

# Minimally invasive mitral valve repair through a right minithoracotomy approach

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## Clinical vignette

The patient is a 63-year-old woman who presented to her cardiologist complaining of dyspnea on exertion. Her past medical history is significant for mild hypertension that was adequately treated with an angiotensin converting enzyme inhibitor. Prior to development of her symptoms, she was physically active and walked 4 miles per week. Six months prior to presentation, she noted a decline in her tolerance of physical activity and breathlessness during her walks. Subsequently, she underwent a transthoracic echocardiogram which revealed posterior leaflet mitral valve prolapse, 3-4+ mitral regurgitation, ejection fraction of 60%, and a left ventricular end diastolic dimension of 5.6 cm. Coronary angiography showed no coronary disease and right heart catheterization revealed normal pulmonary pressures. She was seen in consultation and deemed a candidate for minimally invasive (MI) mitral valve repair via right minithoracotomy.

## Surgical techniques

The patient is induced under general anesthesia in the supine position and monitoring lines are placed. The endotracheal tube is then exchanged for a double-lumen tube to allow for intraoperative left single-lung ventilation and the patient is repositioned to a 30° modified left lateral decubitus position. A 6 cm incision is made in the anterior axillary line of the 4<sup>th</sup> intercostal space just superior to the inframammary crease in order to avoid wound healing complications from an incision directly in the crease. The right lung is deflated prior to entering the pleural cavity, and an Alexis soft tissue retractor (Applied Medical, Rancho Santa Margarita, CA, USA) is placed in the wound followed

by an Estech chest retractor (Atricure, West Chester, OH, USA). The patient is systemically heparinized and an inferior vena cava (IVC) cannula is placed in the right femoral vein via Seldinger technique. The pericardium is opened several centimeters anterior to the phrenic nerve and pericardial retraction sutures are passed through the chest wall. Direct aortic cannulation is undertaken in the greater curvature of the ascending aorta and a direct superior vena cava (SVC) cannula is placed to complete venous drainage. Cardiopulmonary bypass is commenced and the patient is cooled to 32 °C. Following placement of a cardioplegia catheter in the aortic root, a transaxillary crossclamp is placed via a stab wound in the right axilla, applied to the aorta, and antegrade cardioplegia is given to achieve arrest.

The interatrial groove is dissected and a left atriotomy is completed to allow for adequate exposure of the mitral valve. A Heartport retractor blade (Johnson & Johnson, New Brunswick, NJ, USA) is placed against the interatrial septum and the supporting bar is passed through a stab wound in the anterior chest. Thorough valve assessment is completed. In this case, chordal elongation has led to prolapse of the P2 segment and part of the P1 segment. Viable chords on both sides of the prolapsing segment are marked and a wide quadrangular resection is completed, taking care to avoid chords that will support the remaining leaflet tissue. To decrease the distance between resected edges of the posterior leaflet, a plication annuloplasty is done. Following annular plication, a folding plasty of remaining leaflet tissue is accomplished, effectively decreasing the height of the posterior leaflet to a target height of 8-10 mm. Finally, a partial ring annuloplasty

band is implanted to support the repair. Saline testing following the repair confirms valve competence and an adequate leaflet coaptation zone. After testing competence of the valve, the left atriotomy is closed, during which time de-airing is commenced and the patient is rewarmed. Following evaluation with intra-operative transesophageal echocardiography to ensure an adequate repair, the patient is separated from bypass. Two drains are placed, one in the pericardium and one in the pleural cavity, the ribs are apposed with interrupted, non-absorbable, pericostal sutures, and the wound is closed in layers.

### Comment

We have previously demonstrated equivalent outcomes using the right minithoracotomy approach to mitral valve surgery compared to a standard sternotomy approach, even in the elderly population (1,2). In our experience, our MI approach allows for the full spectrum of mitral repair and replacement techniques to be performed, including concomitant procedures such as tricuspid valve repair, atrial septal defect or patent foramen ovale closure, and atrial fibrillation ablation, all with shorter post-operative length of stay and no difference in perioperative complication rate or short or long-term survival. Additionally, we have found the MI approach to be more cost effective than the standard approach (3). Therefore, we maintain that in properly selected patients, a MI approach to mitral valve surgery affords equivalent patient outcomes in a more cost-effective manner compared to a standard sternotomy approach.

Patient selection is paramount for a successful outcome in MI cardiac surgery. The ideal patient is not obese and has no prior right intrapleural surgeries, chest wall deformities, or serious lung disease. The minithoracotomy approach is particularly useful in patients with a large anterior-posterior chest diameter, and in those for whom avoidance of a midline sternotomy is important. Although avoidance of sternal splitting is proposed by some to be an important goal in elderly patients, and may actually be contraindicated in a small proportion of patients, we apply the MI approach very selectively in patients over 80 years of age due to the potential for rib fracture in the very frail.

We have refined several elements of the approach, the most significant of which is our cannulation strategy (4). Many groups employ completely peripheral cannulation techniques for MI mitral valve surgery, with or without endoballoon aortic occlusion. We have found that central aortic cannulation can be performed safely in patients of all sizes and avoids potential vascular complications associated

with femoral arterial cannulation and retrograde perfusion. Additionally, we have found that placement of a direct SVC cannula allows for consistently reliable venous drainage compared to a dual-stage femoral venous cannula. We occlude the aorta with a transaxillary Chitwood crossclamp, avoiding the risks, complexity, and additional monitoring associated with endoballoon occlusion. Finally, we have also adopted the use of single-dose Del Nido antegrade cardioplegia for cardiac arrest, which avoids the need for retrograde cannula placement and intermittent cardioplegia administration. These modifications have allowed us to consistently perform mitral valve repair using the full armamentarium of classic valve repair techniques while decreasing length of hospital stay and healthcare costs.

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### Footnote

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

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