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Case Report

Atrial placement of Aveir-VR leadless pacemaker in a patient with complex cardiac anatomy[☆]

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ABSTRACT

Leadless pacemakers have provided new treatment modalities that can be especially useful in patients with complex cardiac anatomy and contraindications toward other pacemaker approaches. The Aveir™ single-chamber (VR) leadless pacemaker (LP) (Abbott Laboratories, Chicago, IL) is a recently approved device that can be placed in the right ventricle for patients with bradycardia. In this case, we present a novel use for the device through placement in the atrium to control atrial flutter in a patient with a hypoplastic right ventricle.

1. Intro

Leadless pacemakers, such as the Micra™ [1] (Medtronic plc, Minneapolis, USA) leadless pacemaker and more recently the Aveir-VR leadless pacemaker (Abbott, Chicago, USA) present new options for pacing needs in patients with congenital heart disease. The AVEIR-VR leadless pacemaker presents the option of more retrievable leadless pacemakers, which can be especially useful in cases with complex cardiac anatomy [2,3]. Aveir-VR has demonstrated high first-time capture and lower repositioning rates than traditional pacemakers [4]. Due to the novelty of the device, few reports exist demonstrating its clinical usage and no reports demonstrate feasibility of atrial implant of the Aveir VR [4–6]. Here we present a patient with complex congenital heart disease and urgent pacing need, in the setting of conversion pauses after ablation.

2. Case report

Our patient is a 33-year-old male with pulmonary atresia with intact ventricular septum, RV hypoplasia, status post-hemi-Glenn (right superior vena cava to right pulmonary artery anastomosis), right atrial appendage to right pulmonary artery anastomosis and right ventricular outflow tract to left pulmonary artery homograft, with device closure of atrial septal defect (ASD) and small residual ASD, also with large atrial appendage. Over the last several years he had become increasingly desaturated and again over the couple of years had developed complex

atrial flutter with a variable ventricular response and significant edema (gained 35 kg within a couple of years). He was markedly clubbed, cyanotic and with 3+ edema bilaterally in the lower extremities.

Previous work-up included multiple EKGs demonstrating chronic atrial flutter. Echo demonstrated hypoplastic right heart syndrome due to pulmonary atresia and an intact ventricular septum, with systemic left ventricle with reasonable function. Flecainide and metoprolol had been attempted to control flutter, with history of breakthrough on amiodarone prior. After ablation of two of his circuits he presented with intermittent atrial tachycardia with sinus bradycardia to the 20–43bpm range with hypotension and worse desaturation noted, with pauses of longer than 6 seconds after conversion.

Prior to the end of the case (due to prolonged anesthesia time), placement of the Aveir-VR LP in the superior base of the right atrial appendage was performed, to control conversion pauses.

3. Procedure

An 8-Fr sheath was placed in the right femoral vein. Then a super stiff Amplatz 180cm 0.035cm wire was passed through the 8-Fr sheath and up-sizing from 10-Fr to 24-Fr dilators was performed. The 27-Fr (outer diameter) Abbott Aveir sheath (after flushing) was passed over wire into the mid-right atrium. The inner sheath was removed, and the outer sheath was connected to heparinized saline.

Subsequently the Aveir on deployment catheter (23-Fr) was passed through the 27-Fr outer sheath. The Catheter/Aveir were moved into the

[☆] All authors mentioned in the manuscript have agreed on authorship, have read and approved the manuscript, and given consent for submission and subsequent publication of the manuscript. Both Figures are original. Peer review under responsibility of Indian Heart Rhythm Society.

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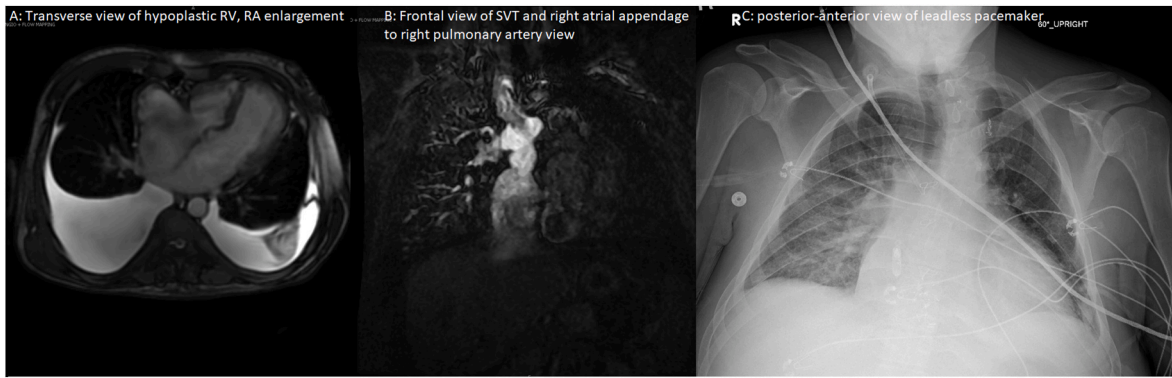


Fig. 1. A-Transverse view of the hypoplastic RV, RA enlargement, B-Frontal view of SVC and right atrial appendage to right pulmonary artery, C-Posterior-anterior view of leadless pacemaker in atrium.

Vent. rate	70	BPM
PR interval	134	ms
QRS duration	182	ms
QT/QTcB	476/514	ms
P-R-T axes	72 267	81

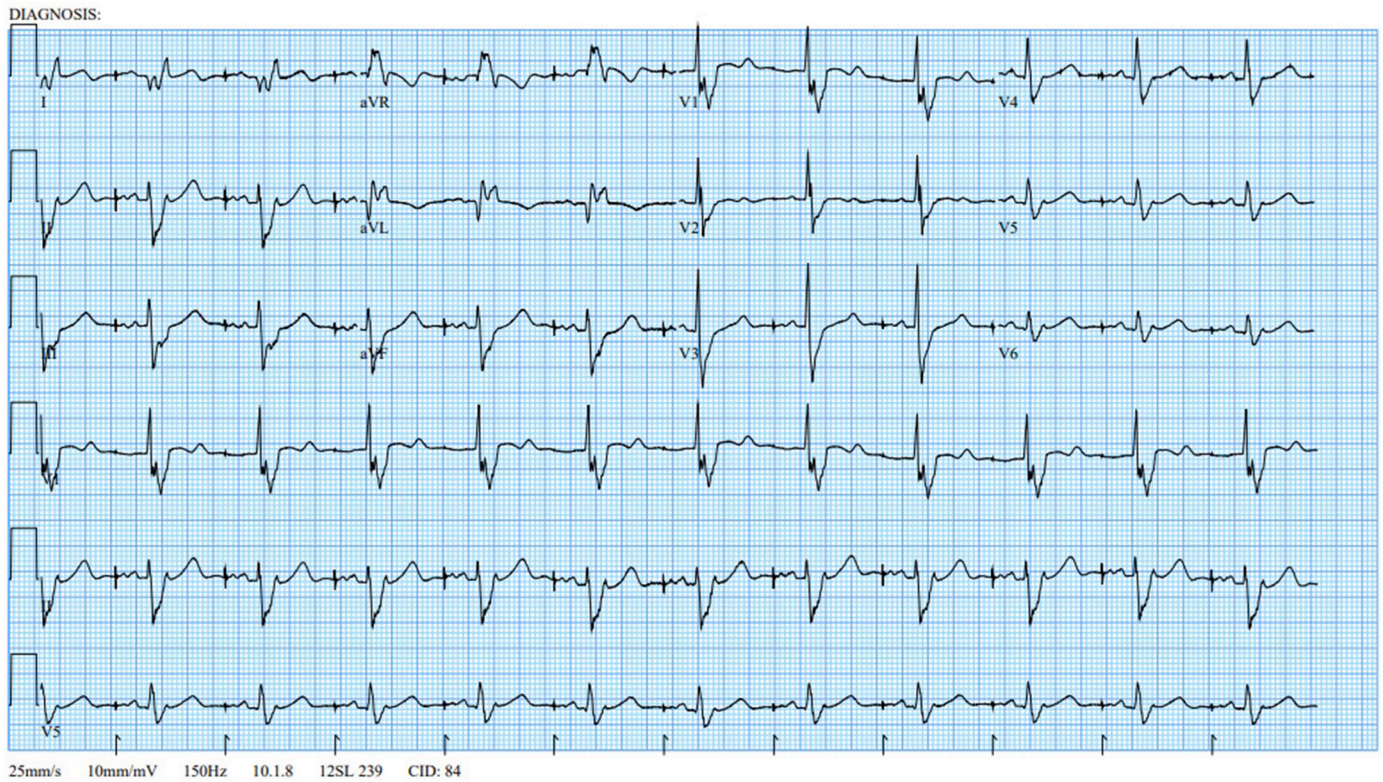


Fig. 2. 12-lead electrocardiogram of atrial pacing with Aveir VR.

heart from the IVC position. Angiograms revealed good placement location after 20 ml of contrast were used. Deployment of the Aveir into the inferior base of the enlarged right atrial appendage and was successful on first attempt with good threshold of 1V@0.4ms, P-wave of 2.5mV, impedance of 540 Ω. Stability test noted device in acceptable position, remaining still with deflection. The capture anchors were then released after further testing.

The 27-Fr sheath was then removed with Figure of 8 stitch placement.

Further pressure was held bilaterally with pressure bandage placed

on right femoral venous site.

Post-device implant testing revealed similar numbers with the following being the last check: threshold 1V@0.4ms, impedance of 570 Ω, R-wave 2.5 mV, and device was programmed AAI of 70 bpm.

On a follow up visit 12 months following the procedure, the patient's medications included taking torsemide 20mg once a day, sotalol 160 mg and apixaban 5milligrams twice daily. He had lost 40 kg with much less edema and no orthopnea noted, also now with activity including daily walking. His device capture threshold was 1.5V@0.4ms, impedance of 350 Ω, and P-wave of 3.0mV (P-wave) with 1 % pacing and predicted

longevity of 16.9 years. Fig. 1 A and B demonstrate transverse and frontal views of the patient's anatomy, while 1C demonstrates a PA view of the Aveir VR in the right atrium. Fig. 2 demonstrates atrial pacing on 12-lead electrocardiogram. Follow-up echocardiogram also demonstrated similarly positioned device at 1-year.

4. Discussion

Leadless pacemakers, such as the AVEIR-VR LP, present new opportunities to intervene in patients with complex cardiac anatomy and electrophysiology. Their smaller size, no need for lead wires, and ability to be retrieved allow them to be used in multiple contexts [7]. Despite the challenges present in this case, the successful placement and effect of the atrial implant demonstrated its advantage in this patient with a challenging cardiac history. One challenge we found was in placement near his enlarged atrial appendage we did have to overcome some oversensing and thus program the device sensitivity to 1mV. Otherwise, regarding access, femoral access seems to be the best approach, and in this patient, given his small right ventricle, we could not approach the pacing via right ventricular pacing. Otherwise, given his hemi-Glenn, transvenous access to his atrium or ventricle also did not seem ideal. Typically, a patient like this could be approached with an epicardial device/lead, however given the pauses became hemodynamically significant during the procedure, we did urgently place this device. Furthermore, now with the approval of the atrial Aveir device by the Food and Drug Administration (FDA) recently, further use of such devices in patients with complex anatomy will likely be employed, but at the time of our procedure, the atrial device was not yet FDA-approved [8]. And otherwise, the atrial appendage base has been the recommended site placement for the Aveir AR but at the time of our placement we also noted sizeable P-waves in this location (high voltage noted during prior electrophysiology study) with enough space by trans-thoracic echocardiogram for the device to not interact with the tricuspid valve (8). Otherwise, caution should be used in placing leadless devices in the atrium, and we recommend it to be done under echocardiogram guidance, as we did during our procedure if unique anatomy is encountered.

5. Conclusion

In this case, we presented how the AVEIR-VR LP can be placed in the atrium as a back-up or primary pacing in a patient with complex cardiac anatomy and electrophysiology. Along with new devices that continue to be introduced, this case demonstrates how novel uses for them can continue to be successful as swift interventions for patients.

Disclosures

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical statement

This study was approved by the internal review board of the University of California at Davis.

Patient Consent statement

The patient was agreeable and consented to the case study.

Declaration of competing interest

No competing interests exist between authors and submitted material.

No funding was used in creation of this manuscript.

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