Transapical approach for transcatheter aortic valve implantation

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Introduction

With the advancement of device technology and procedural techniques, most transcatheter aortic valve implantation (TAVI) procedures have been performed with the transfemoral approach in recent years (1). However, alternative approaches such as transapical, trans-subclavian, direct aortic and others still play an important role in patients with poor vascular access. Transapical approach is the only antegrade approach and provides easy wiring and excellent controllability. In contrast, the transapical approach has some potential drawbacks including apical bleeding risk and postoperative pain. Herein, we introduce technical tips for fast and safe transapical TAVI.

Clinical vignette

An 89-year-old lady was referred to our hospital with the diagnosis of severe aortic stenosis (AS). She had NYHA class III heart failure symptoms and past medical history including hypertension, diabetes and chronic kidney disease. The patient had moderate frailty. Her Society of Thoracic Surgeons (STS) predicted mortality score was 13%.

Transthoracic echocardiography (TTE) showed low-flow low-gradient AS (aortic valve area 0.57 cm^2/m^2, peak velocity 3.1 m/sec, mean pressure gradient 23 mmHg) and reduced left ventricular function (ejection fraction 47%). Dobutamine stress echocardiography demonstrated increased peak velocity and pressure gradient, and the diagnosis of true severe AS was made. Computed tomography showed stenotic iliac arteries and severe tortuosity of the descending aorta. Our heart team decided to perform transapical TAVI for this high-risk old patient with poor vascular access.

Surgical technique

The procedure was performed under general anesthesia and supine position. One-lung ventilation is unnecessary. Before skin incision, we routinely do transthoracic echocardiography with sterile coverage after draping the patient to find the best access point to the apex.

A 5–7 cm skin incision was made right above the apex and a mini-thoracotomy was performed in the 5th or 6th intercostal space. After pericardiotomy, a small size wound retractor was placed into the pericardial space. This technique eliminates the need for pericardial traction stitches. Putting one or two pieces of wet sponges in the inferior pericardial space is useful to mobilize the apex to the center of surgical field. The LAD is confirmed with a direct vision and apical sutures was placed at least 2 cm away from the LAD.

We placed double crossing mattress sutures with pledgeted 2-0 polypropylene sutures with a 36 mm needle. Suturing bites need to be big enough for a 24-french sheath and deep enough for hypertrophic myocardium in AS patients. The important thing is to advance the needle along the needle curve not to tear myocardium by needles. We prefer epicardial pacing to transvenous pacing since it does not need an extra neck line and it is easy to leave for a few days after surgery if necessary. We placed a temporary pacing lead on the myocardium underneath the pledget.

Following heparinization, the apex is punctured and a J-shaped guidewire is passed through the aortic valve under the guidance of fluoroscopy and transesophageal echocardiography (TEE). After advancing the wire to the ascending aorta, we certainly check on TEE that the wire is not tangling with mitral subvalvular apparatus. We made sure that the guidewire is running along the ventricular

septum and that there is not increased mitral regurgitation or new tethering of the anterior leaflet. If there is any sign of wire tangling, we pull back the wire, re-advance it and check TEE findings again.

The wire is exchanged to a stiff guidewire, which is advanced to the descending aorta with a JR 4 catheter. Then, a 24-french sheath (18-french delivery system is not available in Japan in 2017) is inserted into left ventricle. Once the angle and depth of the sheath are determined, the assistant holds it during the procedure.

We do not perform balloon valvuloplasty unless the aortic valve area is very small (<0.5 cm^2) or the valve is extremely calcified. A crimped Sapien XT (Edwards Lifesciences, Irvine, CA, USA) bioprosthesis is then delivered to the aortic root. Sapien 3 is only available with a transfemoral approach in Japan in 2017. The valve is deployed in a regular fashion.

After assessing valvular function and paravalvular leak with TEE, the delivery sheath is removed with a systolic blood pressure <100 mmHg. Two 2-0 mattress sutures are tied securely and gently. Importantly, sutures should not be fastened further once hemostasis is confirmed since tying apical sutures too tight may tear myocardium and could cause serious bleeding. We routinely reinforce the apical sutures with a 3-0 polypropylene purse-string suture to avoid a rare complication, left ventricular pseudoaneurysm (2).

The pericardium is roughly closed and a chest tube is placed in the left thoracic cavity. We routinely do intercostal nerve block by injecting local analgesics into the intercostal space. After irrigating the thoracic cavity, the wound is closed in a regular fashion.

Comments

The patient was extubated on the day 0 and was discharged home on the day 6 without perioperative complications.

Exposure of the apex and precise apical suturing are critical for successful transapical TAVI. Wiring and deployment are straight-forward. Usually, adequate hemostasis is achieved by securing the apical pursetring sutures. TTE and TEE are very useful for fast and safe procedures. In our recent series, most transapical cases were done in 40 to 50 minutes. The amount of contrast medium is smaller and fluoroscopic time is shorter in transapical cases than transfemoral cases. We can reduce the total amount of contrast medium to 20 mL in transapical cases. Pain management and early ambulation are important for fast recovery. We remove a chest tube 12 hours after surgery, which reduces postoperative pain and promotes early mobilization.

The transapical approach provides easy access to the aortic valve and easy controllability of the device. It is a useful option in TAVI, transcatheter mitral valve replacement and other transcatheter cardiac interventions.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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