Alternative access for transapical transcatheter mitral valve implantation

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Central message:

Transcatheter mitral valve replacement performed through a subcostal incision is feasible and reduces the surgical trauma by preserving patient's chest wall integrity.

Central picture legend: alternative approach for implantation of the Tendyne prosthesis
Background:

The self-expanding TendyneTN device (Abbott Cardiovascular, Plymouth, MN, USA) is the first transcatheter mitral valve prosthesis approved for the treatment of severe symptomatic mitral regurgitation. It offers selected patients not eligible for surgery or transcatheter edge-to-edge repair (TEER) the opportunity of TMVR. Recently published data proved the safety and feasibility of the procedure and showed a significant and sustainable reduction of mitral regurgitation up to 2 years of follow up. (1, 2)

Conventionally, a left anterolateral mini-thoracotomy is performed to gain access to the apex of the heart, where the valve is deployed transventricularly.

We present the first case of TMVR, where the procedure was conducted through a subcostal incision in order to preserve patient’s chest wall integrity. The Institutional Review Board (IRB) or equivalent ethics committee of the University Hospital Münster, Germany approved the study protocol and publication of data (3/15/2023/ 2023-164-f-N). Patient written consent for the publication of the study data was waived by the IRB because of the retrospective data collection and the anonymized processing and presentation of data.

Case presentation:

An 85 year old male was admitted to our hospital with recurrent severe heart failure caused by a mixed mitral valve disease with severe regurgitation and moderate stenosis (video 1).

Due to impaired leaflet mobility, the valve was not eligible for TEER, but high operative risk also denied conventional surgery. Despite sensitive anatomic conditions, caused by severe annulus calcification and previous TAVI, the patient was found suitable for off-label TendyneTN implantation (3, 4).
Preoperative 3D–computed tomography (CT) reconstruction located the ideal position for apical access, in terms of orthogonal approach to the mitral valve plane, in the left 6th intercostal space approximately at the parasternal line. Unfortunately, accessory cartilaginous or osseous structures attached the 6th and 7th rib parasternally, requiring an additional transection of these structures or a partial rib resection to reach the target site (Figure 1).

After the patient had been positioned correctly on the surgical table, final transthoracic echocardiography showed that uncommonly, an appropriate trajectory for implantation could also be attained by placing the probe subcostal, slightly left of the xiphoid (Figure 2).

Therefore, the interdisciplinary implantation team decided to access the apex via a 5 cm skin incision left of the xiphoid apex. After transverse dissection of the left ventral abdominal muscles, the pericardium was directly accessed above the diaphragm through the left sternocostal triangle. Additionally, a small portion of the adjoining medial costal insertion of the diaphragm was detached.

A slight reverse Trendelenburg position of the patient shifted the heart more caudally, which facilitated improved apical access and device trajectory.

Implantation of the Tendyne prosthesis (29S LP), preceded by a predilatation of the mitral valve apparatus with a 28 mm balloon valvuloplasty catheter, was performed in a routine fashion and proceeded uneventfully.

Finally, an intrapericardial drainage was inserted, the muscular costal part of the diaphragm was re-attached to the costal margin and the layers of the abdominal wall were closed in anatomical planes.

After immediate weaning the respirator, initial postoperative course was complicated by general vasoplegia with consecutive high demand for vasopressors and a temporary need for
hemofiltration. Later on, the patient suffered from an influenza infection, but on the 19\textsuperscript{th} postoperative day he could be discharged to a rehabilitation unit.

Echocardiography at discharge showed a correct position and function of the mitral valve prosthesis (video2).

**Discussion:**

Preoperative imaging delivers crucial data to determine the correct size and profile of the mitral valve prosthesis, but regarding the access route to the LV apex, surgeons should keep in mind that certain anatomical characteristics and auxiliary patient positioning may offer favorable access sites diverging from the preprocedural 3D-CT reconstruction.

In the presented case, a preexisting mediocaudal shift of the LV apex (Figure 1B, C), increased by a reverse Trendelenburg positioning, enabled an almost perpendicular and centered device trajectory from the LV apex to the mitral valve plane through a less traumatic, paraxiphoidal incision. The slight scaphoid shaped chest of the patient further facilitated this approach due to a greater range of motion for the prosthesis delivery system.

Consequently, transthoracic echocardiography is highly recommended to verify the preoperatively estimated surgical access route and to evaluate potential alternatives.

Caution is advised though, as the technical requirements for a proper and stable alignment of the Tendyne prosthesis tolerate only minor deviations of approximately 6 to 10 degrees from an orthogonal device delivery to the mitral valve plane.

**References:**


Figure legends:

Video 1: mitral valve insufficiency and mitral valve anatomy preoperatively

Figure 1: calculated (yellow) and actual target site (red) as well as corresponding skin incisions for TMVR in 3D-CT scan (A), presentation of the heart in the transversal (B) and sagittal plane (C) of the 2D CT scan.

Figure 2: Echocardiographic evaluation of alternative access site (A, B) subcostal incision (C) and valve deployment (D)

Video 2: postoperative result