Masters of Cardiothoracic Surgery

Valve-sparing aortic root replacement after previous Ross procedure: two different surgical strategies

Gamal M. Marey[1], Mina Estafanos[2], Khaled F. Salhab[3], Sameh M. Said[4,5]^

[1]Department of Cardiothoracic Surgery, Kansas Medical Center, Andover, KS, USA; [2]University of Minnesota, Minneapolis, MN, USA; [3]Department of Cardiothoracic Surgery, New York University Langone, Long Island, New York, USA; [4]Division of Pediatric and Adult Congenital Cardiac Surgery, Maria Fareri Children's Hospital, Westchester Medical Center, Valhalla, New York, USA; [5]Faculty of Medicine, Alexandria University, Alexandria, Egypt

Correspondence to: Sameh M. Said, MBBCh, MD, FACC, FACS. Chief, Division of Pediatric and Adult Congenital Cardiac Surgery, Maria Fareri Children's Hospital, Westchester Medical Center, C2235, 100 Woods Road, Valhalla, New York, USA; Lecturer of Cardiothoracic Surgery, Faculty of Medicine, Alexandria University, Alexandria, Egypt. Email: sameh.said@wmchealth.org.

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Clinical vignette

Case I

A 22-year-old male born with congenital aortic valve (AV) stenosis underwent an open aortic valvuloplasty at 3-week of age, followed by Ross procedure at age fifteen. Comorbidities include obesity, and heterozygous prothrombin gene mutation. He developed progressive autograft dilation and severe right ventricular outflow tract (RVOT) obstruction secondary to calcified pulmonary homograft.

Preoperative evaluation showed severely dilated autograft sinuses (5 cm), trivial neo-AV regurgitation, and calcified pulmonary homograft.

We advised repeat operation with valve-sparing aortic root replacement and re-replacement of the pulmonary homograft.

Case II

A 30-year-old woman born with congenital AV stenosis underwent previous transcatheter balloon aortic valvuloplasty and subsequent Ross procedure. She presented with progressive aneurysmal dilation of the neo-aortic root (pulmonary autograft) and severe RVOT obstruction.

Preoperative work-up showed dilated autograft, trivial-to-mild neo-AV regurgitation and calcified pulmonary homograft.

We advised repeat sternotomy with valve-sparing aortic root replacement and replacement of the pulmonary homograft.

Surgical techniques

Preparation

The procedure is performed in the supine position through repeat median sternotomy. Heparin is administered systemically, and the distal ascending aorta is cannulated, as well as both venae cavae. Once activated clotting time is satisfactory, cardiopulmonary bypass (CPB) is initiated and myocardial protection is achieved using antegrade del Nido cardioplegia.

Exposition

Before commencing CPB, we perform the initial dissection to expose the ascending aorta, the aortic root and the previous homograft. In these two cases, the pulmonary

^ ORCID: 0000-0003-2193-0314.

homograft was calcified and challenging to separate from the aorta.

After initiating CPB, we continue our dissection, separating the ascending aorta from the right pulmonary artery, and mobilize the aortic root.

Operation

The pulmonary homograft is transected, and the pulmonary artery bifurcation is mobilized. This can be done first, or after cardioplegic arrest as in Case I. The distal ascending aorta is further mobilized.

The pulmonary autograft is dissected, and the dilated sinuses of Valsalva are resected. The left, then right coronary artery buttons are excised and mobilized.

The pulmonary homograft is then resected, and the autograft root is prepared by dissecting the autograft to the left ventricular-aortic junction.

To determine the size of the future graft needed for the implantation of the autograft valve, the graft size can be determined based on the height of the left/non-coronary commissures of the autograft (1), or by adding 5–6 mm to the diameter of the sinotubular junction at which the valve competence is maintained.

We then create the first suture line by placement of a total of six subannular sutures using 2/0 pledgeted Ethibond sutures that are placed in a horizontal mattress fashion.

Case I (David V)

In the first case, we used two grafts. The first graft (30 mm) was modified by creating three pseudosinuses using multiple 4/0 polypropylene sutures at the base and the bottom of the graft. The graft was secured using the first suture line. The autograft valve was then suspended by the commissural sutures to the graft. The second suture line (hemostatic line) was then created by using three running 4/0 prolene sutures.

The left coronary button was then implanted into the graft, followed by reconstruction of the distal pulmonary homograft (30 mm) anastomosis to the pulmonary bifurcation due to the anticipated difficulty in exposing the bifurcation if aortic reconstruction is completed first.

A second graft (26 mm) was then used to complete the aortic reconstruction. This was followed by implantation of the right coronary button.

The heart was deaired and the aortic cross clamp removed, followed by completion of the RVOT reconstruction.

Case II (David VI)

In this case, we used a 26 mm Valsalva graft, which was secured, and the autograft valve implanted similar to Case I.

The left coronary artery button was then implanted, followed by completion of the distal aortic anastomosis. The right coronary artery was then implanted, followed by removal of the aortic cross clamp.

The reconstruction of the RVOT was done using a bioprosthetic valved conduit (25 mm Inspiris Resilia®, Edwards Lifesciences, Irvine, CA, USA).

Completion

The patient is ventilated and weaned off CPB on low inotropic support and once transesophageal echocardiogram is satisfactory, the patient is decannulated, and the rest of the procedure is completed in the standard fashion.

Comments

Clinical results

Case I

The patient was extubated in the operating room, required inotropic support for a few days and recovered from acute kidney injury prior to discharge. Follow-up echocardiogram and computed tomographic angiography showed widely patent RVOT, trivial autograft valve regurgitation and good biventricular function.

Case II

The postoperative course was uneventful, and the patient was discharged seven days later. Follow-up echocardiogram and CTA were satisfactory.

Advantages

Valve-sparing aortic root replacement continues to be a safe and useful strategy to manage dilated autografts after previous Ross (2). This provides the patient with excellent quality of life and avoids complications related to long-term anticoagulation if mechanical prosthesis is used.

We tend to address both aortic and pulmonary roots for any patient requiring repeat operation after Ross whether the indication is a dilated autograft or failed pulmonary homograft. This has the potential to give the longest freedom from catheter-based intervention or repeat operations.

The use of Valsalva graft facilitates the root implantation procedure and can be performed with satisfactory perioperative and long-term results.

Caveats

Repeat operation of the aortic root or RVOT can be faced with challenges as demonstrated. A calcified homograft can be adherent to the autograft and may need to be resected as a one with the adherent autograft sinus wall to minimize the risk of injuring the autograft valve.

Determining the size of the graft that will be used for implantation of the autograft can be done using different strategies, and it may be better to use more than one in these cases to make the final decision.

Multiple options exist for reconstruction of the RVOT in these settings, and we demonstrated two different strategies in the current cases—pulmonary homograft (Case I) and bioprosthetic valved conduit (Case II). We believe both options are equivocal in adults and provide an excellent long-term freedom from reoperation in the pulmonary position.

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Footnote

Conflicts of Interest: The author SMS is a consultant to Abbott, Stryker, and Artivion. The other authors have no conflicts of interest to declare.

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