Minimally Invasive Valve Surgery With Bypass to the Right Coronary Artery

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Abstract: Herein, we report the case of a 60-year-old woman who presented with increasing dyspnea on exertion. Echocardiography revealed significant aortic and mitral regurgitation, which were most likely secondary to previous radiation therapy for breast cancer. On cardiac catheterization a 90% ostial right coronary artery lesion was found and treated with a drug-eluting stent. During minimally invasive valve surgery, via a right anterior thoracotomy, it was noted that the stent had restenosed. Therefore, the right coronary artery was bypassed with a segment of venous graft through the same incision.

Key Words: Minimally invasive, Coronary artery bypass grafting, Right coronary artery, Valve surgery, Right thoracotomy.

CASE REPORT

A 60-year-old woman was referred to our institution with complaints of exertional angina, dyspnea on exertion, and pedal edema that had worsened during the past 4 months. She was in New York Heart Association functional class III. Her medical history was significant for carcinoma of the right breast, treated with a lumpectomy, chemotherapy, and radiation, and she was currently in remission. She had hypertension that was well controlled with medication.

Her cardiac workup included a transthoracic echocardiogram that demonstrated severe aortic valve regurgitation and moderate to severe mitral regurgitation, with a preserved left ventricular systolic function. Both valves were heavily calcified, suggesting that the underlying pathology may be radiation-induced valvulopathy. A cardiac catheterization performed 3 months prior demonstrated a 90% ostial lesion of the right coronary artery (RCA) (Fig. 1), which was treated with the placement of a drug-eluting stent. The RCA lesion was also felt to be due to the radiation therapy. Because of the symptoms of shortness of breath, the patient was planned for minimally invasive aortic and mitral replacement. She was medically optimized before her surgery.

OPERATIVE TECHNIQUE

The patient was placed in the supine position after induction of general anesthesia. An intraoperative transesophageal echocardiogram performed revealed severe aortic insufficiency and significant mitral regurgitation. The left femoral artery and vein were exposed, and the Seldinger technique was used to cannulate each vessel for cardiopulmonary bypass. Thereafter, a 6- to 7-cm skin incision was made on the right side of the anterolateral chest wall at the third or fourth space. The lower costochondral cartilage was dislocated (Fig. 2). A soft tissue retractor was placed and the pericardium was opened over the aorta and tacked to the skin. Thereafter, a retrograde cardioplegia cannula was inserted through the right atrial appendage. Full cardiopulmonary bypass was instituted, and the aorta was cross-clamped. Cold blood cardioplegia was given in both antegrade and retrograde fashion until adequate electromechanical arrest of the heart was obtained. The minimally invasive valve surgery was performed using specially designed long-shafted minimally invasive instruments (Geister, Tuttlingen, Germany). A left lateral atriotomy was performed exposing the mitral valve, which showed significant thickening and calcification of both the anterior and posterior leaflets, consistent with radiation-induced valvulopathy. The anterior leaflet was resected, and 2-0 Tevdek pledgeted sutures (Teleflex Medical OEM, Gurnee, IL USA) were placed circumferentially around the annulus. The mitral valve was replaced with a 27-mm Mosaic porcine
mitral valve (Medtronic, Minneapolis, MN USA). The left atrium was closed with a 4-0 Prolene (Ethicon, Somerville, NJ USA) suture in a two-layer closure. A vent was placed in the left atrium. A transverse aortotomy was performed, and the aortic valve leaflets appeared thickened and curled, causing the aortic insufficiency. The leaflets were resected down to the annulus. In an attempt to give cardioplegia via the right coronary ostia, it was noted that the ostium of the RCA had restenosed. A decision was then made to bypass the RCA. A segment of the greater saphenous vein from the right lower extremity was harvested. To perform the coronary anastomosis, we use the minimally invasive instruments that we would typically use for a minimally invasive direct coronary artery bypass. These include long-shafted coronary instruments and a long Castroviejo needle holder (Fine Science Tools, Inc, North Vancouver, BC Canada). With stay sutures appropriately placed on the pericardium, and the heart decompressed, the crux of the RCA is readily accessible. The distal posterior descending artery or the posterolateral artery cannot be accessed via this approach. Silk sutures are placed on either side of the RCA or the proximal posterior descending artery. This allows exposure of the vessel. Occasionally, a sponge stick is used to provide further retraction. An off-pump stabilizing device with suction has also been applied in certain cases for exposure, although this has not proven to be more beneficial than the retraction sutures. It is important to start suturing the anastomosis from the toe and proceed around to the heel. This will allow visibility of the entire suture line. The distal RCA was identified, and an arteriotomy was made with the anastomoses performed proximal to the crux in an end-to-side fashion using a 7-0 Prolene suture. Cardioplegia was then given through the right vein graft throughout the operation. The aortic cross-clamp was removed, and a needle was placed in the root of the aorta to aid in the removal of air. After confirmation of the removal of air and adequate function of both valves by transesophageal echocardiography, a ventricular pacing wire was placed, and cardiopulmonary bypass was discontinued. The venous cannula and the arterial cannula were removed, and direct repair of the left femoral artery was performed. A right-angle chest tube was left in the pleural space; and a Blake chest tube (Ethicon, Inc, Somerville, NJ USA), in the pericardial space. The rib was reattached back to the sternum with a fiber wire. The thoracotomy incision was closed in the routine fashion. The patient tolerated the procedure well, and no complications were encountered.

**HOSPITAL COURSE**

The patient did well postoperatively and was extubated 12 hours after surgery. She was transferred out of the intensive care unit on postoperative day 1 and discharged home on post-operative day 4. At 6-months follow-up, she is free of symptoms.

**DISCUSSION**

Combined surgical procedures have to be envisaged as logical future steps in minimally invasive cardiac surgery. A right anterior minithoracotomy incision provides excellent exposure of the aorta and the RCA.

In 1997, Benetti et al1 first described the right anterolateral minithoracotomy approach for the replacement of the aortic valve. Subsequently, it has been demonstrated that this technique may be superior to aortic valve replacement performed via the standard median sternotomy approach.2-6 The advantages of a minimally invasive approach include reduced pain, less bleeding, earlier functional recovery, shorter hospital length of stay, lower morbidity, and a reduction in mortality in high-risk patients such as the elderly and obese patients.

Historically, one of the exclusion criteria for minimally invasive aortic valve replacement is the presence of significant coronary artery disease.7 An option for patients with coronary artery and valvular disease is performance of a staged procedure in which percutaneous cardiac intervention is done on the coronary artery lesions and is followed by minimally invasive valve surgery. This “hybrid” approach is associated with a reduction in blood product use, lower morbidity, and shorter intensive care unit and hospital lengths of stay when compared with a standard median sternotomy.8

We report a case of minimally invasive valve replacements combined with an isolated RCA bypass performed via a right anterior thoracotomy. This was technically feasible and did not alter the postsurgical course for the patient. In a select group of patients, who are not candidates for a hybrid procedure, this approach provides an alternative to conventional median sternotomy.

**REFERENCES**


