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# Leadless pacemaker placement in a pediatric tetralogy of Fallot patient with previous transcatheter valve replacement

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## Introduction

Pediatric patients with congenital heart disease (CHD) are at risk for heart block [1]. Pediatric patients in need of pacemaker therapy pose a unique challenge to providers. Given increased growth rates and activity level, in addition to smaller anatomy for more difficult placement of either epicardial, or transvenous leads, pediatric pacemakers have a high incidence of lead failures [2]. With the recent introduction of a leadless implantable pacemaker approved for adult use to limit complications related to the pacemaker pocket and epicardial or transvenous leads, discussions may now be had regarding the optimal pacing strategy - epicardial, transvenous, and event leadless - for pediatric patients with CHD [3]. Previously reported implant in a pediatric patient with congenital heart disease - tetralogy of Fallot - has been performed successfully, however it required multiple deployments with suboptimal thresholds [4]. Leadless pacemaker implant has not been described in a patient with previous transcatheter pulmonary valve replacement. We add a case report to the paucity of literature describing pediatric leadless pacemaker implantation and describe good post-implantation values (thresholds, impedances and sensing) based on one deployment.

## Case report

A 14 year-old, 58 kg male with Tetralogy of Fallot with history of transannular patch at 6 months of age and transcatheter pulmonary valve (29 mm Sapien XT valve) at 12 years of age had a post-procedure course complicated by moderate tricuspid regurgitation. He presented with a one-minute episode of sudden-onset of lightheaded and dizzy sensation while walking. A Holter monitor demonstrated intermittent symptomatic type 2 degree AV block as well as 2:1 AV block. Given the patient's bifascicular block, infrahisian disease was the likely etiology. Based on Holter findings in the setting of bifascicular block (right bundle branch and left anterior fascicular block), as well as a patient post-cardiac surgical repair, he met a class I indication for pacemaker placement. After discussion regarding the risks and benefits of epicardial, transvenous, and leadless pacemaker systems, the parents and patient were in favor of placement of a Micra™ leadless pacemaker from Medtronic (Minneapolis, MN, USA).

The patient was prepped and draped in a standard fashion. A venogram was performed through the right femoral vein to assess patency after a 5-French (Fr) sheath was placed using the Seldinger technique. A left 5-Fr femoral venous sheath was placed through which a 4-Fr non-steerable quadripolar pacing wire was passed into the right ventricle.

The right femoral venous sheath was up-sized to an 8-Fr femoral venous sheath. A super stiff Amplatz 260 cm 0.035 cm wire was passed through the 8-Fr sheath and consecutive up-sizing via a 16-Fr, 18-Fr, 20-Fr, 22-Fr, 24-Fr dilators was performed. Subsequently the 27-Fr (outer diameter) Medtronic Micra sheath was flushed and passed over the wire into the mid-right atrium, at which time a 5000-unit bolus of heparin was given. The dilator was removed and the outer sheath was connected to a heparinized saline continuous infusion.

Subsequently, the 23 Fr Micra deployment catheter was passed through the 27-Fr outer sheath. The outer sheath was pulled back to the inferior vena cava over the deployment catheter. The Micra deployment catheter was moved across the tricuspid valve into a mid-RV septal position. Angiograms in both LAO and RAO views revealed good mid-septal placement after 20 ml of contrast were used. Under fluoroscopic guidance the deployment of the Micra into the mid-septal location was successful after the first attempt with a threshold of 0.88 mV@0.24 ms, an R-wave of 12.4 mV, and an impedance of 600 Ω (Table 1). Tug-test revealed 3 splines and possibly a 4th were connected to the RV muscle (Fig. 1). No re-capture was needed. The capture string was then cut at the side with more tension and was pulled gently out of the catheter without dislodgement of the Micra pacemaker. A chest X-ray confirmed stable pacemaker position (Fig. 2). The following day, 11-days post-implantation, and 4-months post-implantation thresholds, impedances

**Table 1**
pacing data on deployment day and subsequent interrogations was recorded as follows:

| Post-deployment | R-wave (mV) | Impedance (Ohms) | Pacing threshold |
|---|---|---|---|
| 0 days | 12.5 | 610 | 0.88 V @ 0.24 ms |
| 1 days | 13.7 | 600 | 0.77 V @ 0.24 ms |
| 11 days | 17.6 | 580 | 0.66 V @ 0.24 ms |
| 4 months | 19.8 | 580 | 0.50 V @ 0.24 ms |

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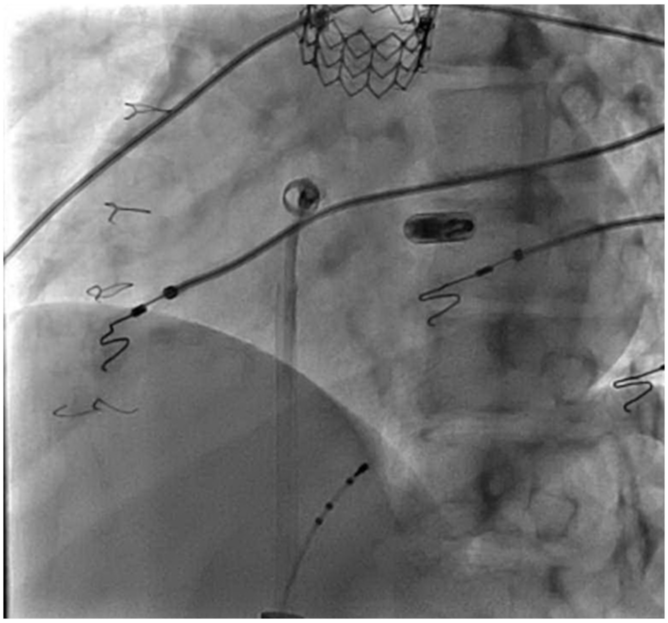

**Fig. 1.** Tug-test revealed 3 tines and possibly a 4th were connected to the RV muscle.

and sensing were obtained with favorable values (Table 1). There was 1% ventricular pacing during follow up.

## Discussion

There is a small subset of pediatric patients where a leadless pacemaker may be most beneficial and deployment can be safe with optimal thresholds. The decision to implant the leadless pacemaker was based on the patient's unique CHD (tetralogy of Fallot), coupled with his residual moderate tricuspid regurgitation after Edward Sapien valve placement in the pulmonary valve position the year prior. A transvenous lead that crossed the already compromised tricuspid valve could increase the severity of regurgitation. With invasive epicardial leads, there are several associated morbidities [3]. Given the likely need for back-up VVI pacing only, as would likely be needed in this patient, the risks of epicardial placement were considered higher than the risk of transcatheter leadless pacemaker placement [3]. Furthermore, given that this patient is likely to have further surgical intervention on his pulmonary valve, a leadless pacemaker could be extracted at that time. If the patient developed need for atrio-ventricular synchrony, he could later receive a dual chamber system with leads (possibly coronary sinus ventricular lead and right atrial lead). Thus the leadless pacemaker in this patient's case may serve as a bridge while assessing development of progressive heart block and maintaining safe back-up ventricular pacing.

## Conclusion

Deployment of the device was deemed a success without the need for recapture and with good thresholds. This is the first known case of a leadless pacemaker implantation in a pediatric congenital heart disease patient, with previously deployed transcatheter valve, and with single pacemaker deployment success and optimal pacemaker thresholds, even at 4-month follow-up. Deployment into the mid-RV septum may avoid the trabeculations seen more apically, and yield more favorable cardiac stimulation parameters in the pediatric population, similar to deployment in adult patients without congenital heart disease.

## Declaration of Competing Interest

None.

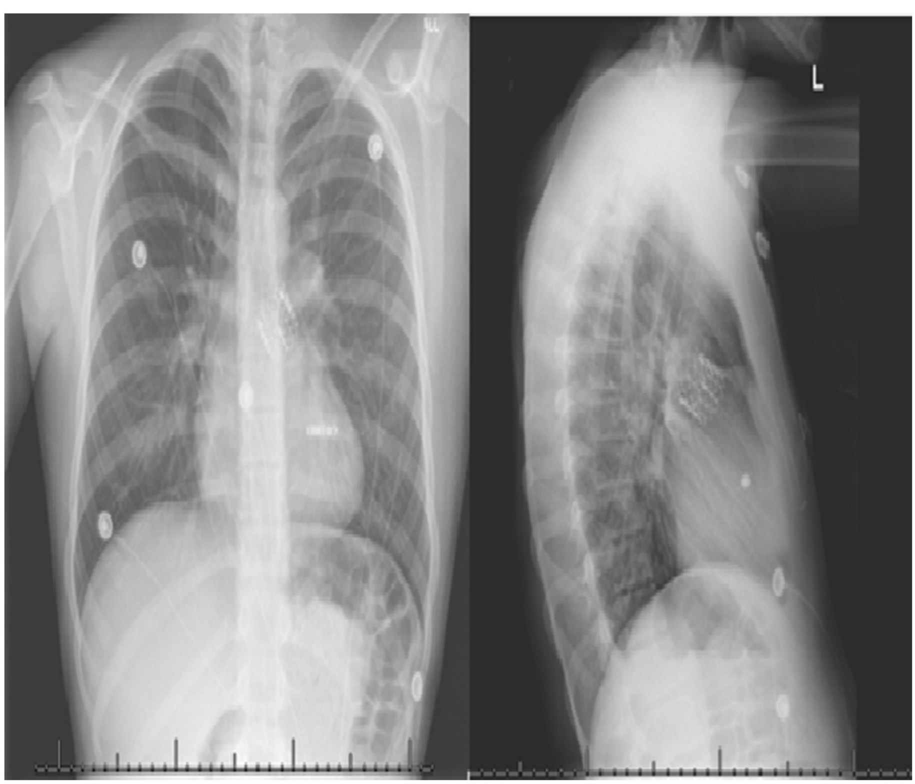


**Fig. 2.** 2-view chest X-ray (AP and lateral) of patient with leadless pacemaker and Edward Sapien valve presence.

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