



Case Report

Successful implantation of leadless pacemaker in patient with the Günther Tulip inferior vena cava filter



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ABSTRACT

Leadless pacemakers have many advantages for some patients in preventing lead- and pocket-related complications. The traveling of the femoral vein is important in the context of normal approach site choice for leadless pacemakers. In this case, the leadless pacemaker could be successfully implanted without disrupting the inferior vena cava filter by using intravascular ultrasound in a hemodialysis patient with complete atrioventricular block and atrial fibrillation who had obstruction of the bilateral subclavian and right femoral veins, and travel abnormality of the left common iliac vein.

< **Learning objective:** The leadless pacemaker is a useful option in patients with complex vascular complications and hemodialysis. However, there are several listed contraindications such as the presence of inferior vena cava (IVC) filter that was excluded in the large-scale trials to leadless pacemakers. Intravascular ultrasound is a useful tool to place the leadless pacemaker without disrupting IVC filter to maintain its filtering capability.>

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Introduction

The leadless pacemaker is delivered directly into the right ventricle of the heart via femoral vein by using the transcatheter delivery system that seems to be another appropriate option when the traditional lead system approaches are unavailable, especially in patients with complex vascular complications such as bilateral subclavian vein and superior vena cava occlusions. However, leadless pacemakers have several contraindications. One of these is the presence of inferior vena cava (IVC) filter that would interfere with the implant of the leadless pacemaker. We report that the leadless pacemaker was successfully implanted via left common femoral vein through the previously placed IVC filter.

Case report

The patient was an 82-year-old male with end-stage renal failure on hemodialysis due to diabetic nephropathy. The bilateral subclavian veins were occluded by repeated blood access troubles.

Then, the artificial graft from the right subclavian proximal artery to the distal artery was used as the blood access for daily hemodialysis. The patient had a history of deep venous thrombosis with implantation of a permanent Günther-Tulip IVC filter (Cook Medical Inc., Bloomington, IN, USA) 17 years previously, and after that, the right femoral vein was occluded by thrombophlebitis. The patient was referred for permanent pacemaker implantation for symptomatic complete atrioventricular block with chronic atrial fibrillation. As occluded carotid vein was found on the ultrasound examination, the temporal pacemaker lead was inserted from the left internal carotid vein. After admission, the occluded bilateral subclavian and the right femoral vein, and two left iliac veins that were running in parallel were confirmed by the angiography. As the treatment plan, (1) left internal carotid transvenous lead placement, (2) leadless pacemaker implantation via the left internal carotid vein, (3) leadless pacemaker implantation via the left femoral vein, and (4) the surgical epicardial lead placement were discussed by the expert physicians. Since the blood access troubles had frequently occurred, the left internal vein would be needed for using blood access route for hemodialysis in the future. Moreover, the risk of open chest surgery might be high for a frail patient undergoing hemodialysis. Finally, we fully explained all treatment choices which were mentioned above and told the patient that with a

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leadless pacemaker via femoral vein the principle contraindication is when there is an IVC filter. As a result, the patient himself selected leadless pacemaker implantation via the left femoral vein. Thus, we planned to implant the leadless pacemaker from the left femoral vein.

In advance of the procedure, we simulated the insertion of a leadless pacemaker delivery catheter into a transparent tube built-in the Günther-Tulip IVC filter. The result of this simulation showed that the delivery catheter could reach the heart without damaging the IVC filter by passing through the widest area of the Günther-Tulip IVC filter (Fig. 1 and Video 1 in Supplemental material).

Left femoral venous access was obtained under ultrasound guidance, 5French peripheral guiding sheath (Destination[®], Terumo, Tokyo, Japan) was pushed to the distal lesion of the IVC filter through the largest vein in the two left iliac veins that were running in parallel. Then, the 0.014 inch guide wire (Hi-Torque Command[®], Abbott, Abbott Park, IL, USA) was passed through the widest strut of the IVC filter that was confirmed by the intravascular ultrasound (IVUS). In detail, it could be confirmed that the guide wire was passing through the area surrounded by the vessel wall and individual legs but not strut of the IVC filter by using IVUS. It was judged that it passed through the widest area in terms of the appropriate route as shown Fig. 2 and Videos 2 and 3 in Supplemental material. Then, the guiding sheath was pushed until it passed through the IVC filter, and the 0.014 inch was exchanged to the 0.035 inch J-tip wire (Radifocus Stiff[®], Terumo). After serial dilations of the puncture site, a 27 French long delivery sheath was advanced to the IVC filter. Since the catheter did not pass through the common iliac vein bifurcation, the guide wire was changed to the stiffer guide wire (EGoist[®], Medicos Hirata, Tokyo, Japan). The delivery sheath passed smoothly through the IVC filter as shown in Fig. 2, and the leadless pacemaker device (Micra[™], Medtronic, Minneapolis, MN, USA) was successfully placed into the right ventricle without damage through the IVC filter. There was no visible fracture of struts, dislodgement, or disruption of individual legs of the IVC filter on the fluoroscopic evaluation as shown in Fig. 3. At the time of implantation, the VVI leadless pacemaker was programmed to 50 beats/min with a sensed R wave of

19.5 mV, pacing impedance of 500 Ω , and pacing threshold of 0.88 V at 0.24 ms. There were no vascular complications or recurrence of venous thrombotic embolism during the hospital stay. At a month after discharge, the device interrogation revealed the sensed R wave of 20.0 mV, pacing impedance of 480 Ω , and pacing threshold of 1.0 V at 0.24 ms.

Discussion

We demonstrated that a large-size delivery sheath could advance safely in the presence of a Günther-Tulip IVC filter when it passed an appropriate route between two legs of IVC filter confirmed by IVUS, and a transcatheter leadless pacemaker was successfully implanted. Actually, no fracture of struts and dislodgement or disruption of the legs of the IVC filter were observed after removal of the sheath, suggesting the filtering capability might be maintained. It is uncertain whether other IVC filter designs preclude leadless pacemaker implantation. However, several cases reported successful implantation in other IVC filters under fluoroscopic guidance alone [1–3]. Gabriels et al. also reported that a balloon inflation was needed to cross the IVC filter for implantation of leadless pacemaker since the delivery sheath could not be advanced past the IVC filter in patients with tachycardia-bradycardia syndrome [4]. The deformation of IVC filter induced by balloon expansion, however might not guarantee the maintenance of its filtering capability. Thus, the delivery sheath passes through the widest area of the IVC filter by using IVUS without ballooning as it will minimize filter deformation and will be able to preserve its function.

The approach site commonly selected is the right femoral vein for leadless pacemaker implantation for the reason of the steeper angle between the left iliac vein and IVC in comparison with that between the right iliac vein and IVC. Thus, the delivery sheath could not be advanced past the left iliac vein to IVC by using stiff guide wire in this case. To exchange the stiffer guide wire, it could be advanced to the right ventricle.

Another reason for leadless pacemaker implantation via IVC filter in this patient is that hemodialysis is an independent predictor of transvenous and epicardial permanent pacemaker

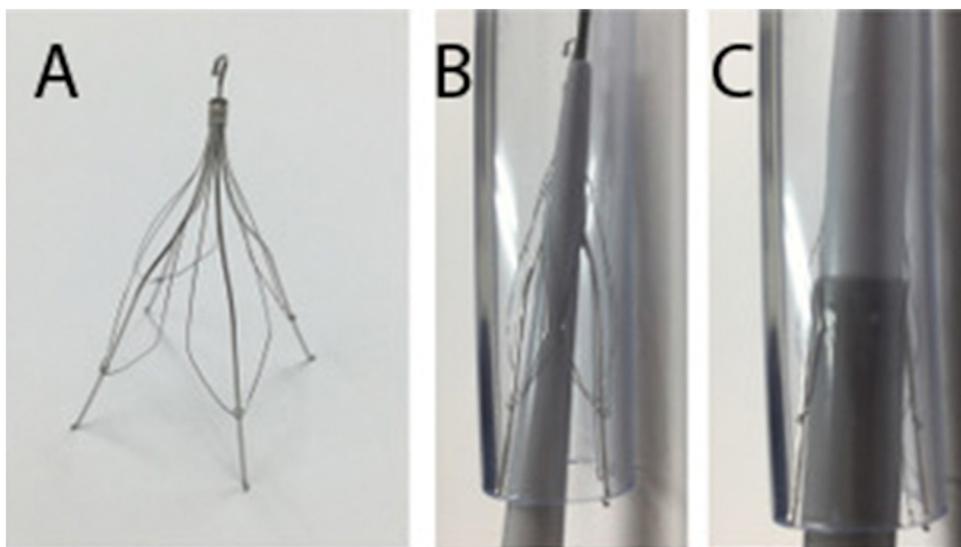


Fig. 1. Günther-Tulip inferior vena cava (IVC) filter and simulation of the insertion of a delivery catheter with dilator into a transparent tube built-in the Günther-Tulip IVC filter. (A) Implanted shape of the Günther-Tulip IVC filter. (B, C) This simulation showed that the catheter could be smoothly passed through the widest area of the Günther-Tulip IVC filter.

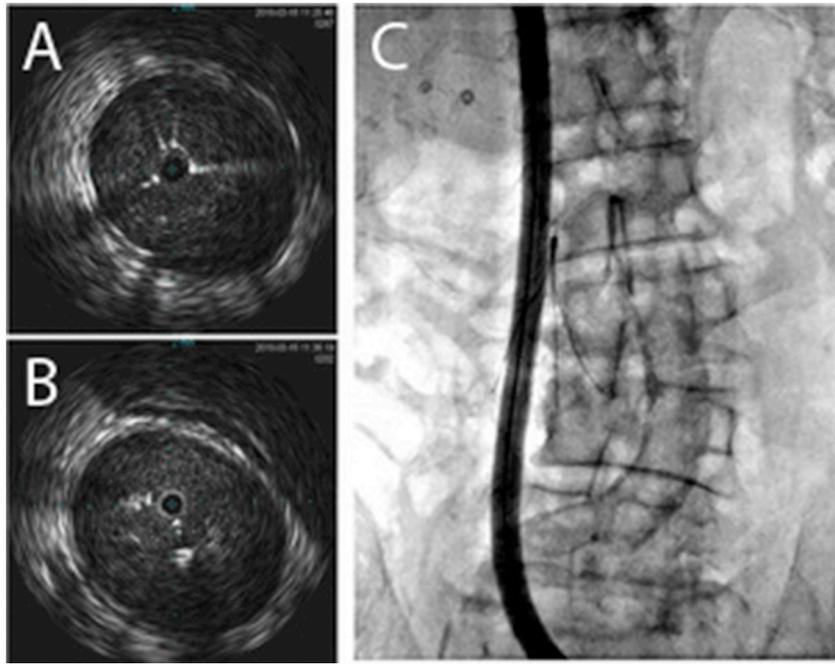


Fig. 2. Intravascular ultrasound (IVUS) and fluoroscopic image of the delivery catheter passed through the inferior vena cava (IVC) filter. (A) IVUS catheter surrounded by the struts or legs (inappropriate narrow area). (B) IVUS catheter surrounded by the legs and vessel wall (appropriate wide area), and it is judged that it passed through the widest area in terms of the appropriate route. (C) The delivery catheter passed through the IVC filter in the fluoroscopic image.

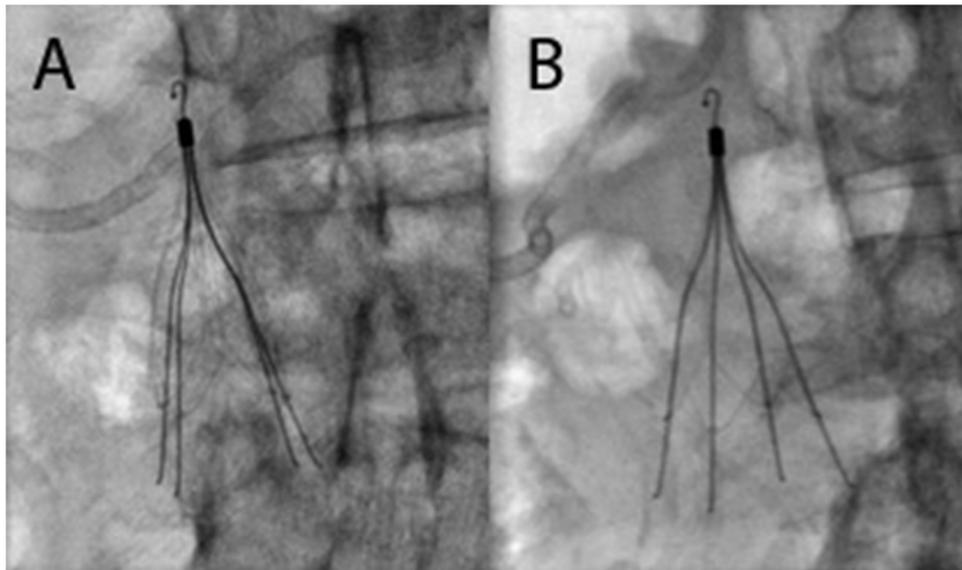


Fig. 3. Fluoroscopic image of the Günther-Tulip inferior vena cava (IVC) filter after removal of the sheath. Fracture of the struts and dislodgement or disruption of the legs of the IVC filter were not observed by the fluoroscopy in the antero-posterior view (A) and the left antero-oblique view (B).

infection, leadless pacemaker may have a lower risk of infection [5].

In the large clinical trials of the leadless pacemaker, patients with IVC filter were actually excluded. Some of those excluded patients will benefit from treatment with a leadless pacemaker. However, the technique of the leadless pacemaker implantation is complicated in those patients with the limitation of vascular access and/or prior another implantable device. Therefore, further trials

are necessary to evaluate the safety and long-term outcome of leadless pacemakers in such patients.

Conclusion

In this case, the leadless pacemaker could be successfully implanted without disrupting the IVC filter by using IVUS in a hemodialysis patient with complete atrioventricular block and

atrial fibrillation who had obstruction of the bilateral subclavian and right femoral veins, and travel abnormality of the left common iliac vein.

Conflict of interest

The authors declare there is no conflict of interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.jccase.2018.11.001>.

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