Mechanical Aortic Valve-on-Valve Replacement in Previous Bentall Procedure: An Alternate Technique

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Acute aortic valve regurgitation due to thrombosed prosthetic valve can present as a surgical emergency. This article reports a successful and unusual management of a young pregnant female patient who presented with acute aortic valve regurgitation due to a thrombosed mechanical aortic valve. As the patient had previous multiple cardiac surgeries, the options were limited for repeat aortic valve or aortic root replacement. The patient had caesarean section followed by implantation of a mechanical valve-on-valve in a previously placed composite valved conduit. This technique may be useful for reoperative valve replacement in the setting of a prior mechanical Bentall patient.

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Previous cardiac surgeries can pose as an independent risk factor in any repeat cardiac procedure. Although there are reports of transcatheter valve implantation of aortic valve-in-valve in aortic as well as mitral valve position, a surgical valve-on-valve in either of the positions has never been attempted. We describe a case of repeat sternotomy and aortic valve replacement in a young pregnant female, who, in her third trimester, presented with severe aortic valve incompetence due to valve thrombosis.

Technique
A 25-year-old pregnant female with a complex history of congenital heart disease presented with severe shortness of breath. She was originally diagnosed with congenital aortic valve stenosis and initially underwent balloon dilatation of the aortic valve at the age of 6 years. This was followed by a Ross procedure (free-standing root) at the age of 9 years. In 2007, she had a successful pregnancy but later was found to have severe pulmonary regurgitation and autograft and ascending aortic dilatation. At the adult congenital heart disease (ACHD) multidisciplinary team meeting, there were detailed discussions regarding each procedure and then with the patient regarding completion of her family, highlighting the risks of warfarin prior to the double root replacement. She underwent a repeat sternotomy and a double root replacement with a composite mechanical aortic valve and tissue pulmonary valve prosthesis. She was commenced on long-term warfarin in 2010. However, in 2011 she became pregnant again. Warfarin was stopped and therapeutic doses of low molecular weight heparin were commenced. She was closely monitored by the hematologist, obstetricians, and the obstetric congenital cardiologist. At 31 weeks of pregnancy, she presented with severe breathlessness. A transthoracic echocardiogram was performed that revealed severe aortic incompetence due to thrombosis of her mechanical aortic valve, which had 1 of its leaflets stuck partially in an open position. This was also confirmed with a computed tomograph (CT) (Fig 1A). She was initially stabilized with diuretics. After discussion in the ACHD meeting along with the input of the obstetricians, she underwent caesarean section with full backup of the cardiac surgical team followed by repeat cardiac surgery 2 days later.

As a result of her previous multiple sternotomies, the heart was densely adherent within the mediastinum but it was dissected and cardiopulmonary bypass was instituted uneventfully. The prosthetic valve, which was part of a composite aortic root, had 1of its leaflets stuck partially in an open position due to thrombus at its hinge (Fig 1A). Attempts to clear the thrombus resulted in breaking the leaflet. We evaluated the risks of re-replacement of the aortic root which could have also included re-doing the pulmonary root, which was practically very challenging. We hence removed the remaining valve leaflet and measured the distance between the previous valve ring and the position of the coronary ostia (13 mm) to the height of the new valve to be implanted (6.6 mm). Once the height was confirmed to be satisfactory, a size 21-mm Carbomedics Top Hat valve (Sulzer, Carbomedics, Austin, TX) was implanted systemically. This included nonpledgeted horizontal mattress sutures in an interrupted fashion. The sutures were placed between the tube graft just above the previous ring and the sewing ring of the new valve (Fig 1B). Due to the design of the supraannular valve ring, there was at least a distance of 6 mm between the coronary ostia and the new sewing
ring (Fig 1B). Special attention was paid in protecting the coronary ostia from the new valve ring. Once implanted, we made sure that there was no obstruction to the coronary buttons (Fig 1C). The patient came off cardiopulmonary bypass smoothly and on-table transesophageal echocardiogram demonstrated free movements of the bileaflets with no obvious obstruction to the coronary flow. The patient made a steady recovery and was discharged home once the anticoagulation of the mother was therapeutic. A gated CT done 1-year later demonstrated a well-seated valve with no restriction of the movements of the leaflets and no paravalvular leak (Fig 2A). A volume-rendered image of the CT showed the coronary ostia to be well protected from the valve rings (Figs 2B–2D).

Comment

Our report highlights an alternate technique used due to very limited options in such a challenging situation. Our patient had multiple sternotomies, hence it would have been difficult to perform the valve replacement before caesarian section due to dense adhesions. Korkmaz and colleagues [1] and Bonow and colleagues [2] suggest that the initiation of cardiopulmonary bypass before or after the delivery of the baby depends upon the hemodynamic stability of the patient.

Once the cardiopulmonary bypass was instituted safely, an aortic root re-replacement was felt to be too risky due to the dense adhesions. It also meant that the patient would have to undergo a pulmonary root re-replacement as the patient had previous pulmonary root replacement and percutaneous pulmonary valve implantation at a later stage. Any aggressive approach in the aortic root would mean extensive mobilization and disturbing the pulmonary valve. Here we used the Top Hat valve, as the orifice-to-annulus ratio of the valve for a small aortic root was felt appropriate. The improved hemodynamic parameters of the Top Hat valve for small aortic root assessed by echocardiography have been reported [3, 4]. It appeared that without the prosthetic leaflets, there was enough valve orifice and the coronary buttons were fortunately at a reasonable height to the previous sewing ring. Hence, this practical approach was felt worthwhile considering. As there was already the ring of previous valve embedded, special attention had to be paid to protect the coronary blood flow from multiple stacked valve rings. The interrupted sutures were used here in anticipation of removal of 1 or more sutures had it obstructed the coronary flow. There was at least a distance of 6 mm between the coronary ostia and the new leaflets.

Fig 1. (A) Axial nongated computed tomograph demonstrating the thrombus which kept the leaflet open (red arrow) at the hinge of aortic valve. (B, C) Sketch (drawn by Harry Hayes) to demonstrate the new valve replacement, above the previous ring as close as possible and above the left coronary button. (LCA = left coronary artery; RCA = right coronary artery.)

Fig 2. Sagittal view of gated computed tomograph showing the left main stem to be above (A) the new valve and (B) opening of the new aortic valve without any obstruction. (C) Coronal view of gated computed tomograph, demonstrating the rings of 2 aortic valves, on top of each other and pulmonary valve. (D) Volume-rendered three-dimensional image of the heart with great vessels demonstrating the new valve seated nicely above the old aortic valve and the right coronary artery well above the new valve.
sewing ring. However, there are reports of left coronary obstruction after Top Hat valve implantation in a small aortic root [5]. We were also fortunate that during the original aortic root replacement the coronaries especially the left was buttoned at a distance from the valve. We hope that in the near future the guidelines will be reflective of these important issues.

References