Case Reports

Transvenous Transcatheter Valve-in-Valve Implantation

after Bioprosthetic Tricuspid Valve Failure

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We describe the case of a 38-year-old man with a history of metastatic testicular cancer who had undergone multiple thoracic surgical procedures, including tricuspid valve replacement with a bioprosthetic valve as a result of tricuspid involvement of his malignancy. He presented at our outpatient cardiology clinic with worsening fatigue, shortness of breath, and peripheral edema, investigation of which revealed severe tricuspid bioprosthesis stenosis with central regurgitation. Because of the patient's medical history, he was considered to be a high-risk surgical candidate. Therefore, transcatheter tricuspid valve-in-valve implantation of a 26-mm Edwards SAPIEN® valve was attempted through a transjugular approach. The procedure restored tricuspid valvar competence and substantially improved the patient's symptoms. We discuss the technical aspects of this case and briefly review the usefulness of the valve-in-valve technique in the tricuspid position. ***(Tex Heart Inst J 2014;41(5):507-10)***

Key words: *Heart valve prosthesis; heart valve prosthesis implantation/instrumentation/methods/trends; prosthesis design; surgical procedures, minimally invasive/methods; treatment outcome; tricuspid valve insufficiency; tricuspid valve stenosis/therapy*

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Transcatheter valve-in-valve implantation has gained substantial momentum as a viable alternative to surgical valve replacement in patients who are thought to be at high risk for adverse perioperative outcomes. Valve-in-valve implantation of the Edwards SAPIEN® valve (Edwards Lifesciences Corporation; Irvine, Calif) in the tricuspid position is a relatively new procedure, and few cases have been reported. We describe the percutaneous delivery of the Edwards SAPIEN valve across an existing bioprosthetic tricuspid valve in a patient with metastatic testicular cancer who had undergone multiple previous thoracic operations. We discuss the technical aspects of the case and briefly review the usefulness of transcatheter valve-in-valve techniques in the tricuspid position.

Case Report

In June 2013, a 38-year-old man with severe tricuspid stenosis and regurgitation presented with New York Heart Association functional class III right-sided heart failure. His medical history included malignant neoplasm of the testes, for which he had undergone radical left orchiectomy in 1995 at the age of 19 years. That same year, he underwent exploratory laparotomy, left nephrectomy, bilateral pulmonary resections through a median sternotomy, and removal of multiple metastatic lesions. In 1996, he underwent right thoracotomy to remove additional metastases. During this operation, his tricuspid valve was replaced with a 27-mm Carpentier-Edwards® PERIMOUNT® bioprosthesis (Edwards Lifesciences) because of valvular involvement of the malignancy. He did well until 2009, when he presented with atrial flutter and underwent successful radiofrequency ablation. He emergently presented in 2012 with atrial flutter that was medically managed with success; the treatment included therapeutic oral anticoagulation.

The patient had remained free of cancer for more than 15 years. However, in the 2 years before his current presentation, he had become more fatigued, with worsening shortness of breath and peripheral edema. Physical examination and transthoracic echocardiograms revealed severe tricuspid bioprosthesis stenosis with central regurgitation. The mean transvalvular gradient was 13 mmHg and the peak gradient was 22 mmHg (Fig. 1A), with a peak velocity of 2.34 m/s. No evidence of thrombus, vegetation, or abscess was seen. The right atrial cavity was severely dilated, and the

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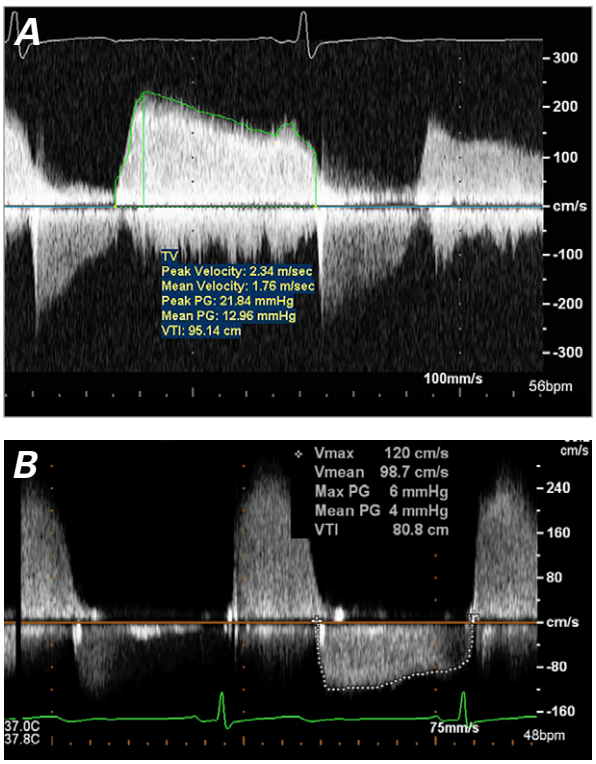

Fig. 1 *Transesophageal echocardiograms.* ***A****) Preprocedural image shows a peak gradient of 21.84 mmHg and a mean gradient of 12.96 mmHg.* ***B****) After the 26-mm Edwards SAPIEN® bioprosthesis was deployed, the peak gradient fell to 6 mmHg with a mean gradient of 4 mmHg.*

bpm = beats per minute; Max = maximal; PG = pressure gradient; TV = tricuspid valve; Vmax = maximal velocity; Vmean = mean velocity; VTI = velocity-time integral

right ventricular cavity was mildly enlarged and had low-normal systolic function. The systolic pulmonary artery pressure was estimated to be 45 mmHg, and the right atrial pressure was 16 to 20 mmHg. The patient's left ventricular ejection fraction was normal.

Because of the patient's medical history and the high risk associated with repeat tricuspid valve replacement, it was decided to request compassionate use of the Edwards SAPIEN transcatheter aortic valve, with its placement in the tricuspid position. After administrative approval was obtained, the risks of the transvenous transcatheter procedure were discussed with the patient and his family, and informed consent was obtained.

Repeat thoracotomy for a transatrial approach was not considered, because of the patient's hostile chest. Gated computed tomograms showed that the right internal jugular vein was at least 9 mm in diameter (Fig. 2), a size that would accommodate the 24F 9000TFX Edwards SAPIEN valve delivery system. A transjugular approach was therefore thought to be preferable. The diameter of the bioprosthetic tricuspid internal strut was 27 mm, according to the manufacturer's specifications; in the patient, we confirmed by means of computed tomography a vascular diameter of 25 × 24 mm (Fig. 3), which was adequate for anchoring the 26-mm Edwards SAPIEN valve.

The procedure was performed in the endovascular suite in the catheterization laboratory, with the patient under general endotracheal anesthesia. A transesophageal probe was inserted for continuous monitoring. The patient was prepared and draped in typical sterile fashion, and a full cardiopulmonary bypass system was primed and ready for rapid surgical conversion, if needed. The right femoral artery and vein were cannulated, and 8F and 7F sheaths were placed for standby bypass support.

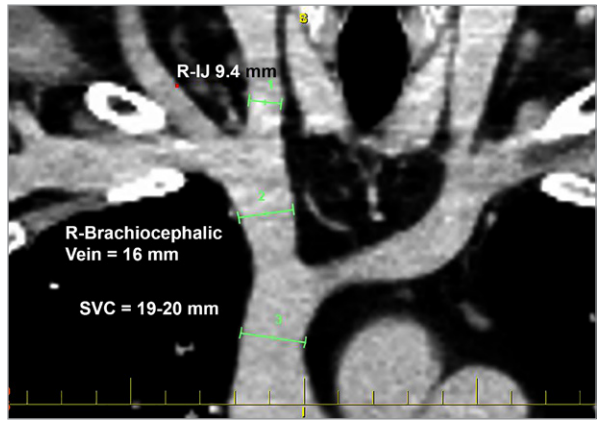

Fig. 2 *Computed tomographic angiogram of the chest shows these diameters: right internal jugular vein (R-IJ), 9.4 mm; right brachiocephalic vein, 16 mm; and superior vena cava (SVC), 19.5 mm.*

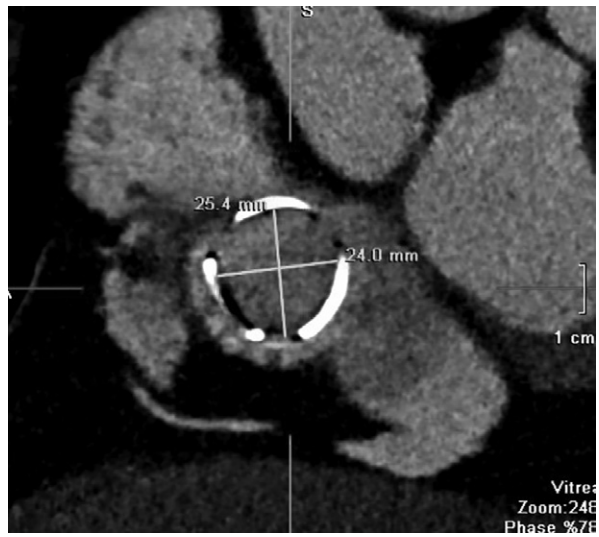

Fig. 3 *Computed tomogram shows the 27-mm Carpentier-Edwards® PERIMOUNT® bioprosthesis; measurements of the stent frame confirm the internal diameter of 25 mm.*

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A surgical incision was made, and purse-string preclosure of the right jugular vein was performed. A 24F RetroFlex™ introducer sheath (Edwards Lifesciences) was inserted into the right internal jugular vein over a 0.035-in guidewire, and heparin was administered in order to achieve an activated clotting time of 275 s. A 6F Amplatz Left 2 (65-cm) catheter (Boston Scientific Corporation; Natick, Mass) was passed over a 0.035-in straight-tip guidewire through the prosthetic tricuspid valve. Right-heart and pulmonary artery pressures were measured before the wire was exchanged for a 0.035-in extra-stiff Amplatz Apex® guidewire (Cook Medical, Inc.; Bloomington, Ind), which was positioned in the pulmonary artery. Predilation was performed with use of a 20-mm × 3-cm Ascendra™ balloon (Edwards Lifesciences). Rapid ventricular pacing was not performed (for reasons explained in the Discussion). The balloon remained stable during the predilation (Fig. 4). Next, a transfemoral 9000TFX Edwards SAPIEN 26-mm system was aligned in the tricuspid position under fluoroscopic and echocardiographic guidance; the wire frame of the existing tricuspid bioprosthesis was used as a reference. The 26-mm Edwards SAPIEN valve was then deployed and fully expanded into position with use of the 26-mm Edwards balloon (Fig. 5). Post-deployment echocardiograms showed a well-seated valve and no paravalvular regurgitation. The mean gradient had immediately improved from 13 to 4 mmHg (Fig. 1B). The delivery system and sheath were then removed, and the right jugular vein was surgically closed.

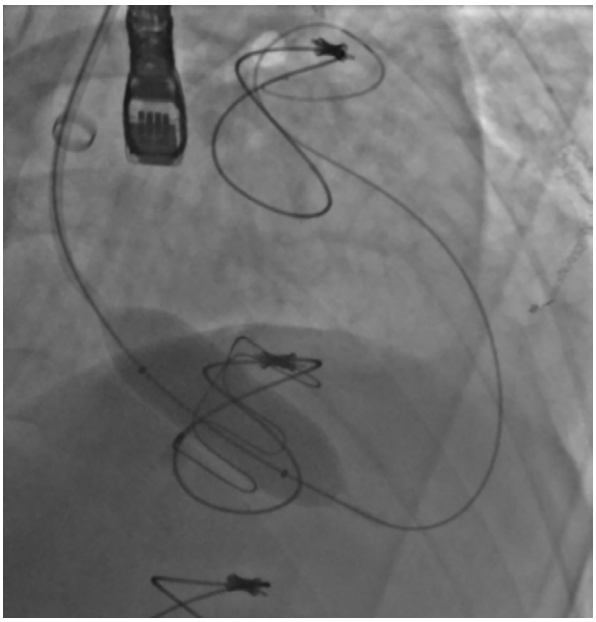

Fig. 4 *Dynamic cineangiographic snapshot shows the Amplatz extra-stiff guidewire, which crosses the tricuspid bioprosthesis and is anchored in the right pulmonary artery. Predilation was performed with a 20-mm × 3-cm Ascendra™ balloon.*

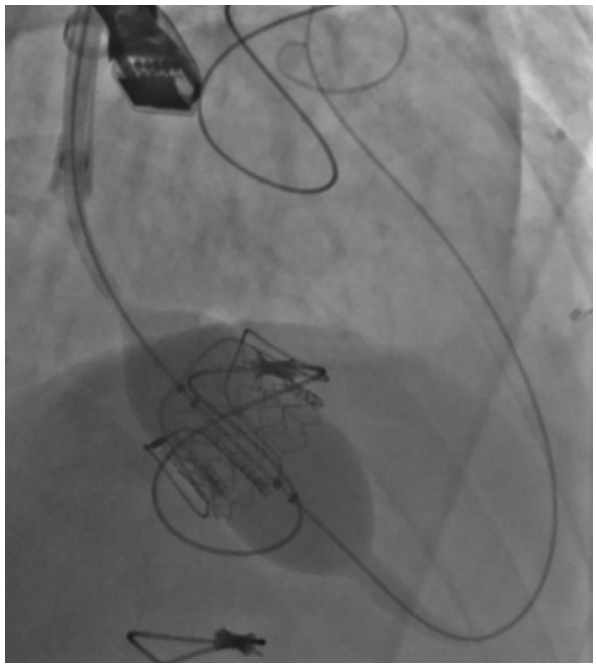

Fig. 5 *Dynamic cineangiographic snapshot shows the fully expanded 26-mm Edwards SAPIEN valve inside the original bioprosthesis.*

The patient was extubated in the catheterization laboratory and was mobilized that same day. He reported immediate improvement in his dyspnea and fatigue. He resumed taking his home medications, including his oral anticoagulant, and he was discharged from the hospital on postoperative day 2.

At the patient's follow-up visit 1 month later, he reported symptoms consistent with New York Heart Association functional class I. He noted marked improvement in his energy level and no significant shortness of breath. He also reported a 3.6-kg (8-lb) weight loss and near-complete resolution of the edema in his hands and feet. At the patient's 6-month evaluation, he remained symptomatically improved.

Discussion

Isolated native tricuspid valve stenosis is rare and is usually associated with carcinoid heart disease, atrial myxoma, atrial thrombus, or congenital causes.[1-3] Surgeons' willingness to perform tricuspid valve replacement has been diminished by early results showing that mechanical valves do not perform well in a low-flow setting[4] and that bioprosthetic valves have a limited lifespan, which is particularly problematic in younger patients.

Repeat valve surgery for bioprosthetic valve failure is especially challenging, because the patients are often in poor clinical condition and the procedure is technically difficult. Transcatheter treatment of heart valve disease is rapidly becoming a viable alternative and can produce

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favorable outcomes in selected patients. Transcatheter valves have been successfully used to restore the function of failing bioprosthetic valves in the aortic, pulmonary, mitral, and tricuspid positions. Given the current data, the argument can be made that such valves are the best available option for high-risk surgical patients.[5]

Alternative prosthetic valves are available for potential use in the tricuspid position, most notably the Melody® pulmonary valve (Medtronic, Inc.; Minneapolis, Minn), which is limited by its maximal diameter of 22 mm.[6] To our knowledge, there are fewer than 25 reported cases in which the Edwards SAPIEN valve was deployed in the tricuspid position, and only one other such procedure was performed in the United States. Successful transatrial, transjugular, and transfemoral deployments have been reported. In most instances, rapid pacing was used for positioning. Because of our patient's low-pressure system, slow heart rate at the time of the procedure, and minimal cardiac motion detected during angiography, we chose not to use rapid pacing, concluding that the risks outweighed any potential benefits. We were satisfied with the valve's post-deployment position.

The results of the present case add to the evidence that transvenous transcatheter tricuspid valve-in-valve implantation can be performed safely by an operator experienced in transcatheter valve placement, provided that the procedure is understood and that all possible eventualities have been considered. The choice of transfemoral, transjugular, or transatrial access can be tailored to each patient. Knowledge of the size and design of the failed bioprosthesis, especially its radiologic appearance and the relationship between the strut and the sewing ring, is important for correctly positioning the valve. We were able to find only one report of Edwards SAPIEN valve implantation into a native tricuspid valve; in this case, pre-stenting techniques were used to establish the rigid target zones that are typically needed for successful transcatheter valve implantation.[7]

Large registry studies are necessary to further evaluate the usefulness of this procedure. Long-term follow-up evaluation will ultimately determine the safety and durability of transvenous transcatheter valve-in-valve implantation after bioprosthetic tricuspid valve failure.

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