Hybrid implantation of a Melody valve in the neoaortic position in a single-ventricle patient

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Percutaneous pulmonary valve implantation serves as a less invasive alternative to surgical treatment of dysfunctional right ventricular outflow tracts [1]. Initially, this treatment was limited to pulmonary position but more recently percutaneous or hybrid valve implantation in at tricuspid, mitral, and even aortic position has been reported [2, 3]. There are few reports of transcatheter valve implantation in the neoaortic position in single ventricle patients [4–6].

A 13-year-old boy (36 kg) with a hypoplastic left ventricle, atrial and ventricular septal defects, and bilateral superior caval veins was initially palliated with pulmonary artery banding. Subsequently, he underwent a connection of both superior caval veins to ipsilateral pulmonary arteries and occlusion of the main pulmonary artery. At that stage, he was referred to our center. Due to systemic hypoxemia, cardiac catheterization was performed which revealed unrecognized partial anomalous drainage of the right superior pulmonary vein into the right superior caval vein, multiple venovenous fistulas, and restrictive intraventricular connection. At the age of 3.5 years, a fenestrated lateral tunnel Fontan procedure was performed. Simultaneously the pulmonary artery trunk was reconstructed using a 12 mm Matrix prosthesis, and it was connected to the native aorta to decompress the right ventricle. Cardiac catheterization at the age of 12 years revealed significant neoaortic valve regurgitation with biventricular diastolic dysfunction and elevated mean pressures in the Fontan system (20 mm Hg). The largest fistulas were closed.

A three-dimensional model of the heart and large vessels was printed to explore the option of transcatheter valve delivery in the neoaortic position (Figure 1A and 1B). Percutaneous and transapical approaches were ruled out due to the relatively small femoral arteries and the short distance between the right ventricular wall puncture and the valve's landing sites, respectively. A hybrid trans-aortic approach was selected for the shortest route for valve delivery.

Diagnostic left-sided cardiac catheterization revealed elevated right ventricular end-diastolic pressure (16 mm Hg), wide pulse pressure in the descending aorta (49 mm Hg), and severe regurgitation of the neoaortic valve (Figure 1C and Supplementary material, *Video S1*). The chest was opened above the right clavicle and a short 10 Fr sheath was introduced through the anterior wall of the ascending aorta, just below the brachiocephalic trunk. A 20 mm balloon was inflated across the neo-aortic valve with simultaneous aortic angiography to exclude potential coronary artery compression (Figure 1D and Supplementary material, *Video S1*). Next a Melody valve (Medtronic, Minneapolis, MN, US) on an 18 mm Ensemble delivery system was deployed into the neoaortic graft. Check angiography showed the competent valve and unobstructed flow to the ascending aorta and coronary arteries (Figure 1E and Supplementary material, *Video S1*). The pulse pressure in the descending aorta decreased to 23 mm Hg, and arterial oxygen saturation increased from 64% to 72%.

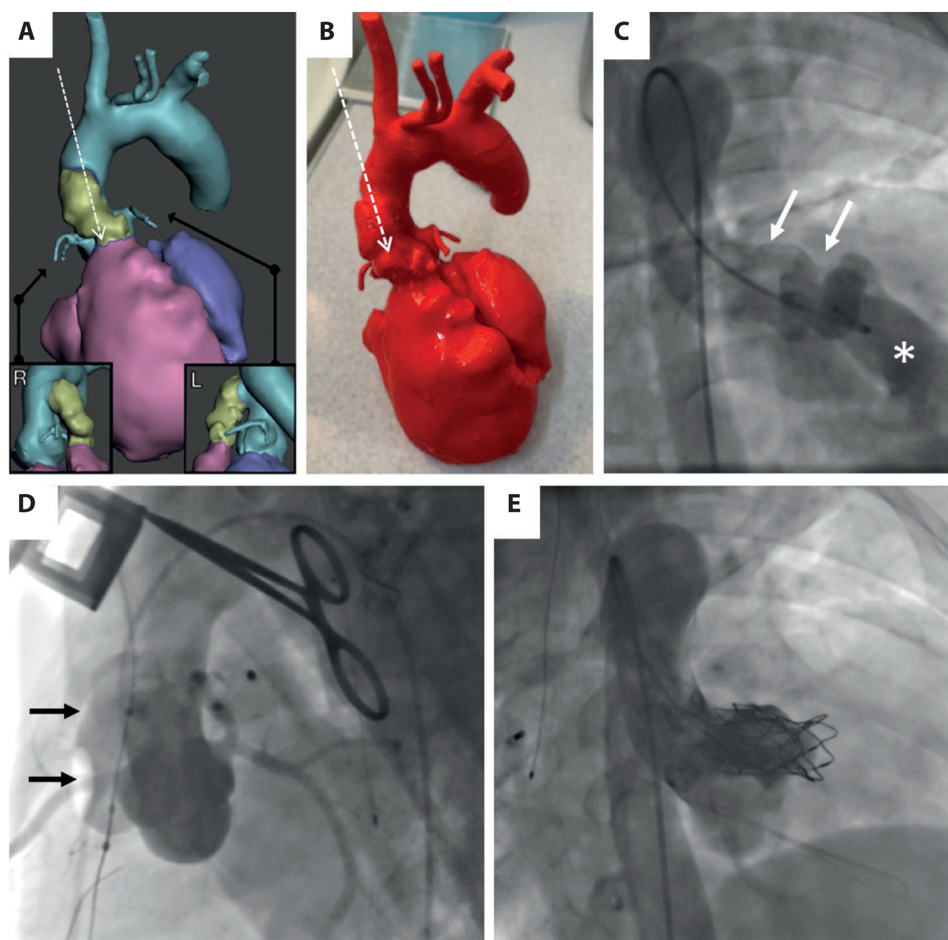

Figure 1. Hybrid implantation of a Melody valve in the neoaortic position in a single-ventricle patient. **A.** Anterior view of the digital whole-heart and aorta model, Damus-Kay-Stensel anastomosis in olive, insets present views from the (R) right and (L) left coronary arteries. **B.** Three-dimensional printed model in solid filament for anatomical demonstration (arrow). **C.** Neoaortic root (white arrows) angiography showing severe regurgitation (asterisk). **D.** Balloon (black arrows) testing for potential coronary artery compression. **E.** Competent Melody valve in the neoaortic position

At six months of follow-up, a marked increase in exercise capacity and oxygen saturation (80%) were observed. A transthoracic echocardiogram showed the competent Melody valve with unobstructed flow to the ascending aorta.

Transcatheter valve implantation for neoaortic valve regurgitation in a patient after Fontan palliation enables deferring repeat cardiac surgery, restoration of valve function, and improvement of the patient's functional status.

Supplementary material

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

Article information

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