Transjugular transcatheter tricuspid valve replacement

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Clinical vignette

An 82-year-old male was admitted for recurrent hospitalization due to heart failure, classified as New York Heart Association (NYHA) functional class III. He had a history of persistent atrial fibrillation for over five years, coronary artery disease with 60% stenosis of the left anterior descending (LAD) artery, and a permanent pacemaker implanted 25 years earlier. Transthoracic echocardiography showed severe tricuspid regurgitation. Transcatheter edge-to-edge repair was not feasible due to an enlarged annulus and a wide leaflet coaptation gap.

Surgical techniques

Preparation

The procedure was performed from the patient's head side. The C-arm was positioned as needed, and extended ventilator tubing was used to provide sufficient operating space on the patient's right head side.

Exposition

The patient was placed in the supine position with exposure of the right neck. The head was turned to the left to allow full access to the right internal jugular vein. A transesophageal echocardiography (TEE) probe was inserted for intraprocedural guidance.

Operation

Step 1: right ventricle (RV) access

Under ultrasound guidance, the lower right internal jugular vein was punctured, and two ProGlide (Abbott Vascular, Santa Clara, CA, USA) sutures were pre-positioned for closure. A 10-Fr sheath (Oscor, Integer Holdings Corp., New Hope, MN, USA) was inserted, and a pigtail catheter was advanced into the RV and then into the left pulmonary artery for invasive hemodynamic assessment.

A steerable catheter could be used to optimize the trajectory toward the RV. A Safari wire (Boston Scientific, Marlborough, MA, USA) was then advanced via the pigtail catheter and positioned at the RV apex. Serial dilatation was performed up to 25 Fr, and finally, a 33-Fr LuX-Valve Plus delivery sheath (Jenscare Scientific, Ningbo, China) was placed.

The C-arm was rotated to the predicted deployment view aligned with the tricuspid annulus and an en-face view of the interventricular septum. Then LuX-Valve Plus delivery system was inserted with the upper logo facing the C-arm projection and was gradually flexed as it advanced through the superior vena cava. The insert-and-flex maneuver continued until the tip reached the tricuspid annulus and entered the RV. The "Coupling Advancement" knob was rotated to elongate the distal flexed segment, reaching an appropriate RV depth, which was measured by TEE with multiplane reconstruction (MPR) as 3.5 cm or at the root of the "rabbit ears" under fluoroscopy. Coaxiality was carefully

checked using MPR to ensure the delivery system was perpendicular to and centered within the tricuspid annulus.

Step 2: ventricular-side deployment

Once depth and coaxiality were confirmed, the deployment knob was slowly rotated to release the ventricular portion. The two "rabbit ears" were visualized gradually flipping up until they reached 90 degrees, symmetrically under fluoroscopy. TEE with transgastric short-axis view of the tricuspid annulus with x-plane confirmed that the "rabbit ears" were positioned 0.5–1 cm below the lateral leaflets. The system was rotated laterally to adjust the positioning, ensuring that the rabbit ears were completely buried beneath the leaflets. Recapture was still possible at this stage.

Step 3: atrial-side deployment

Deployment continued by rotating the knob until the atrial portion of the LuX-Valve was fully released. The large atrial skirt may require a few minutes to fully expand. TEE was then used to assess valve position, function, and hemodynamics. Fine adjustments of depth and coaxiality were made to minimize potential paravalvular leak.

Step 4: septal anchor and release

TEE in the short-axis RV view (3 cm below the tricuspid annulus) was used to locate the septal anchor position. X-plane imaging confirmed central attachment of the anchor. Gentle septal rotation of the delivery system was applied to create minimal compression on the septum. The pin channel was then advanced, showing a symmetrical "glasses" sign under fluoroscopy. Final TEE confirmation of anchor position was obtained before deploying the three-hock pin into the ventricular septum.

The septal anchor was released by pulling out the fixation lines. The pin channel was retracted, and the release knob was rotated to disconnect the delivery system from the atrial portion of the prosthesis. The inner core was gradually withdrawn, the system unflexed, and retracted to the superior vena cava.

Completion

Final TEE assessment confirmed no paravalvular leak. The valve frame was fully expanded with optimal coaxiality, the skirt was well-sealed, and pacemaker leads remained in their appropriate positions.

Comments

The TRAVEL Study evaluating the first-generation of LuX Valve via the transatrial approach demonstrated favorable outcomes, with a one-year all-cause mortality of 10.3% and 95% of patients achieving tricuspid regurgitation (TR) reduction to mild or less (1). Early compassionate-use outcomes of the LuX-Valve Plus system using a transjugular approach further confirmed its safety and feasibility, showing an in-hospital mortality of 5.3% and TR reduction ≤1+ in 90.8% of patients (2). At one-year follow-up, clinical success was achieved in 76.9% of patients, with durable TR reduction to ≤2+ in 86.5% (3).

The LuX-Valve Plus features a septal anchoring mechanism with a pin-based design, which does not rely on radial force for fixation. This design contributes to a relatively low permanent pacemaker implantation rate of 8% (3). Moreover, it accommodates a wide range of anatomical variations, including tricuspid annuli up to 65 mm in diameter. Comprehensive pre-procedural computed tomography is essential to assess anatomical feasibility, including sizing, trajectory, and septal anchor positioning.

The presence of pacemaker leads is not an absolute contraindication unless they are positioned centrally along the septum and interfere with the septal anchor or prevent the full expansion of atrial shirt due to tightness. When necessary, an inferior steerable sheath can be used to gently displace the leads inferiorly, creating sufficient space for the septal anchor. Except for anatomical stenosis, the internal jugular vein generally accommodates a 33-Fr sheath because of the venous congestion due to right heart failure. A lower puncture can optimize trajectory and provide additional maneuvering space, particularly when the access line is more septal than central. In patients with a small right atrium, infusion of 500 mL of saline can help enlarge the chamber and facilitate the trajectory.

Pre-procedural TEE is helpful to check the tricuspid valve morphology. A Type IIIb classification with two posterior leaflets is not a contraindication for LuX-Valve implantation, though special attention is required during deployment of the ventricular portion to prevent "rabbit ears" from prolapsing into the right atrium.

Although the LuX-Valve Plus employs a novel transjugular approach, its standardized procedural steps and TEE views allow for safe and effective implantation across a wide range of anatomical variations.

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