Implantation of ileofemoral stents: A novel approach for bilateral occlusions of the iliofemoral vein in a patient with a Glenn operation

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Introduction

Iliofemoral venous occlusions may sometimes be encountered in patients with congenital heart disease (CHD), because of repeated catheterizations, a cut-down of the femoral vein, insertion of central venous catheters, or surgical venous anastomoses.[1–3] Consequently procedures for catheter intervention, including catheter ablation, may sometimes become difficult or impossible because of a femoral venous occlusion. We report a patient with bilateral iliofemoral venous occlusions after a Glenn operation who subsequently underwent a successful radiofrequency catheter ablation (RFCA) of atrial flutter (AFL) after the implantation of ileofemoral stents.

Case report

A 32-year-old woman was referred to our hospital for RFCA of AFL. She was diagnosed with pulmonary atresia with an intact ventricular septum just after her delivery, and underwent a Blalock-Taussig shunt and Brock operation when she was 3 months old, right ventricular outlet tract repair at 3 years old, and Glenn operation and closure of an atrial septal defect at 10 years old. AFL was first noted when she was 30 years old. Because 1:1 conduction of the AFL was documented by Holter monitoring and her daily life was impaired owing to the tachycardia, RFCA of the AFL was attempted in a previous hospital, but it was unsuccessful because catheter insertion into the atrium was impossible owing to bilateral femoral vein occlusions and a Glenn operation. Treatment with digoxin and warfarin was then started for rate control of the AFL and to prevent thromboembolisms. She was referred to our hospital to undergo a possible RFCA.

On physical examination, an early diastolic murmur (Levine II/VI) was audible and the jugular vein was overdistended. There were scars from a surgical cut-down on the bilateral inguinal regions. An electrocardiogram showed 2:1 conduction of the AFL. An echocardiogram revealed right atrial and ventricular dilatation, moderate pulmonary regurgitation, and mild tricuspid regurgitation (pressure gradient 18 mm Hg); however, there was no shunt between the atrial septum and ventricular septum. In the blood tests, the prothrombin time was within normal limits while she was taking warfarin. The protein C, protein S, and antiphospholipid antibody levels were all within normal limits.

Angiography of the great saphenous veins revealed that the iliac vein was occluded with the development of collateral vessels to the inferior vena cava (IVC) (Figure 1A). After written informed consent was obtained, a recanalization procedure and stenting were performed under general anesthesia. A 7F sheath (Radifocus introducer; Terumo interventional systems Co Ltd., Japan) was inserted from the right femoral vein by an echo-guided approach. A 0.035 inch guidewire (Glidewire; Terumo interventional systems Co Ltd, Japan) was then advanced through the collateral vessel by guidance with a contrast injection from the sheath, and advanced to the IVC across the restricted vessel. Balloon-expandable stents (Palmatz; Cordis Co Ltd, Miami, FL) and self-expandable stents (Wall stent; Boston Scientific Co Ltd., Marlborough, MA) were implanted one after another in the stenosed segments (Figure 1B and C) through the IVC, and from the iliac vein to the femoral vein. After the stent implantation, the femoral vein was opened and drained into the IVC (Figure 1D).

After obtaining venous access into the IVC, we performed an electrophysiologic study and catheter ablation. A stiff guidewire (Amplatz, Super Stiff; Boston Scientific Co Ltd, Marlborough, MA) was advanced through the implanted

KEYWORDS Iliofemoral vein obstruction; Adult congenital heart disease; Glenn operation; Atrial flutter (Heart Rhythm Case Reports 2016;2:138–141)

This work was supported by a Health Science Research grant from the Ministry of Health, Labour and Welfare of Japan for Clinical Research on Measures for Intractable Diseases (2016-032). **Address reprint requests and correspondence:** Dr Naokata Sumitomo, Department of Pediatric Cardiology, Saitama Medical University International Medical Center, 1397-1 Yamane Hidaka, Saitama, 350-1298, Japan. E-mail address: sumitomo@saitama-med.ac.jp.

 http://dx.doi.org/10.1016/j.hrcr.2015.11.010

KEY TEACHING POINTS

- In this patient, a conventional femoral approach was difficult because of bilateral iliofemoral vein occlusions. Moreover, an internal jugular vein approach would have also been difficult, because of her postoperative status of a Glenn procedure.
- A stent implantation into an occluded iliofemoral vein could be an alternative novel method for performing a radiofrequency catheter ablation.
- Complications involving pulmonary embolization, infections, and fractures of stents should be noted after the implantation of stents in the ileofemoral vein

stents into the right atrium (RA), and then a long sheath (8.5F Swartz Braided Transseptal Guiding Introducers; St Jude Medical Co Ltd., Marlborough, MA) was advanced over the guidewire. Then an 8F catheter (ThermoCool SmartTouch; Biosense, Webster Co Ltd,) was advanced into the atrium through the long sheath. Additionally, a conventional sheath (5F Radifocus introducer; Terumo interventional systems Co Ltd., Japan) was introduced from the right femoral vein by an echo-guided approach, and an 4F 20 polar electrode catheter (EPstar; Japan Lifeline Co Ltd., Japan) was advanced into the RA under fluoroscopy. The voltage mapping revealed a low voltage area in an extensive area of the RA. Using a propagation map, AFL1 was identified to be a counter-clockwise macroreentrant AFL around the tricuspid valve. The postpacing interval during the AFL was consistent with the AFL cycle length in the area above the scar in the RA and the area around the tricuspid valve (AFL1). During the linear ablation from the tricuspid annulus through the IVC (cavo-tricuspid isthmus), the AFL sequence changed (AFL2) (Figure 2). AFL2 was finally terminated by completing the linear ablation of the cavotricuspid isthmus. Digoxin was discontinued after the RFCA, and the patient remained in sinus rhythm with no recurrence of the AFL during a follow-up of 7 months.

Discussion

In this patient, the bilateral iliofemoral veins were occluded from a surgical operation, cannulation of the catheters, and a cut-down of the femoral veins.[1–3] Systemic vein occlusions after CHD surgery are not a rare condition. If the iliofemoral veins are occluded, the approach to the intracardiac chambers can be quite difficult. The other option when the femoral approach is difficult is a superior approach from a Glenn operation through the pulmonary artery and right ventricle into the RA. The superior approach via the jugular vein or azygos vein is an effective method for an IVC deficiency and occluded iliofemoral veins. Thus far the successful ablation of atrioventricular reentry tachycardia, atrioventricular nodal reentry tachycardia, and AFL have been reported by a superior approach.[4–7] However, catheter manipulation can be quite difficult because the catheter has to pass multiple vessels and cardiac chambers. The second option is a retrograde approach from the aorta through the left ventricle and left atrium into the RA;[8] however, in this patient it was impossible because there was no atrial shunt. A transhepatic approach has been reported in these patients as another option to reach the RA.[9–13] Singh et al[10] reported 2 patients with interrupted IVCs in whom a transhepatic approach was successfully performed to terminate atrial arrhythmias. Nguyen et al[12] reported that the transhepatic approach is a safe and feasible method in patients with limited venous access for a successful ablation of AFL, atrial tachycardia, and atrioventricular nodal reentry tachycardia. Shim et al[13] reported that the complication rate of the transhepatic approach is $<5\%$ in pediatric populations.

Stent implantations were reported to be effective for occluded veins.[14–16] Neglén et al[14] reported that the long-term patency rate was quite satisfactory in 982 limbs with obstructive iliac vein lesions after implanting stents. To the best of our knowledge, this is the first report of implanted stents for an occluded iliofemoral vein for the purpose of catheter ablation. Although we succeeded in creating access through the femoral vein into the IVC, the number of catheters was limited because of the stent size and the stent had no ability to expand.

For the purpose of catheter ablation, implanting stents for an occluded ileofemoral vein can be an alternative and an effective and safe procedure. However, the occurrence of pulmonary embolisms or embolisms of other organs should be considered during this procedure if there is a right-to-left shunt with an organized old thrombus while advancing the guidewire or guiding catheter through the stent.

Conclusion

In the case of an iliofemoral venous occlusion after a CHD operation, a stent implantation into an occluded iliofemoral

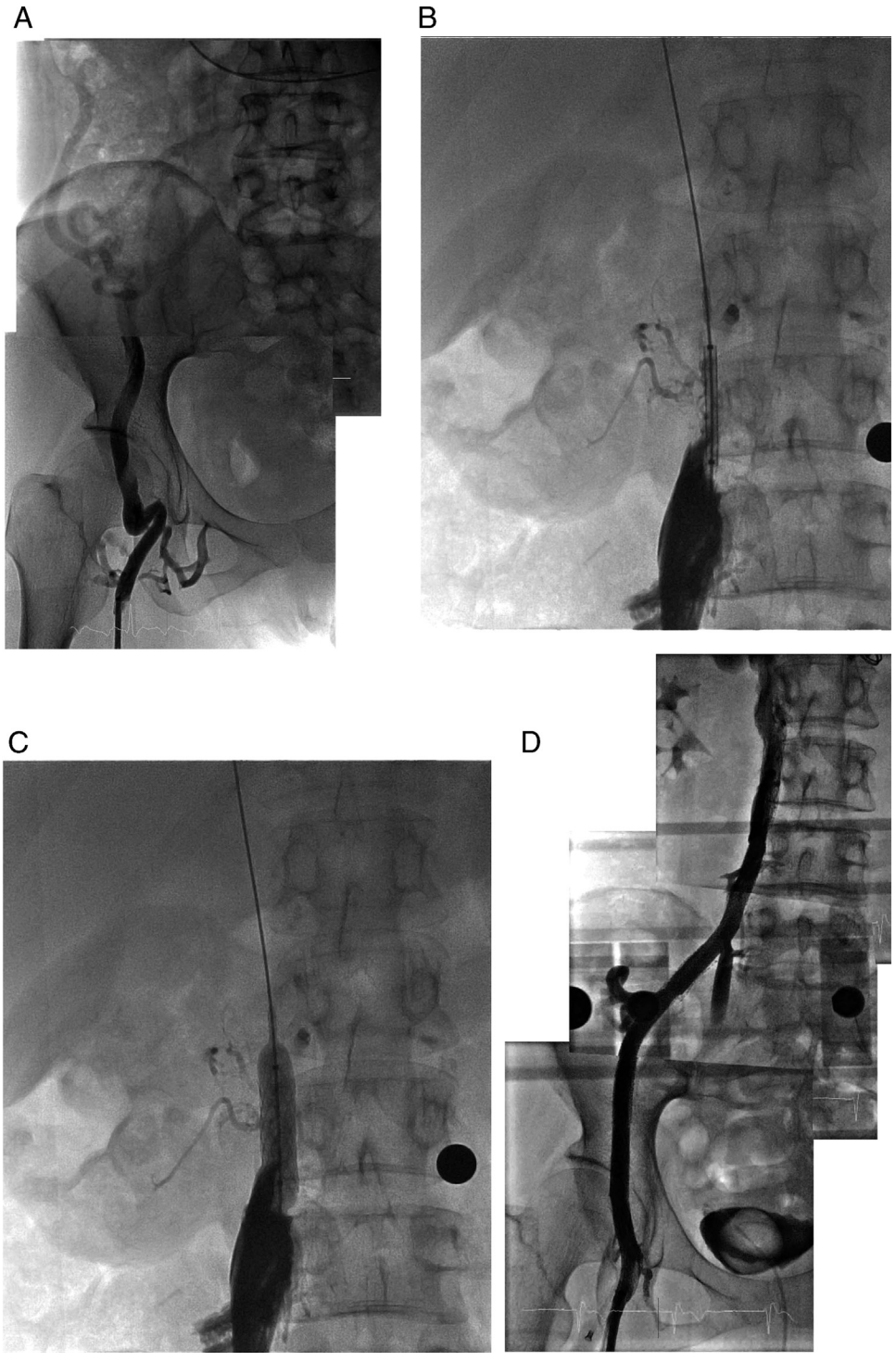

Figure 1 Angiogram of the femoral vein before and after implanting the stents. **A:** Image demonstrates an occluded right iliofemoral vein and the development of collateral vessels running above to the inferior vena cava (IVC). **B:** An 0.035-inch guidewire was advanced to the IVC across the restricted vessel. **C:** Balloon-expandable stents (Palmatz) were implanted in the stenosed segments through the IVC. **D:** After the stent implantation, the femoral vein was opened and drained into the IVC.

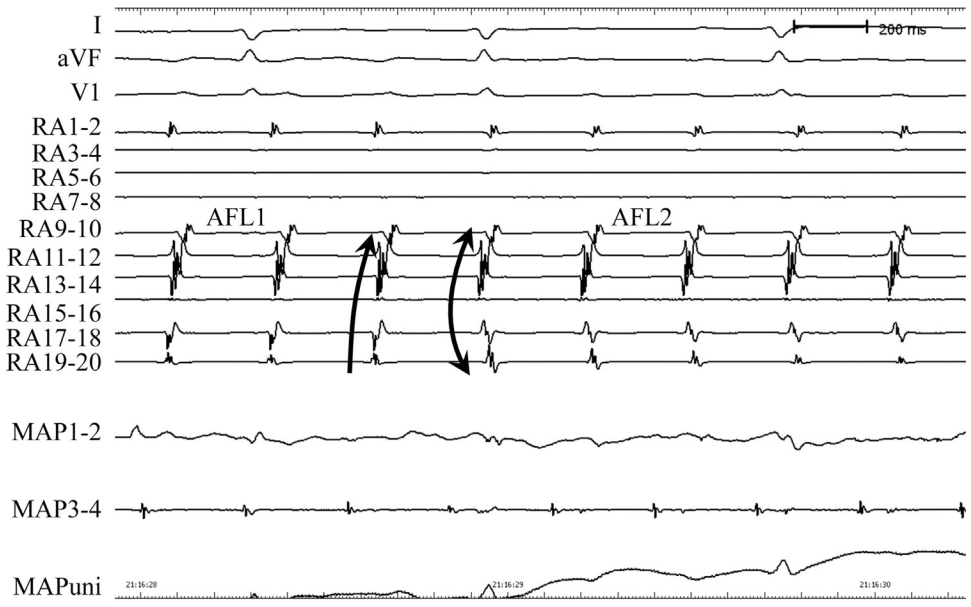

Figure 2 Sequence change during linear ablation of cavotricuspid isthmus. I = lead I; aVF = lead aVF; V1 = lead V1; RA = right atrial electrocardiogram; MAP = mapping catheter electrocardiogram. AFL = atrial flutter.

vein could be an alternative novel method for performing an RFCA.

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