Chapter 12: Step-by-Step Guide: Transapical Sapien S3 TAVR

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Essential or Key Steps

- The location of the left thoracotomy incision is critical to locating the left ventricular (LV) apex.
- Use the preoperative computed tomography angiogram (CTA) scan, transesophageal echo (TEE), and fluoroscopy to assist with identifying the correct location for the left thoracotomy incision and LV apex.
- Take deep bites at the LV apex within the myocardium (but not full thickness) with pledgeted mattress sutures and avoid the left anterior descending artery.
- Valve deployment should be completed with 50% of valve on the aortic side and 50% on the ventricular side of the aortic annulus initially, aiming for a 70-80% aortic final position.
- After removing the access sheath from the LV, rapid ventricular pacing should be initiated to decompress the LV apex while tying the sutures.

Pearls and Pitfalls

- Avoid the transapical approach in patients with severe chronic obstructive pulmonary disorder or severe LV dysfunction.
- Always have a definitive plan to get onto bypass if there is instability.
- When crossing the aortic valve anterograde from the LV apex, it is important that the wire passes straight without any deviation, as this may indicate entanglement within the mitral chordae. When this happens, remove the wire completely for a second attempt, or use a balloon tipped pulmonary artery catheter to cross the aortic valve.
- Do not leave the OR with moderate or severe aortic insufficiency (AI) or paravalvular leak (PV). If there is moderate to severe AI or PVL, then a repeat balloon inflation should be performed, or a valve in valve implantation may be needed.

Introduction

Over the past decade, TAVR access has evolved to become less invasive. In 2011, transapical access through the LV accounted for approximately 50% of all TAVRs (1). However, as TAVR technology improved and delivery sheaths decreased in diameter, transfemoral TAVR now comprises approximately 80-90% of all cases, with transapical access less than 10%. While multiple studies have demonstrated that transfemoral TAVR has the best outcomes when the iliofemoral anatomy is suitable (2-3), alternative access, including transapical TAVR, remains an important skill set and should be mastered by all TAVR operators.

In the United States, only the Edwards Sapien S3 (Edwards Lifesciences, Irvine, CA) valve is approved for transapical access. When the iliofemoral and axillary arteries are small (< 6.0mm) in

diameter with severe calcification and tortuosity, alternative access is indicated. Transapical access should be avoided in patients with moderate to severe chronic obstructive pulmonary disorder or severely depressed ejection fractions.

Procedure Description

In a hybrid operation room, the patient is positioned supine and general anesthesia is used with a single lumen endotracheal tube. Transesophageal echocardiography (TEE) is used to assist with valve positioning and postoperative function. Invasive hemodynamic monitoring with a PA catheter is often used. First, femoral arterial and venous access are obtained with a 6F and 7F sheath, respectively. A 6F transvenous pacing wire is advance into the right ventricular apex, and threshold limits and rapid ventricular pacing are tested. Next, a 6F pigtail catheter is advanced into the right coronary sinus under fluoroscopic guidance and will be used for a root aortogram before valve deployment. The preoperative CTA and intraoperative fluoroscopy should be used to determine the exact location on the chest to locate the LV apex. It is critical to avoid accessing the LV free wall, as this decreases post-operative bleeding complications. A 5 cm left thoracotomy is usually made in the fifth intercostal space to expose the LV apex. Fluoroscopy may also be used to identify the location of the left ventricular apex and guide the location of the thoracotomy incision. The TEE can assist in finding the LV apex by locating an area of digital depression through the thoracotomy incision. Heparin is then administered (100U/kg) to achieve an ACT > 250 seconds. Next, two 2-0 Prolene sutures with large pledgets are mattress sutured perpendicular in the LV apex (Figure 1). These sutures should be placed deep within the myocardium but not full-thickness and avoid the left anterior descending artery. In a redo situation, it is best to keep the fused pericardium on the heart at the site of the sutures. An 18-guage needle is inserted into the LV apex centered within the mattress sutures, and a 0.35-inch soft J wire is advanced across the aortic valve under fluoroscopy. If the wire does not pass in straight line, there should be low suspicion for entanglement of the wire within the mitral chordae, and a second attempt should be completed. Once the wire is across the aortic valve, a 7Fr bright tip sheath is then inserted into the LV to maintain intraventricular access. Next, a 6F right Judkins catheter is placed over the J-wire and used to direct the wire into the descending aorta. The wire is then exchanged for a 260cm 0.35-inch Extra Stiff Amplatz wire (Boston Scientific, Marlborough, Massachusetts) with a soft J tip. The Judkins catheter and sheath are then exchanged for the 18F Edwards Certitude transapical sheath (Edwards Lifescience, Irvine, CA). This sheath is inserted into the LV cavity approximately 4cm. At our center, we do not routinely perform balloon aortic valvuloplasty (BAV) but could be performed at this point.

Next, a root aortogram is completed to create a coplanar view with the C-arm where the inferior aspect of all 3 coronary cusps are on same plane. The S3 valve on the Edwards Certitude delivery sheath is then evaluated under fluoroscopy to verify proper loading and orientation. The valve-delivery system is then advanced over the Extra Stiff Amplatz wire across the aortic annulus using short, smooth movements. The valve should be positioned within the aortic annulus so that 50% of the valve is on ventricular side and 50% is on the aortic side (Figure 2). The Edwards Certitude delivery sheath has an articulation feature at the distal end that can adjust the angle of the valve so that it sits perpendicular to the aortic annulus. At this stage, a repeat aortogram can be completed to further identify the aortic annulus for proper valve positioning in addition to using TEE. When the valve is correctly positioned within the annulus, one operator holds the device to make micro-adjustments and another uses the balloon inflator to

deploy the device. When ready to deploy, ventilation is held and rapid ventricular pacing is initiated at a rate of 180-220 beats/minute to drop the systolic blood pressure < 70 mmHg. A slow, controlled balloon inflation helps to stabilize the valve and prevent large movements, but the balloon should be fully inflated within several seconds. The balloon is held inflated for four seconds and then quickly deflated. Rapid pacing is stopped when the balloon is completely deflated. Prolonged pacing runs may lead to hemodynamic instability.

After valve deployment, the delivery sheath is retreated through the new valve and brought out through the sheath in the LV. It is important to keep the wire across the valve at this point. A completion root aortogram is performed to evaluate for valve function, position, and filling of the coronary arteries. A TEE is also performed to assess valve position, leaflet mobility, and for evidence of AI and PVL. While trace or mild PVL is common after TAVR, moderate to severe PVL or AI should be addressed before leaving the OR.

Once valve function and position are acceptable, anticoagulation is reversed with protamine and the wires and sheath are removed from the LV apex. While tying the mattress sutures on the LV apex, rapid ventricular pacing should be initiated at a rate of 120-160 beats/minute to decompress the LV. A chest tube is then placed in the left pleural space through a separate chest incision. The ribs are reapproximated with a 2-0 Vicryl suture and the thoracotomy incision is closed in normal fashion. If there is no evidence of heart block, the pacing wire and femoral venous sheath are removed. The 6F arterial sheath is removed and a vascular arteriotomy closure device or manual compression is used to achieve hemostasis.

Potential Complications

The most significant complication of transapical approach is major bleeding due to disruption of the LV apex and is seen primarily in frail, elderly patients. Other complications include valve migration and embolization, moderate to severe PVLs and AI, coronary ostial obstruction, rupture or the aortic root or annulus, LV dysfunction, kidney failure, left ventricular pseudoaneruysm, and cardiac arrest requiring ecmo or cardiopulmonary bypass (4-5).

References:

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Figures

Figure 1. Two 3-0 pledgeted Prolene sutures placed perpendicular to each other in the left ventricular apex.

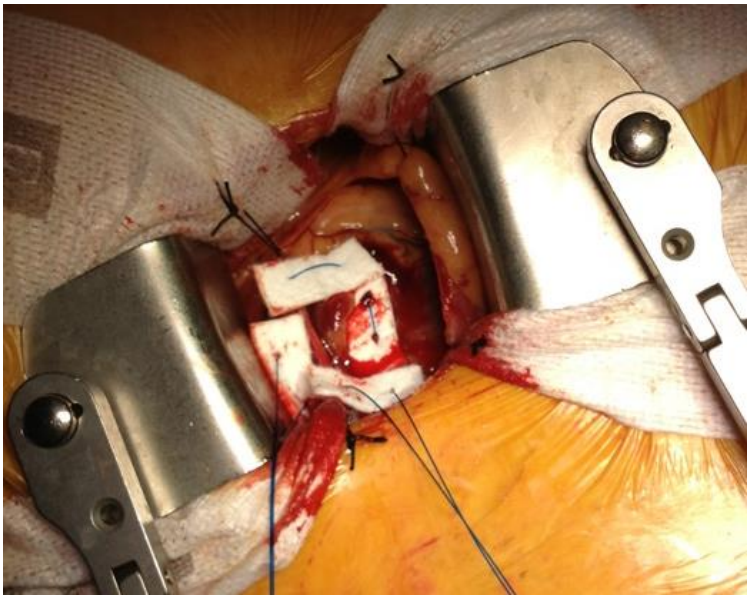

Figure 2. Fluoroscopy of the Edwards S3 valve within the aortic annuls before deployment.