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SPOTLIGHT

Helix-fixation leadless pacemaker as a potential alternative to conventional transvenous pacemaker in post-Mustard baffle stenosis

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The implantation of transvenous pacemaker has traditionally been the standard therapy for bradyarrhythmia in adult congenital heart disease (ACHD), but some patients with ACHD have complex anatomy or venous occlusion due to a prior procedure that makes the conventional treatment difficult. Although the use of a leadless cardiac pacemaker (LCP) system could resolve these issues, its clinical experience for ACHD is limited. This case report illustrates that a helix-based active fixation LCP (Aveir VR; Abbott, Chicago, Illinois,

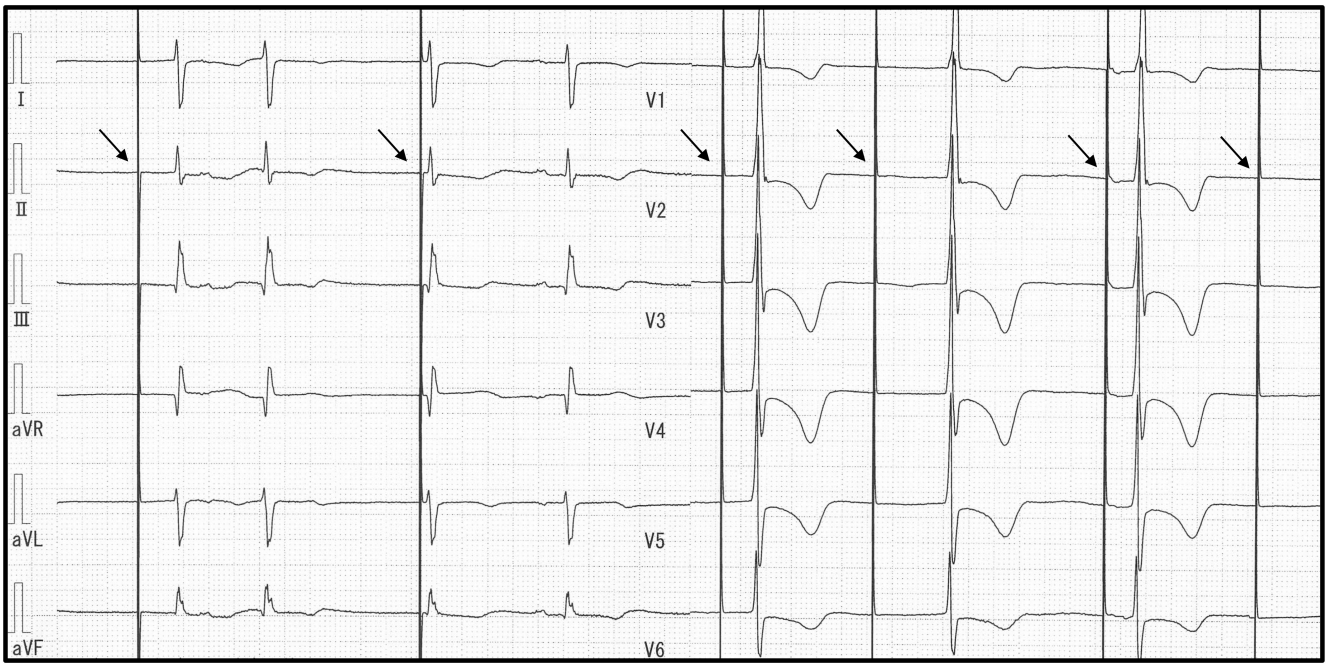

FIGURE 1 Preprocedural 12-lead ECG shows ventricular pacing failure. Pacing spikes were accompanied by the absence of pacing QRS (arrows).

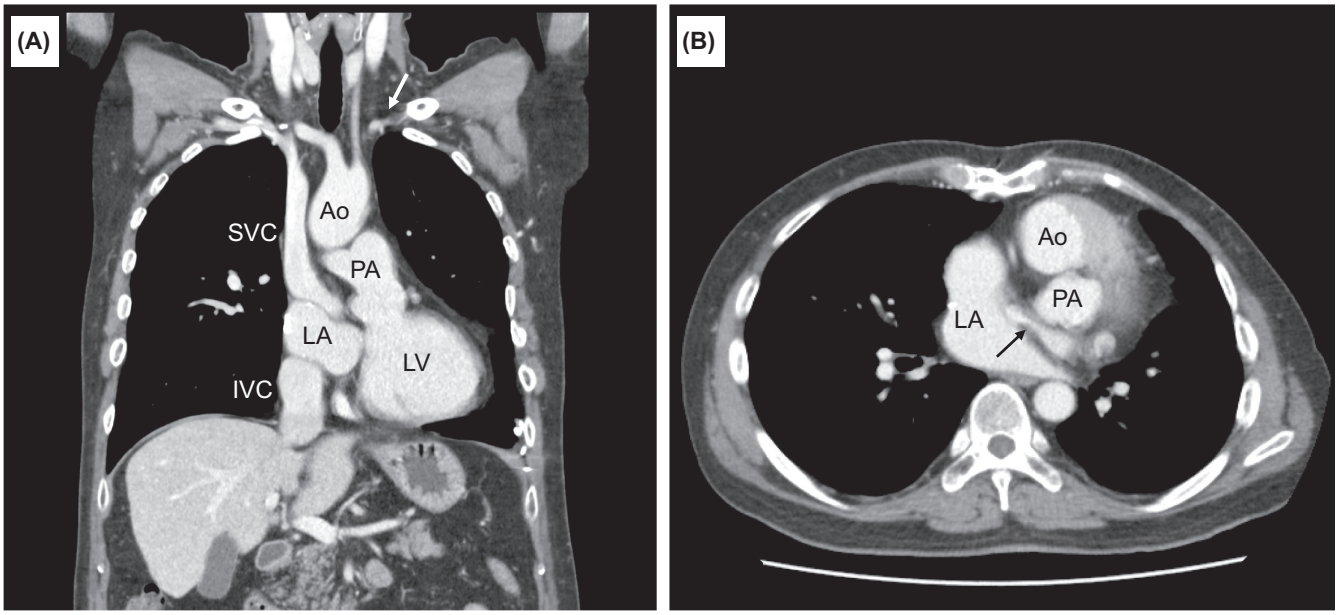

FIGURE 2 Preprocedural contrast-enhance computed tomography shows the stenosis of left subclavian vein (A, white arrow) and superior limb of the Mustard baffle (B, black arrow). Ao, aorta; IVC, inferior vena cava; LA, left atrium; LV, left ventricle; PA, pulmonary artery; SVC, superior vena cava.

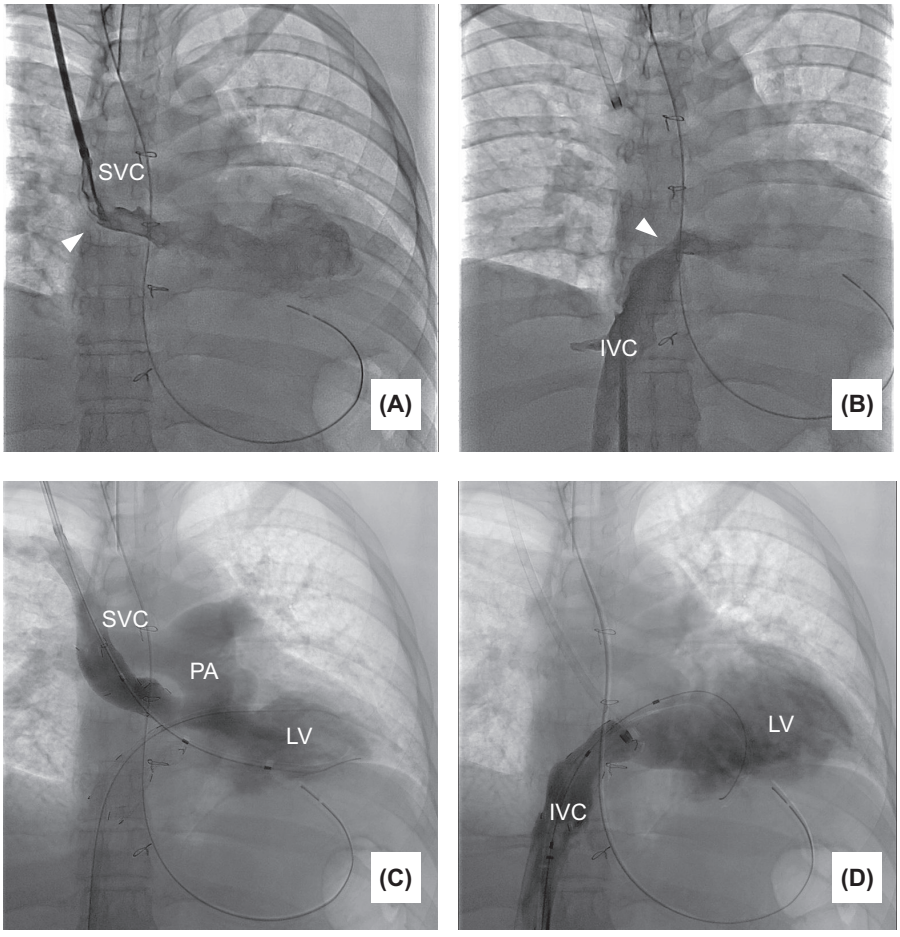

FIGURE 3 Fluoroscopic images in anteroposterior projection (in another post-Mustard patient) show the stenosis of superior (A) and inferior (B) limbs of the Mustard baffle (white arrow heads), and post-stenting SVC (C) and IVC (D). After this procedure, a conventional transvenous pacemaker was implanted through the superior limb. IVC, inferior vena cava; LV, left ventricle; PA, pulmonary artery; SVC, superior vena cava.

USA) could be safely implanted in a patient with dextro-transposition of the great arteries (d-TGA) after the Mustard repair. To our knowledge, this is the first reported case of the Aveir VR implanted in a patient with d-TGA.

As a cyanotic congenital heart disease in newborns, d-TGA is relatively common. In this malformation, the aorta originates from the right ventricle (RV) and the pulmonary artery arises from the left ventricle (LV). Since this condition cannot support life, d-TGA is accompanied by a shunt through a patent foramen ovale, ventricular septal defect, or patent ductus arteriosus. The Mustard repair is one of the surgical methods that has been performed to treat d-TGA. In this method, a baffle made of Dacron polyester fabric or pericardium is sewn to the atrium to direct the systemic venous blood flow into the LV, and the pulmonary venous return is rerouted into the RV. Consequently, all systemic venous blood is directed into the pulmonary circulation through the morphologic LV, and pulmonary venous blood is directed into the aorta through the morphologic RV. However, baffle obstruction is one of the major long-term complications after the Mustard operation.[1]

We describe a 49-year-old male with d-TGA who underwent a Mustard repair at the age of 2 years. 4 months after that repair, the development of sinus node dysfunction required a single-chamber VVI epicardial pacemaker system. Because of progressive deterioration of the epicardial lead's performance, pacing failure was observed at the most recent outpatient clinic visit (Figure 1). Since he was partially dependent on pacing, the necessity of another epicardial lead implantation by open-chest surgery or a new conventional transvenous pacemaker system was clear; however, the former option was too invasive, and the latter was not feasible because the patient's preprocedural contrast-enhanced computed tomography revealed significant stenosis of the left subclavian vein and the superior limb of the baffle (Figure 2). In the similar case, we previously encountered, transvenous conventional pacemaker was implanted after superior and inferior baffle stenosis was dilated by stenting (Figure 3). In the present patient, however, the vascular access from the inferior vena cava to the LV did not appear to be obstructed. We therefore selected the implantation of an LCP (Aveir) from the right femoral vein.

The procedure was performed with the patient under a light sedation with midazolam. Local anesthesia was applied at the puncture

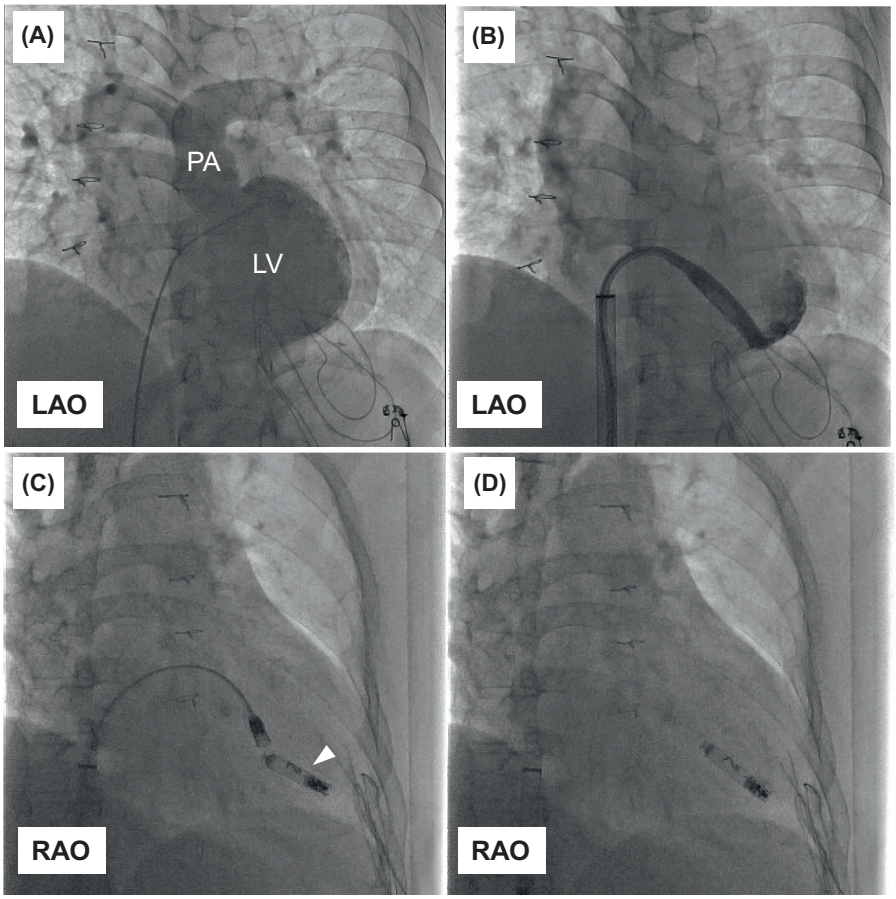

FIGURE 4 Fluoroscopic images of Aveir VR implantation procedure. (A) Ventriculography in LAO projection reveals little trabeculation in the morphologic LV. (B) The Aveir VR delivery system was advanced into the morphologic LV under ventriculography guidance. (C) The Aveir VR (white arrow head) was deployed in the apical septum, and the stability was checked by deflection of the delivery catheter. (D) The Aveir VR was finally released, and the delivery system was removed. LAO, left anterior oblique; LV, left ventricle; PA, pulmonary artery; RAO, right anterior oblique.

site. A 27-Fr introducer sheath was advanced to the systemic venous atrium over an Amplatz Super Stiff guidewire (Cook Medical, Bloomington, Indiana, USA). The delivery catheter was then manipulated into the LV apex under ventriculography guidance. The counterclockwise maneuver used to aim the tip of the delivery catheter toward the interventricular septum was the opposite of the maneuver in a usual LCP implantation. On the second attempt, we successfully deployed the Aveir VR at the septo-apical site (Figure 4) with satisfactory pacing and sensing thresholds (pacing threshold: 0.5 V at 0.4-ms pulse width, R wave: 16.0 mV, and impedance: 850 ohms). The total procedural time was 94 min and there were no complications. The measured pacing values were favorable 1 month after implantation.

This case illustrates the feasibility of implanting the Aveir VR in the subpulmonic LV in a d-TGA patient after an atrial switch operation. Two types of LCP currently available in Japan include the Aveir VR and the Micra VR/AV (Medtronic, Minneapolis, Minnesota, USA), adopting a tine-based passive fixation mechanism. In the implantation of an LCP in the morphologic LV, a helix-fixation LCP seems to be more suitable than a tine-fixation LCP. Because of little trabeculation in the morphologic LV, tines could not be attached to the implant site, even if they were pressed hard against the interventricular septum, which might cause cardiac perforation. In addition, the Aveir VR system allows pre-fixation mapping of electrical measurements; therefore, frequent device repositioning could be avoided, which also reduces the risk of cardiac injury. The other advantages of the Aveir VR are longer battery longevity and the system enabling retrieval even in chronic setting. Since the patient in the present case is relatively young, a retrievable LCP would be better. On the contrary, the disadvantage of the Aveir VR includes a longer length of the flexible part of the delivery system compared to the Micra (80 mm vs. 65 mm), which might be unfavorable for small hearts. In the first place, the published preclinical data regarding LCP implantation is limited to the RV.[2,3] Although several reports describe implantation of the Micra in the morphologic LV,[4,5] further research is required to evaluate LCP implantation in the morphologic LV.

In conclusion, we successfully implanted a helix-fixation LCP in the subpulmonic but morphologic LV in a d-TGA patient with a Mustard repair history and failure of a previously implanted epicardial lead. Since obstruction of a systemic venous pathway is a relatively common post-Mustard complication, the implantation of a helix-fixation LCP could be a reasonable therapeutic option for this condition.

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CONFLICT OF INTEREST STATEMENT

Authors declare no conflict of interests for this article.

DATA AVAILABILITY STATEMENT

The data underlying the results are available within the article.

ETHICS STATEMENT

Informed consents were obtained from the patients to publish the case report.

CLINICAL TRIAL REGISTRATION

Not applicable.

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