Robotic mitral repair after Rastelli operation and replacement of the aortic valve and Right Ventricle-Pulmonary Artery conduit

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Central Message (200 characters):
The robotic approach offered a less invasive and effective alternative to traditional redo-
 sternotomy or right thoracotomy in a patient who undergone Rastelli operation.

Abbreviation:
LEAR; lateral endoscopic approach with robotics
MR; mitral regurgitation
PLSVC; persistent left superior vena cava
RV-PA; right ventricle-pulmonary artery
VSD; ventricular septal defect
Mitral surgery is one of common procedures in adults after initial repair for congenital cardiac disease\(^1\); however, redo operations can be challenging. We have utilized a lateral endoscopic approach with robotics (LEAR) technique for redo cases to repair mitral regurgitation (MR) to promote better visualization, effective operative manipulation, and less invasiveness by avoiding redo sternotomy\(^2\).

**Case Summary**

A 37-year-old gentleman developed symptomatic severe MR after an initial Rastelli operation for D-transposition of the great arteries with the ventricular septal defect (VSD) and subpulmonic stenosis at 4 years old and subsequent 25mm-bioprosthetic aortic valve replacement and right ventricle-pulmonary artery (RV-PA) conduit replacement (23mm-bioprosthetic valve and 24mm-dacron tube) for infective endocarditis at 27 years old. This study was approved by the Institutional Review Board (IRB00073906, 4/21/2014); written informed consent for publication of study data was obtained from the patient.

Preoperative echocardiography showed flail P2 leaflet. Preoperative computed tomography showed persistent left superior vena cava (PLSVC), the aorta adjacent to the sternal bone, and the mitral valve located just behind the pulmonary artery stump (Central Picture, Figure 1). We employed LEAR technique to avoid a third sternotomy (Figure 2). We cannulated the bilateral internal jugular veins, left femoral vein, and right femoral artery to establish cardiopulmonary bypass and the left femoral artery to deliver an IntraClude intra-aortic occlusion device (Edwards Lifesciences, Irvine, CA). We carefully dissected adhesions around the left atrium. After cardiac arrest using the occlusion device, we opened the left atrium and exposed the mitral valve. Severely dilated mitral annulus with P2 prolapse was identified. We resected the P2 segment and
closed the cleft between P1 and P2. We placed a 34mm SimuPlus annuloplasty band (Medtronic, Minneapolis, MN) to the dilated annulus. As the coaptation depth was still shallow, we applied a A2-P2 edge-to-edge stitch. The operative time, cardiopulmonary bypass time, and cross-clamp time was 483, 220, and 108 minutes, respectively. Postoperative echocardiography did not showed residual MR with mean pressure gradient of 2mmHg. Red blood cell transfusion was not required. The patient was extubated the following day and discharged home 5 days after surgery.

**Comments**

Redo valve surgery carries a high risk of morbidity and mortality. In the present case, proximity of the aorta to the sternal bone amplifies the risks, compounding the standard challenges associated with redo surgery. Consequently, we opted for a robotic approach to address mitral valve repair. Additionally, through the use of a robotic approach, we achieved sufficient visualization from a lateral angle without the need for extensive dissection of adhesion or distortion of the heart. For the purpose of achieving optimal decompression of the right atrium and enhancing visualization of the mitral valve, we cannulated both the superior jugular veins.

In this case, we employed an intra-aortic occlusion device to occlude the ascending aorta, deliver cardioplegia solution, and vent blood and air from the aortic root. Utilizing the intra-aortic occlusion device eliminated the necessity for dissection around the ascending aorta. The precise placement of the occlusion device plays a pivotal role in achieving effective occlusion and successful cardioplegia delivery (Video). Transesophageal echocardiography provides essential images for guiding the device’s positioning during the balloon inflation. The use of indocyanine green within the balloon of the aortic occlusion device is also efficacious in a majority of redo
cases if the lateral wall of the ascending aorta is exposed. Continuous monitoring of blood pressure in the right arm serves as a valuable method for promptly detecting significant migration. It is crucial to closely monitor aortic root pressure during mitral valve tests using pressurized saline solution to prevent the migration of the aortic occlusion device.

Conclusions

We report a successful robotic approach for MR after two previous sternotomies including Rastelli operation. LEAR technique provided a less-invasive and effective alternative to traditional redo-redo sternotomy or right thoracotomy.


Central picture

Three-dimensional reconstruction of computed tomography scan. The aorta was adjacent to the sternal bone.

PLSVC; persistent left superior vena cava, RV-PA; right ventricle-pulmonary artery.

Figure 1

Preoperative computed tomography scan in axial view. A: Persistent left superior vena cava connected to the right atrium. The mitral valve was located just behind the pulmonary artery stump. B and C: The aorta was adjacent to the sternal bone.

LA; left atrium, LV; left ventricle, MV; mitral valve, PA; pulmonary artery, PLSVC; persistent left superior vena cava, RA; right atrium, RV; right ventricle, RV-PA; right ventricle-pulmonary artery, VSD; ventricular septal defect.

Figure 2
Our standard port placements in a lateral endoscopic approach with robotics technique. The femoral arteries were narrow and bilateral cannulation was required for perfusion and delivery of intra-aortic occlusion device.

**Video**

Robotic approach for third redo mitral repair following Rastelli operation.
Aorta adjacent to the sternal bone

PLSVC

RV-PA conduit