployed in the LSPV.[6]

In the present case, although the septum appeared normal, the angle between the SVC and the trajectory needed to puncture the septum did not allow the sheath to advance into the LA. Although ABS did not permit the sheath to advance, it did provide an access for an ablation catheter to pass to the LA supported by a deflectable sheath that remained in the RA. The ABS was performed using a 35LP Advance balloon, commonly used for angioplasty to peripheral arteries. The use of the 14F steerable sheath was crucial for a number of reasons. The large sheath is stiffer than the smaller sheaths, providing greater stability and control. This is helpful to overcome the difficulties presented by the angulations of the venous system via the left subclavian access. Also, the large-bore sheath allows the delivery of a number of wires, catheters, and balloons of variable sizes, at the same time expanding the number of interventional options. In this case, the 14F sheath facilitated ABS and, owing to its stiffness, remained in a stable position in the RA and enabled 3D mapping and PVI; if required, an 8.5/9F sheath could be used via the 14F sheath. The 14F outer diameter of the deflectable sheath may have contributed to the difficulty in advancing it across the septum, but our impression was that it would have been impossible to direct the ablation catheter into the LA with a nondeflectable sheath.

Conclusion

In AF patients with IVC obstruction, superior transseptal access via the SVC is achievable but difficult. When standard transseptal techniques are ineffective, atrial balloon septoplasty should be considered.

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