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Masters of Cardiothoracic Surgery

How I perform totally endoscopic robotic mitral valve repair

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Clinical vignette

A sixty-two-year-old male presented with significant symptoms related to severe mitral regurgitation with posterior leaflet flail and prolapse on transesophageal echocardiogram (TEE). Preoperative computed tomography (CT) angiography showed normal caliber thoracoabdominal aorta and patent access vessels. The patient underwent totally endoscopic robotic mitral valve repair (rMVr) with left atrial CryoMAZE procedure.

Surgical techniques

Preparation

The patient was intubated with a dual-lumen endotracheal tube and placed in the supine position with the right chest bumped up fifteen degrees. His neck, chest, abdomen and pelvis were prepped and draped in typical sterile fashion with both groins exposed.

Exposition

Five 8-mm robotic ports were placed in the right lateral chest wall including a camera port in the 4/5 intercostal space just anterior to the anterior axillary line; robotic left arm, right arm and atrial retractor ports; and an air seal working port (through which standard, long-shafted instruments were employed by the bedside assistant). Three 14-gauge angiocatheters were placed through the right lateral chest wall to facilitate pericardial retraction suture exteriorization, and a 12 French (Fr) peel-away sheath was used to place a cardiac sump drain into the right pleural space via the Seldinger technique.

Operation

Cannulation for cardiopulmonary bypass (CPB) began with percutaneous access of the right femoral vein and artery, each pre-closed with two ProGlide™ devices (Abbott Laboratories, Chicago, IL, USA). CPB was established with a 28-Fr femoral venous cannula with the tip in the superior vena cava (SVC) and a 23-Fr EndoReturn femoral arterial cannula (Edwards Lifesciences, Irving, CA, USA). The endoballoon was placed through the arterial cannula side port into the ascending aorta, and the SVC was cannulated via the right internal jugular vein with a 21-Fr drainage catheter connected to the venous side of the bypass circuit.

A GORE-TEX® CV-2 (Gore Medical, Newark, DE, USA) figure of eight suture was placed through the tendon of the right hemidiaphragm to minimize diaphragmatic injury and improve exposure. Cryoablation of the right chest intercostal nerves was performed from T3 to T9 (5 cm lateral to the spine, for one minute at –60 ℃) using a cryoSPHERE™ probe (AtriCure, Mason, OH, USA) inserted through the working port.

The pericardium was opened, and two pericardial retraction sutures were placed and exteriorized through the previously placed 14-gauge angiocatheters using a 0-silk loop. The heart was arrested with the endoballoon using TEE guidance and fluorescence imaging. A left atriotomy

was performed in Waterson's groove, and a patent foramen ovale was closed with a 3-0 V-Loc™ nonabsorbable suture (Medtronic, Minneapolis, MN, USA). A complete left atrial CryoMAZE was performed including an encircling lesion around all the pulmonary veins in the posterior atrium at –60 ℃ for two minutes. A retraction suture was placed in the posterior left atrium just above the P2/3 segment of the mitral valve to the pericardium. The left atrial appendage was closed with a double-layer 3-0 V-Loc™ nonabsorbable suture.

Static testing revealed prominent prolapse of a long P2 segment and a short P3 segment. Three sets of neochords were placed: one from the anterolateral papillary muscle to the left-sided P2, another from the right posteromedial papillary muscle to the right-sided P3, and the third from the right papillary muscle to P3/P2. Each neochord was dynamically adjusted under static testing and tied with ten knots. A 38-mm flexible band was placed in the annulus with two 3-0 V-Loc™ nonabsorbable sutures in a running mattress fashion, commencing at the trigones and meeting in the middle of P2, where they were secured to the band. The posterior annulus was further reinforced with an everting pledgeted 2-0 Ethibond Excel® suture (Johnson & Johnson, New Brunswick, NJ, USA) secured to the annuloplasty ring with a Cor-Knot® device (LSI Solutions, Victor, NY, USA). The left atrium was closed with two 3-0 V-Loc™ nonabsorbable sutures.

After endoballoon deflation, a right ventricular pacing wire was placed and exteriorized through the left atrial retraction port. The pericardium was loosely reapproximated with a 3-0 V-Loc™ nonabsorbable suture.

Completion

A Bentson wire (Cook Medical, Bloomington, IN, USA) was placed across the arterial cannula, and the two arterial ProGlide™ devices were tightened. The arterial cannula was removed, and an 8-Fr Angio-Seal™ (Terumo Medical Corporation, Tokyo, Japan) was used to ensure hemostasis. The venous cannula was removed, and the two venous ProGlide™ devices were tightened. The SVC cannula was removed, and a percutaneous purse-string suture was tightened around the insertion site with a Rumel. This suture was removed around twenty minutes after placement. The port sites were closed. The patient's postoperative course was uncomplicated, and he was discharged on postoperative day three.

Comments

Advantages

Our totally endoscopic approach offers multiple advantages. In addition to cryoablation, avoiding rib spreading reduces postoperative pain, a key consideration to decrease postoperative narcotic requirements. Percutaneous femoral cannulation for CPB provides multiple advantages over open cutdown including reduced postoperative groin complications and decreased length of stay (1). The use of barbed, nonabsorbable suture eliminates knot tying, increasing efficiency within the limited working space.

Caveats

The main caveat to totally endoscopic rMVr is the need for specialized robotic equipment and personnel. Additionally, individual patient anatomy may preclude the use of the robotic platform, as robotic instruments are best maneuvered in patients with deep chest cavities and long aortic roots (2). As such, initial experience with the approach should be limited to patients with favorable anatomy for robotic instrumentation and percutaneous femoral cannulation (i.e., large chest cavities and femoral vessels greater than seven cm in diameter bilaterally), while patients requiring more complex considerations (e.g., grade V atheroma of the abdominal aorta necessitating axillary cannulation) can be treated as experience with the technique increases (3).

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Footnote

Conflicts of Interest: Dr. Guy is a consultant for Edwards Lifesciences, Medtronic, and a case observation site and proctor for Intuitive Surgical. The other authors have no conflicts of interest to declare.

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