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Brief Report

Edwards valve-in-valve implantation in tricuspid position

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Abstract We present two cases of percutaneous Sapien XT valve-in-valve implantation in the tricuspid position: a 20-year-old man with severe congenital pulmonary stenosis and percutaneous valvuloplasty, who required surgical implantation of two protheses, pulmonary and tricuspid, and a 12-year-old boy with CHD and a degenerated tricuspid prosthesis. We implanted three Sapien XT valve-in-valves, two in the tricuspid position and one in the pulmonic position. Sapien XT valve-in-valve implantation in the tricuspid position is feasible and can decrease the number of surgeries in CHD patients.

Keywords: CHD; percutaneous valve implantation; tricuspid valve disease; pulmonary valve disease

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CHD PATIENTS REQUIRE MULTIPLE SURGERIES IN their lives. Bioprosthetic valves have a limited life expectancy, and therefore their implantation in children and young adults will require multiple replacements in the future.[1] Until the year 2000, when the first percutaneous pulmonary Melody® (Medtronic Inc., Minneapolis, Minnesota, United States of America) valve was implanted,[2] the only alternative for valve replacement was surgery. Since 2008, the Sapien Edwards Lifesciencie® (Irvine, California, United States of America) percutaneous valve is also available,[3] and since March 2016 Sapien valves have the indication to be implanted in surgical conduits, native stented right ventricular outflow tracts, and valve-in-valve implantation.[4,5] In valve-in-valve procedures, the bioprothesis is used as support for the percutaneous valve and, because of its radio-opacity, it is an optimal anatomical reference.[4] The implantation of the Sapien valve in the tricuspid position is still an off-label indication, but it can be an option to avoid re-interventions on a surgical tricuspid bioprothesis.[6]

In the last year, we have implanted seven Edwards Lifescience® Sapien valves, two in tricuspid and five in pulmonic positions. Among all, one patient received two valves in the same procedure – that is, in the pulmonary and tricuspid positions. Until now, there has been only one publication of a double implant of Sapien XT valve in a patient during the same procedure.[7] Our patient is the first young adult patient with CHD in Europe to undergo a double implant in the same procedure.

Case 1

A 20-year-old man, weighing 89 kg, born with severe pulmonary stenosis, hypoplasic right ventricle, and dysplasic tricuspid valve presented to us. He had undergone previous procedures such as Rashkind atrioseptostomy and percutaneous pulmonary valvuloplasty in the neonatal period, and surgical closure of the atrial septal defect at 8 years of age. At age 14, two Carpentier Edwards® (Edwards Lifesciences, Irvine, California, United States of America) bioprosthetic valves were surgically implanted (25 mm pulmonic and 29 mm tricuspid) because of severe tricuspid and pulmonic regurgitation.

At age 20, the patient presented with deterioration of NYHA functional class and supraventricular tachycardia. Echocardiographic studies showed degeneration of both bioprosthetic valves: tricuspid peak and mean Doppler gradients of 15 and 8 mmHg,

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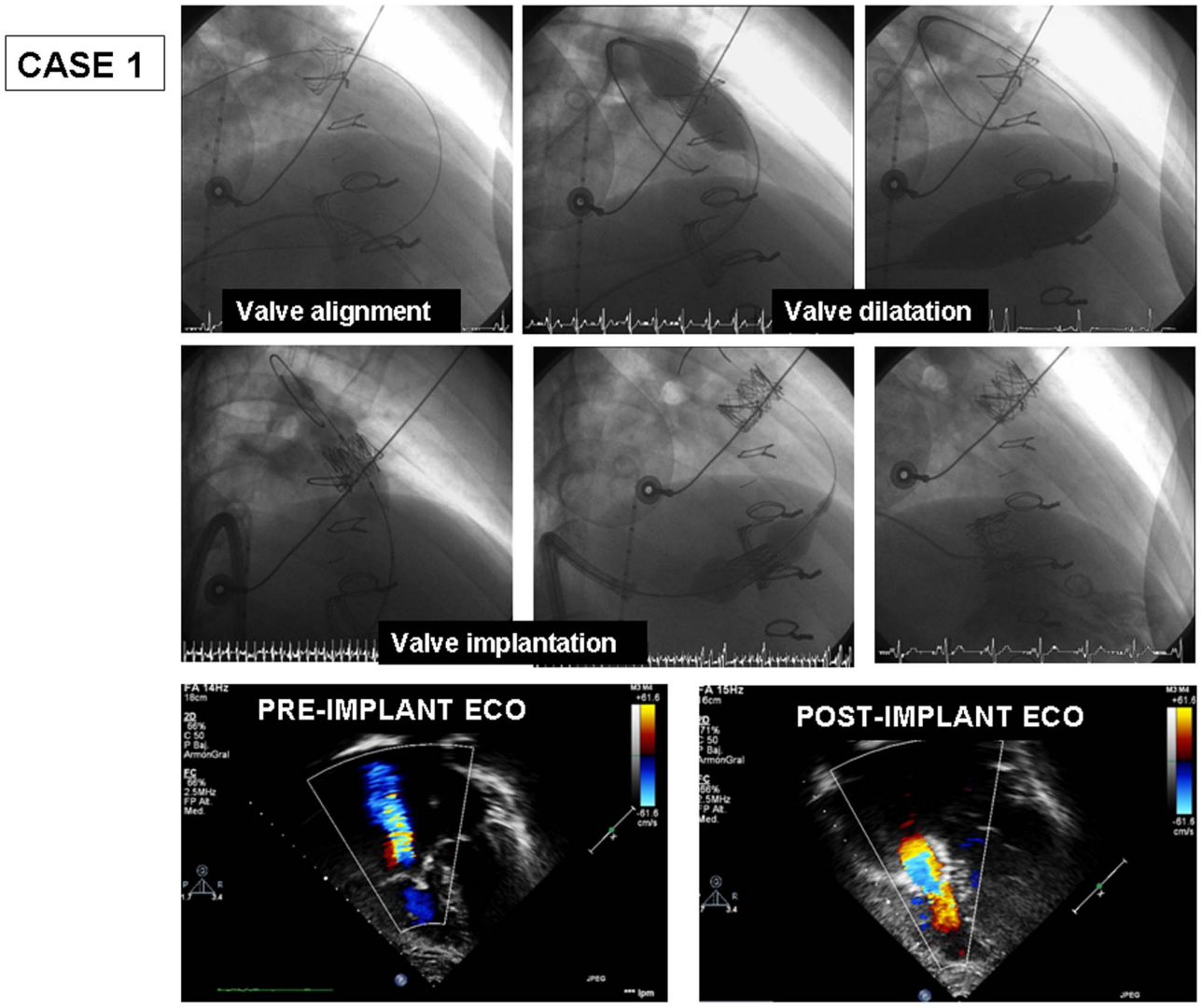

Figure 1.
Valve implantation steps during catheterization. Echocardiography pre and post valve implantation.

severe tricuspid regurgitation, and severe right atrium dilation (area of 56 cm^2). The pulmonary bioprothesis was also dysfunctional, with a peak Doppler gradient of 40 mmHg and severe regurgitation. The right ventricle was hypertrophic and mildly dilated, with preserved function (cardiac MRI: end-diastolic right ventricular volume 82 ml/m^2, right ventricle ejection fraction 70%).

Considering the elevated tricuspid gradient, great dilation of the right atrium, increase in the patient's functional class, as well as the presence of frequent supraventricular tachycardia, we decided to implant percutaneously in the same procedure both a pulmonary valve and a tricuspid valve.

Under general anaesthesia, mechanical ventilation, and fluoroscopy guidance, through femoral access, a right-heart catheterisation was performed, finding a right ventricle/aortic pressure ratio of 54%. Angiographies showed severe tricuspid and pulmonary regurgitation. A Lunderquist Cook Medical® (Bloomington, Indiana, United States of America) wire was placed in the left pulmonary artery, and a 30-mm-diameter × 40-mm-length balloon was used to size and dilate both prosthetic valves. A 26-mm Sapien XT valve was implanted in the pulmonary bioprosthesis, and a 29-mm Sapien XT was implanted in the tricuspid bioprothesis (Fig 1). Advancing the Sapien XT delivery system to the pulmonary bioprothesis was difficult because of right ventricle hypertrophy and an abnormally distal position of the pulmonary bioprothesis. The fluoroscopy time was 148.8 minutes, and the radiation dose was 839 $Gycm^2$. The right ventricle/aortic pressure ratio decreased to 32%. The patient remained in hospital for 10 days due to aspiration pneumonia. After 15 months of follow-up, he is in functional class I,

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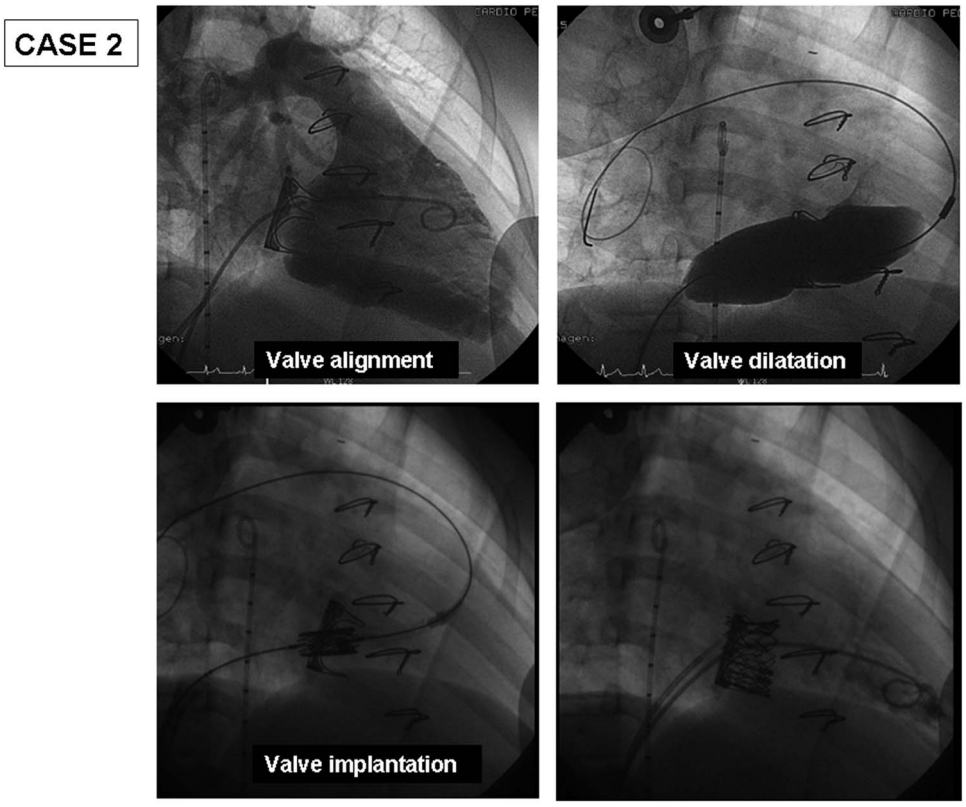

Figure 2.
Valve implantation steps during catheterization.

and has not had any other hospital admission or atrial tachyarrythmias. Echocardiographic studies show a stable mean Doppler gradient of 6 mmHg in the tricuspid Edwards valve and 25 mmHg Doppler gradient in the pulmonic position, without significant regurgitation.

Case 2

A 12-year-old boy, weighing 44.5 kg, with ventricular septal defect corrected in infancy, presented with severe residual tricuspid regurgitation. A bioprosthetic tricuspid valve – Edwards Perimount no. 26 – had been implanted at the age of 6 and replaced at the age of 8, because of accelerated degeneration. At age 12, the second bioprothesis was severely stenotic, with a mean Doppler gradient of 15 mmHg, severe right atrium dilation, and hepatomegaly. Under general anaesthesia, mechanical ventilation, and fluoroscopy guidance, a right-heart catheterisation was performed through the right femoral access. A Lunderquist wire was positioned in the right pulmonary artery, and a 28×40-mm balloon was used to size and dilate the tricuspid bioprothesis. A 29-mm Sapien XT valve was advanced and implanted in the tricuspid bioprothesis without complications (Fig 2). The fluoroscopy time was 12.5 minutes, and the radiation dose was 52 Gycm^2. The patient was discharged from the hospital within 48 hours. After 15 months of follow-up, the patient remains in NYHA I, without hepatomeagly. Serial echocardiographies have shown a mean Doppler gradient of 6 mmHg across the Edwards valve and absence of tricuspid regurgitation.

Both patients received oral anticoagulation for 6 months, followed by aspirin.

Discussion

The implantation of the Sapien XT valve in the tricuspid position is still an off-label procedure. The percutaneous valve-in-valve implantation provides an alternative for valve replacement in patients with CHD, who frequently undergo multiple surgeries. Case 1 is the first case to be reported of a double implant in a young adult with CHD, and the first double percutaneous valve-in-valve Sapien XT implant in the same procedure reported in Europe.

For proper implantation of the percutaneous valve, fluoroscopy should be used in a projection that shows perfect alignment of the surgical bioprosthesis cusps and ring (Figs 1 and 2). The balloon sizing of the

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valve is a matter of debate, and there are data guiding the size selection according to the model and size of the surgical bioprothesis. The valves were implanted in the middle point of the bioprothesis, with slow inflation of the Edwards balloon. The surgical valve makes a good landing zone and it avoids the need of pre-stenting the right ventricular outflow tract, which shortens the procedure. Ventricular pacing was not used in any of the patients. The use of an 18–20-French Sapien XT delivery system was not associated with any vascular access complication. Although the short- and mid-term results of the percutaneous Edwards valve-in-valve in the right heart are good, long-term follow-up data are still required.

Conclusions

Implantation of the Sapien XT valve in the tricuspid position is still an off-label procedure. This technique is feasible and relatively easy in patients with a previous bioprosthetic valve, as the radio-opacity of the valve is an optimal anatomical reference. The valve-in-valve procedure can reduce the number of surgeries in CHD patients.

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Conflicts of Interest

Dr. Haas is proctor for Edwards Lifescience®, although the company has no involvement in the submission of this manuscript. All other authors have no conflicts of interest.

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