Leadless pacemaker implantation in a univentricular heart in a patient with a double-inlet left ventricle and L-transposition of the great arteries

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Leadless pacemakers (LP) should be viewed as an alternative to conventional transvenous systems to address typical limitations including venous route issues, lead-related complications, and infections [1, 2]. Additionally, they may be considered in complex patients [3]. Published data regarding LP implantation in adults with congenital heart disease (ACHD) are scarce [4, 5]. ACHD patients with complex cardiovascular anatomy are at high risk of conduction disturbances including complete heart block. This report describes a successful LP (Micra™ VR, Medtronic Inc., Dublin, Ireland) implantation in an ACHD patient with a univentricular heart.

A 42-year-old male with a single, double-inlet, significantly enlarged left ventricle (LV), with good global contractility, hypoplastic right ventricle (RV), ventricular septal defect, subvalvular pulmonary stenosis, aneurysmal dilated main pulmonary artery, and L-transposition of the great arteries (Figure 1A–C,

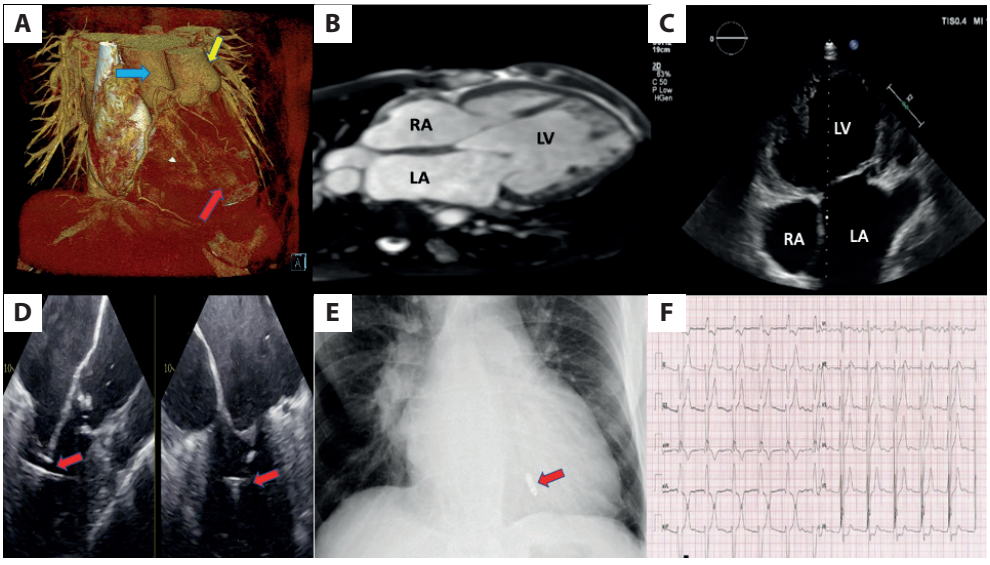

Figure 1. A. Computed tomography scan — Volume Rendering Technique. L-transposition of the great arteries — the main pulmonary artery (blue arrow) and the aorta (yellow arrow) are in transposition. A significantly functionally enlarged single ventricle (red arrow). **B.** Cardiac magnetic resonance. Double-inlet left ventricle (LV) with two separate atrioventricular valves, enlarged left (LA) and right atrium (RA), rudimentary right ventricle, ventricular septal defect, and transposition of the great arteries. **C.** Transthoracic echocardiogram. Double-inlet LV with two separate atrioventricular valves, enlarged LA and RA. **D.** Transesophageal echocardiogram. Positioning of the leadless pacemaker. Delivery system (red arrows). **E.** Chest X-ray after the implantation; in anteroposterior view, the position of leadless pacemaker (red arrow). **F.** Electrocardiogram after leadless pacemaker implantation showing a successful ventricular-paced rhythm with underlying atrial fibrillation

Supplementary material, *Video S1*), and permanent atrial fibrillation was admitted for symptomatic complete heart block. Several concerns were recorded regarding the higher risk of transvenous or epicardial system implantation, mainly including infective issues, potential lead-related thrombus formation and its embolization into the systemic circulation, and last but not least, lead-related mechanical complications (fracture, dislodgement), and the need for many re-do interventions. Using a multiple imaging modalities evaluation and following a careful discussion between the Heart Team and the patient, a decision was made to implant an LP into the LV.

The LP procedure was carried out under general anesthesia, based on fluoroscopy and transesophageal echocardiogram navigation. A 12 F vascular sheath was introduced after the left femoral vein puncture and upsized through the 18 F to a 27 F Micra delivery system. The system with a Micra LP was directed from the right atrium to the LV with an attempt to place it in the LV apex (Figure 1D, Supplementary material, *Video S2*). Most probably, due to unfavorable angulation between the enormous right atrium and very large LV, effective LP implantation was technically demanding and the device, after initial release, was dislocated several times (with no possibility to push the LP against the LV wall), or unacceptable electrical parameters were noted (pacing threshold above 3 V/0.4 ms). As a result, the entire LP system was removed, and the patient was checked and prepared once again. Additionally, the delivery sheath was manually reshaped to obtain larger curvature (Supplementary material, *Video S3*). Consequently, the LP system was successfully placed near the LV apex (Supplementary material, *Video S4*). Multiple stability "tug" tests and electrical parameters (R wave of 11.4 mV, threshold of 0.5 V@0.4 ms, and impedance of 640 ohms) were evaluated before ultimate LP system deployment (Supplementary material, *Video S5, S6*). The device was released and its position rechecked for the stability, and electrical parameters on the day following the implantation were measured (Figure 1E–F). The patient was discharged two days later in good clinical condition.

We have shown that LP implantation, though challenging, is safe and feasible in a patient with a univentricular heart. It may be presumed that the number of ACHD patients with a high incidence of severe atrioventricular conduction disturbances secondary to disease progression and multiple interventions will grow. LP implantation seems to be a very attractive clinical option in this population.

Supplementary material

Supplementary material is available at https://journals.viamedica.pl/kardiologia_polska.

Article information

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REFERENCES

1. Glikson M, Nielsen JC, Kronborg MB, et al. 2021 ESC Guidelines on cardiac pacing and cardiac resynchronization therapy. Eur Heart J. 2021; 42(35): 3427–3520, doi: 10.1093/eurheartj/ehab364, indexed in Pubmed: 34455430.
2. Kempa M, Mitkowski P, Kowalski O, et al. Expert opinion of a Working Group on Leadless Pacing appointed by the National Consultant in Cardiology and the Board of the Heart Rhythm Section of the Polish Cardiac Society. Kardiol Pol. 2021; 79(5): 604–608, doi: 10.33963/KP.15982, indexed in Pubmed: 34125944.
3. Okabe T, Afzal MR, Houmsse M, et al. Tine-Based leadless pacemaker: strategies for safe implantation in unconventional clinical scenarios. JACC Clin Electrophysiol. 2020; 6(10): 1318–1331, doi: 10.1016/j.jacep.2020.08.021, indexed in Pubmed: 33092762.
4. Sterliński M, Demkow M, Plaskota K, et al. Percutaneous extraction of a leadless Micra pacemaker from the pulmonary artery in a patient with complex congenital heart disease and complete heart block. EuroIntervention. 2018; 14(2): 236–237, doi: 10.4244/EIJ-D-17-00660, indexed in Pubmed: 28943497.
5. Dunne L, Breatnach C, Walsh KP. Systemic ventricular implantation of a leadless pacemaker in a patient with a univentricular heart and atrioventricular node calcification. HeartRhythm Case Rep. 2020; 6(5): 265–267, doi: 10.1016/j.hrcr.2020.01.008, indexed in Pubmed: 32461891.