Cardiology in the Young

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Tricuspid valve in valve procedure with an Edwards S3 valve© in a 10 kg child

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Brief Report

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Abstract

A 4-year-old child of 10 kg weight, with four previous sternotomies, presented a severe right heart failure, due to a severe regurgitation of his bioprosthetic tricuspid valve. A percutaneous tricuspid valve in valve procedure with an Edwards S3 valve was offered for compassionate use, and performed, with no complications, and significant clinical condition improvement.

A 10-month-old baby with a severe valvular and subvalvular aortic stenosis was referred to our centre.

In June 2016, the patient was accepted for surgical treatment of his aortic and subaortic stenosis, and a Ross-Konno procedure was performed, with a good result.

In the following months tricuspid regurgitation increased from moderate to massive with right heart failure, leading to a new surgery in January 2017. A mechanical tricuspid valve was implanted.

Five months later, the mechanical valve experienced an important thrombosis not responding to pharmacological therapy. In June 2017, the mechanical valve was surgically replaced by a 23-mm-Edwards S3 valve dilated with a 20-mm-diameter balloon.[1]

Some months later, a very important inferior tricuspid leak appeared, with clinical repercussion, leading to the fourth surgery in October 2017. A successful suture of the tricuspid dehiscence was performed.

In May 2018, the patient experienced an endocarditis in his tricuspid valve, producing a new severe tricuspid regurgitation, a very important perivalvular leak and a mild stenosis. Antimicrobial therapy was effective, but the patient developed, progressively in the following months, symptomatology of severe right heart failure, with exercise intolerance, pleural effusion, and ascites.

In August 2019, the patient was 4 years old, and his weight was 10 kg. In this situation, a new surgery was discarded in the heart team meeting, and a percutaneous tricuspid valve in valve procedure was offered for compassionate use. Informed consent was obtained from the parents. The procedure conformed to the guidelines of the local ethics committee.

In August 2019, the procedure was performed in the cardiac catheterisation laboratory under general anaesthesia and using transoesophageal echocardiography to asses valve function as well as guiding implantation. The right jugular vein was punctured after echographic evaluation, with a 6 French sheath. The right femoral artery was punctured with a 4 French sheath for invasive blood pressure monitoring. Intravenous antibiotics and heparin were administered. Initial transoesophageal echocardiography exam showed an important tricuspid regurgitation and paravalvular leak (Fig 1a, Supplementary video S1). Initial haemodynamic study revealed a medium right atrium pressure of 29 mmHg, right ventricular pressure of 43/11/25 mmHg, pulmonary pressure of 35/12/21 mmHg, medium wedge pressure of 15 mmHg, and a cardiac index of 2.5 L/min/m^2. An Amplatz ultra-stiff guidewire© (Cook, Inc. Bloomington IN, USA) was placed in the distal right pulmonary artery. We chose a 22F Dryseal© (Gore, Inc. Flagstagg, AZ, USA) because it allowed to pass the 23-mm-Edwards S3 valve (Edwards Lifesciences, Inc, Irvine, CA, USA) mounted on the balloon. Some difficulties were found to reach the target area, due to the size and stiffness of the delivery system, and the acute curve from the Dryseal sheath to tricuspid valve. Finally, the new valve was in position, and implanted successfully (Fig 2a). Due to the persistence of an important paravalvular leak, a 14 -mm-Amplatzer vascular plug II© (Abbott, Inc. Abbot Park, IL, USA) was implanted (Fig 2b), with a good result, and a transoesophageal echocardiography exam showing only trace of valvular regurgitation (Fig 1b, Supplementary video S2). Final right atrial pressure was 17 mmHg.

The patient was in the intensive care unit the first 12 hours, being discharged home 36 hours after the admission, with improvement of the right heart failure symptoms, and on antiplatelet therapy. Ten months later, the valve continues to perform well with no significant stenosis or regurgitation.

Tricuspid valve dysfunction is a relatively uncommon occurrence, with a higher prevalence in individuals with congenital heart abnormalities, often involving complex patients and

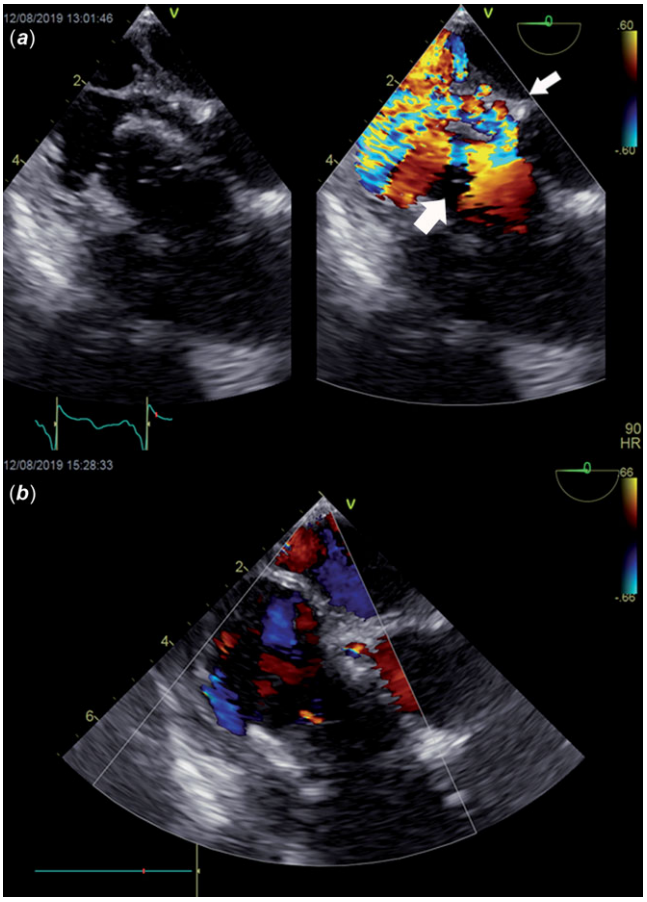

Figure 1. (***a***) Simultaneous 2D and colour transoesophageal echocardiography, 0 degrees view: tricuspid valve with severe regurgitation (wide white arrow) and significant paravalvular leak (narrow white arrow). (***b***) Colour transoesophageal echocardiography, 0 degrees view: traces of tricuspid regurgitation and closure of paravalvular leak.

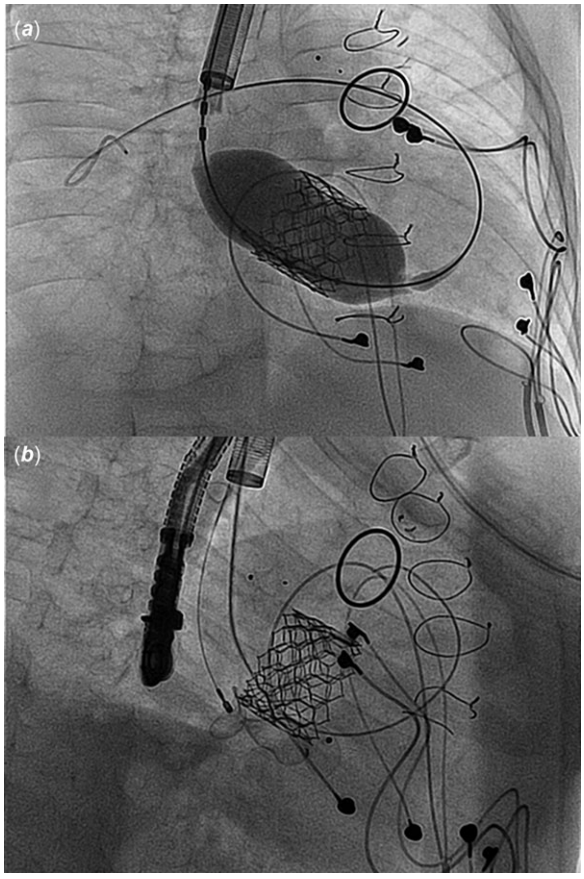

Figure 2. (***a***) Fluoroscopy, right anterior oblique projection: 23-mm-Edwards S3 valve, tricuspid valve-in-valve implantation. (***b***) Fluoroscopy, right anterior oblique, and caudal projection: closure of the tricuspid paravalvular leak with a 14-mm-Amplatzer vascular plug II.

frequently quite debilitated.[2,3] Severe tricuspid valve dysfunction and especially severe regurgitation is associated with increased mortality independently from other factors. Surgical tricuspid valve replacement is the main indication for the treatment of severe tricuspid valve dysfunction (regurgitation, stenosis or mixed).[3] In the tricuspid position, bioprosthetic valves are generally preferred over mechanical valves, given failure rates and anticoagulation associated complications. However, these bioprosthetic valves undergo a gradual degeneration requiring successive replacements.[2,3] Management of these patients is complicated by the presence of previous sternotomies, and a high surgical morbidity and mortality, which makes a percutaneous approach an appealing option.[2,3] The implantation of percutaneous valves in the tricuspid position is still an off-label indication, but it can be an option to avoid re-interventions on tricuspid bioprosthesis. Here, we describe a case of successful percutaneous tricuspid valve-in-valve procedure, with a 23-mm-Edwards Sapien S3 valve© in a 10 kg boy. To our knowledge, this is the smallest patient reported in which a tricuspid valve-in-valve procedure with an Edwards Sapiens valve has been performed.

Sapien and Melody© (Medtronic, Inc, Minneapolis, MN, USA) valves have been used in tricuspid valve-in-valve procedures,[3] but Melody valve is significantly longer than Sapien, even though the valve can be cut to reduce its length[5] it was an important issue in a 10 kg patient.

Given the small size of our patient, with a small part of the sheath inside the patient, short distance and acute curve between the sheath and target, and an adequate diameter of the jugular vein, anticipating the possibility of difficulties in this step, we preferred to use a 22F Dryseal©, allowing to mount the Sapien valve on the balloon out of the patient, and diminishing the manipulation inside the patient.

McElhinney and cols, reported a multicentre registry, with 152 cases of tricuspid valve-in-valve procedures with Melody and Sapien valves, with a medium-term follow-up. Successful implant was performed in 150 patients, with a 3.3% of 30-day mortality (all NYHA III–IV at baseline). Estimated survival free from re-intervention was 85 ± 3% at 1 year, with NYHA IV, baseline renal insufficiency, and in hospital acutely ill as statistically significant risk factors. All the centres in the registry performed 1–3 procedures, showing that tricuspid valve-in-valve procedure appears to be technically straightforward and reproducible across a large number of centres despite small volume, and confirming that the risk-benefit profile of tricuspid valve-in-valve procedures are generally favourable.[3]

Percutaneous tricuspid valve-in-valve is a valuable option to treat complex patients with symptomatic severe tricuspid valve dysfunction, even in very small patients, and offers the possibility of delaying and decreasing surgical procedures in the lifetime of these patients.

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Conflicts of Interest. None.

Ethical Standards. The procedure conformed to the guidelines of the local ethical committee. Informed consent was obtained from the parents.

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