Management of the Aortic Root in Type A aortic Dissection: A Valve Sparing Approach

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Abstract

Background: Type A acute aortic dissection (TAAAD) is rapidly fatal without emergency surgical. Surgical outcomes have improved over the years with improvements in technique and postoperative care. Classically, supracomissural aortic replacement has been the standard of care. However, reintervention rates, particularly on the aortic root, in certain groups of patients shifted the focus towards improving long terms results of surgical repair. With regard to the aortic root, root replacement has been the gold standard. However, the surgical community realised that valve replacement in itself is a disease, and valve sparing aortic root replacement (VSRR) took centre stage in the care of these patients. Methods: We search the Pubmed and EMBASE for articles related to VSRR, composite valve conduit root (CVC) replacement, and the long terms results of both in TAAAD. Results: Supracomissural repair is limited by reintervention and CVC results are affected by complications related to the prosthetic valve. Conversely, VSRR is associated with good short-term outcomes, improvement in quality of life, and it is durable. Conclusion: VSRR is a sound technique in TAAAD in experienced hands.

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Short running title: Sparing the valve in TAAAD

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Methods:

We search the Pubmed and EMBASE for articles related to VSRR, composite valve conduit root (CVC) replacement, and the long terms results of both in TAAAD.

Results:

Supracomissural repair is limited by reintervention and CVC results are affected by complications related to the prosthetic valve. Conversely, VSRR is associated with good short-term outcomes, improvement in quality of life, and it is durable.

Conclusion:

VSRR is a sound technique in TAAAD in experienced hands**.**

Introduction:

Bentall and De Bono described aortic root replacement with a composite valve conduit in their seminal paper in 1968[(1).] The Bentall procedure underwent several modifications over the following decades and remained the standard of care for addressing aortic root aneurysms[(2, 3)]. However, it was realized that there was a subset of patients with aortic root pathology confined only to the aortic sinuses with normal aortic cusp anatomy and valve function; in this cohort of patients it is conceivable that addressing the aortic wall pathology while preserving the native valve function would be advantageous. Based on this observation Sir Magdi introduced the remodelling procedure, replacing the sinuses of valsava while preserving the valve leaflets[(4)]. Subsequently, the reimplantation procedure was developed to address the limitation of the remodelling technique in stabilising the aortic annulus[(5, 6)].

In Type A aortic dissection, the aortic valve cusps are often normal which makes the application valve conserving techniques to patients with Type A Acute Aortic Dissection very appealing (TAAAD)[(7)]. The enthusiasm for valve sparing root replacement (VSRR) is driven by reoperation rates following supracomissural aortic replacement in TAAAD being as high as 44% in young patients; conversely, in the same cohort of patients who had root aortic root replacement the freedom from root reintervention was 100% at 7 years; furthermore, replacement of the aortic valve with prosthesis is associated with risks related to anticoagulation for mechanical valves and structural valve degeneration of bioprostheses[(8, 9)].

In this paper we discuss -in patients with TAAAD- when should the root be replaced, selecting the right patients for VSRR, techniques of VSRR, lessons learnt from our experience at Emory, and outcomes of VSRR in patients with TAAAD.

When should the root be replaced in TAAAD?

It is clear that replacement of the aortic root should be performed if the aortic root is aneurysmal or extensively destroyed in patients with TAAAD[10]. It has been realized that the classic teaching of supracomissural repair (SCR) for all patients is inappropriate due to the documented increase in reoperation rates[11]. However, the decrease in reoperation rate observed following root replacement is associated with an increase in cardiopulmonary bypass (CPB) time[11]. Furthermore, it is well documented that the increase in CPB time is associated with a pronounced increase in mortality and morbidity[12, 13]. Therefore, multiple investigators studied the risk factors for reoperation following limited repair in TAAAD to identify a cohort of patients that would benefit the most from extensive root repair[14]. While the data is mostly retrospective and single institution, the risk factors identified for reoperations on the aortic root following SCR include: dilated aortic annulus > 27 mm, the use of glue, Age <60, Marfan syndrome, the number of sinuses involved, [11, 14-17]. At Emory, our policy is to replace the aortic root if the aortic root diameter is >4.5 cm, the tear is located in the root, in young patients, and patients suspected to have connective tissue disease. We do not perform root replacement in patients with evidence of malperfusion or clinically unstable patients. We believe that a shorter CPB time is of paramount importance in TAAAD patients who have complex clinical presentation.

Bentall or VSRR in patients with TAAAD?

When deciding if the aortic valve replacement is warranted as well as the appropriate type of prosthesis, there are several clinical variables which should be considered. The decision should be a shared process between the surgeon and the patient, and it is unfortunate that the emergency nature of the disease doesn't allow for an informative heart team discussion [18]. Mechanical prostheses are associated with 10% risk of major haemorrhage secondary to anticoagulation at 10 years, freedom from valve dysfunction was 91% at with a modest 80% freedom from valve dysfunction at 10 years; furthermore, the long –term survival of young patients following mechanical valve replacement was poor in comparison with a healthy cohort of contemporaries[19]. Biological valve replacement comes with a lower risk of thromboembolism and major bleeding; however, the freedom from reintervention or death is as high as 40% at 10 years[20]. It is therefore reasonable to conclude that prosthetic valve replacement in itself is a disease that carries the risk of complications and death. In aortic root disease, the prosthetic valve component is a major drawback and should be avoided if possible, particularly in the young. In aortic root replacement, Salsami et.al meta-analysis reported a lower operative mortality, better 5-year survival, lower thromboembolic events in favour for VSRR in comparison with Bentall; however and increase in reoperation rate was noted (OR1.3, 95% CI 0.72-2.33)[21].

Which patients should have VSRRR?

While the advantages of VSRRR are evident, it is a more complex operation requiring a longer cardiopulmonary bypass and ischaemic times[22]. Therefore, patients should be carefully selected for a successful outcome. It is critical to consider the presentation of the patient in the decision-making. Aubin et.al used the reimplantation procedure preferentially in patients with TAAAD, unless the patient is critically ill [23].In general, if a root replacement be indicated and a patient is haemodynamically unstable patients or has malperfusion, VSRR should not be performed. We also consider the patient's age and co-morbidities, while there is no age cut-off, the mean age in our series was 46 years of age and the mean age in other series was not much different [24, 25] .

Transesophageal echocardiography should be carefully studied in the operating room for valve morphology, AI degree, AI jet direction, cusp prolapse, annular diameter together with concomitant valvular pathologies[26].

How to perform VSRRR in patients with TAAAD?

There are several options for VSRRR in TAAAD including remodelling, remodelling with subannular ring, and reimplantation Some of the technical aspects of the operation are shared among the three alternatives with the differences being primarily in how the root is reconstructed. In the remodelling procedure the graft is fashioned into three tongues that are sutured to the remnants of the aortic root with subannular stabilisation that can be added with a external ring annuloplasty. In the reimplantation procedure the remnant tissue of the native aortic root and the valve are telescoped inside the graft with subannular anchoring of the graft.

In general cardiopulmonary bypass (CPB) is established, in our institution was use the axillary artery and the right atrium. At target temperature, circulatory arrest is established and the arch is reconstructed with an aggressive hemiarch replacement unless the arch is >4.5 cm in diameter. Following arch reconstruction, attention is paid to the aortic root and an initial inspection of the valve is carried out. If there is obvious degeneration or abnormalities that preclude VSRRR then valve preservation is abandoned. Otherwise the aortic sinuses are excised leaving 4-5 mm of root tissue. The commissures are suspended using 4/0 Polypropylene sutures that are put under radial tension. Subsequently the valve is inspected carefully for fenestration, evidence of prolapse, degeneration, or cup retraction. We measure the three cusps from the nadir to the centre of the free margin and the formula $2*[H_{cusp}*2/3]+8$ to 10 is used to choose the graft size. The root is subsequently dissected to the nadir of the cusps with the anatomical limitation in mind. Six 2/0 Polyester sutures are placed in the subannular plane at the commissures and the nadir of each cusp, except at the non-coronary/right coronary cup commissure where the suture is placed externally. The valve is telescoped inside the graft and the graft is anchored to the 2-0 Polyester sutures, which are then secured. We visually determine optimal height of commissural implantation based on the appearance of the valve, water-test and suction test on the cusps. Once the optimal commissural height is determined the aortic root rim is sutured to the inside of the graft starting at the nadir using 5/0 Polypropylene sutures. Afterward, we assess the valve and determine if any leaflet repair is required. Prolapse is corrected either by adjustment of the commissural height or central plication of the leaflets. If the repair is deemed satisfactory the aortic root prosthesis is sutures to the distal Dacron graft and the operation is conducted as usual. We give cardioplegia into the root and assess for evidence of regurgitation by means of manual root pressure and volume returned through the right superior pulmonary vein vent prior to releasing the aortic cross clamp. TEE is evaluated for evidence of AI after releasing the cross clamp prior to discontinuing CPB.

TEE is evaluated after weaning from CPB for evidence of AI. If AI is detected the AI jet degree, direction, cusps motions and gradient across the valve are assessed to determined if re-clamping is needed and plan additional repair of the cusps. Our strategy is to re-clamp if there is evidence of more than 1+ AI.

What are the results of VSRRR in TAAAD?

We reported our institutional series of 43 patients who had reimplantation for TAAAD. The mean age was 46 years-of-age, > 50% of the patients had 3+AI, 9% had EF [?] 35%, and 90% had concomitant hemiarch repair. Our perioperative mortality was 5% with renal failure requiring dialysis and a similar stroke rate. Freedom from 2+AI was 94% and none of the patients required aortic valve replacement during follow-up. Our selection criteria outlines earlier translated in performing VSRR in approximately 10% of patients presenting with TAAAD; which highlights the importance of patients' selection[(25)]. Seiver's group performed VSRR in over a third of patients referred with TAAAD. In their series of 20 over 6 years, 11 patients had remodelling and 9 had reimplantation. The mortality was 10% with no reoperations[(27)].

In a study by Wayne State University group of VSRR in 135 patients with TAAAD; the mortality was 9.5% for the cohort with reoperations in 0% and 2% in the VSRR and Bentall respectively. The long-term survival was better in the VSRR group, which may be explained by the fact that the VSRR group was younger. The important finding of their study that with appropriate patient selection VSRR can be performed safely in patients with TAAAD[(22)]. A propensity-matched study of VSRRR Vs Bentall by our group demonstrated an improved long-term survival in patients treated with VRRR(28). Hannover group reported a mortality of 11% in patients with TAAAD following VSRR, with a freedom from reoperation of 85% at 10 years[(24)].

It is likely that a selection bias in patients who had VSRRR exists together with reporting bias of experienced centres results in the literature. However, it is no unreasonable to conclude that in selected patients VSRRR has favourable outcome in comparison with composite valve conduit aortic root replacement.

Conclusion:

VSRR in selected patients presenting with TAAAD is safe and has reproducible and durable results in experienced centers.

Author's contribution:

Eltayeb Mohamed Ahmed prepared the manuscript, and revised the final manuscript.

Edward P Chen prepared the manuscript and revised final manuscript

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