Circumferential pulmonary vein ablation of atrial fibrillation via superior vena cava approach in a patient with interruption of the inferior vena cava

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 Interruption of the inferior vena cava (IVC) is a very rare congenital abnormality. Such patients have many difficulties during ablation procedures. We report a case of successful ablation of paroxysmal atrial fibrillation using the superior vena cava in a patient with interruption of the IVC.

A 63-year-old woman with hyperthyroidism and paroxysmal atrial fibrillation (AF) was referred to our centre for radiofrequency ablation. She had been treated with thiamazole for 5 years. Despite a euthyroid state and antiarrhythmic agent administration, she had frequent episodes of palpitations due to paroxysmal AF. Before the procedure, computed tomography was performed to depict the left atrium (LA) and pulmonary veins (PV). We noticed that the inferior vena cava (IVC) was completely obstructed at the infra-renal level (Figure 1A). Subsequently, abdominal MRI findings confirmed the diagnosis of interrupted IVC (Figure 1B). Abdominal venous return occurred via the hemiazygous vein.

It was quite evident that transseptal puncture and LA ablation would be impossible by an IVC approach via the femoral vein.

Therefore, we decided to perform LA ablation via a superior vena cava (SVC) approach. Very recently, Lim et al.1 reported that transseptal puncture and LA ablation can be safely performed via a right internal jugular vein access. Another publication described left atrial ablation from a superior approach albeit for left atrial tachycardia after previous AF ablation.2

After written informed consent was obtained, electrophysiological study and ablation procedure via the right internal jugular vein and left subclavian vein were performed. First, a 10-pole catheter was placed into the coronary sinus from the 6 Fr sheath via the left subclavian vein. Transseptal puncture under intracardiac echocardiography (ICE) and fluoroscopic guidance was performed via the right internal jugular vein with an 8 Fr long sheath (SL3, St Jude Medical, Inc., St Paul, MN, USA) and manually curved Brockenbrough needle with a 120° angle to manipulate the tip downward to the fossa ovalis (Figure 2). After successful transseptal puncture without any complications, a 7 Fr mapping catheter (NAVISTAR, Biosense Webster, Inc., Diamond Bar, CA, USA) was introduced into the LA and PV from an 8.5 Fr steerable sheath (Agilis, St Jude Medical) via the left subclavian vein (Figure 3A–D). Three-dimensional (3D)

Figure 1 (A) Computed tomography (CT) image of the upper abdomen shows the liver, aorta, and absence of the inferior vena cava (IVC). (B) MR image of the chest and abdomen shows the heart, liver, aorta, and absence of the IVC.

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voltage maps of the whole LA and bilateral PVs were constructed using an electroanatomical mapping system (CARTO, Biosense Webster). Circular mapping catheters were not used. Circumferential pulmonary vein ablation (CPVA)3 was performed with a radiofrequency energy (power 30 W and temperature 55°C) to encircle the ipsilateral PV ostia and LA antrum (Figure 4).

At the end of the procedure, rapid atrial pacing revealed that AF was no longer inducible. She was discharged home without recurrence of AF 4 days after the procedure. Brief episodes of atrial tachycardia occurred 5 days after discharge and were terminated by verapamil. Then, she maintained sinus rhythm during the follow-up period of 3 months. Twenty-four hour Holter ECG monitoring at 35 days and 3 months after ablation demonstrated no atrial tachyarrhythmia. No major complications occurred during or after the procedure.

Interruption of the IVC is a very rare congenital abnormality. Koc and Oguzkurt4 reported that interruption of the IVC was noted in 8 (0.1%) of 7972 patients. Such patients have many difficulties during ablation procedures. Usual transseptal puncture via a femoral vein is impossible in this setting. Previously, only one report described an SVC approach for LA ablation to cure AF.1 We performed transseptal puncture from the right internal jugular vein, and made a success of CPVA from the left subclavian vein approach. First, facilitating this was the use of ICE from the left subclavian vein to guide the transseptal puncture from the right internal jugular vein. Real-time echocardiographic imaging for tenting of the fossa ovalis enhanced the safety of the transseptal access into the LA, because the abrupt leftward movement (snap-in), which indicates passage over the limbus into the fossa ovalis, cannot be observed from the SVC approach. Second, we used a steerable sheath for mapping and ablation for the LA and PV.5 The SVC approach was associated with a very tight curve of the ablation catheter at the bottom of the right atrium and LA. Therefore, special back up and manipulation of the sheath were
needed. In particular, the tight loop of the steerable sheath and ablation catheter was very useful to map and ablate the right PV antrum (Figure 3C and D), because the SVC approach is more likely to direct the catheter and sheath toward the mitral valve, which exists on the side exactly opposite to the right inferior PV.

In summary, we successfully performed CPVA in a patient with paroxysmal AF and complete interruption of IVC using the superior route through the internal jugular vein and the subclavian vein. Long-term maintenance of sinus rhythm should be confirmed with careful follow-up.

**Conflict of interest:** none declared.

**References**