Symmetric Tricuspidization of a Regurgitant Quadricuspid Truncal Valve: A Versatile Adaptation for Aortic Valve Repair

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Glossary of Abbreviations:

LCA: left coronary artery

LV: left ventricle

TV: truncal valve

Central Picture

Central Picture Legend

Truncal valve tricuspidation with resection and single pericardial leaflet creation
Central Message

Quadricuspid truncal valve repair with deficient tissue may be addressed by pericardial leaflet to construct a symmetric trileaflet valve without altering the aortic root for future interventions.

Perspective Statement

Severely regurgitant truncal or aortic valves may be repaired in neonates and infants without altering the geometry of the aortic root by replacing deficient leaflet tissue with newly constructed pericardial leaflets to create a symmetric trileaflet valve with significant coaptation area that will persist despite aortic root growth

Keywords

quadricuspid truncal valve repair; tricuspidization; pericardial leaflet creation
Case Report

Introduction

Quadricuspid truncal valve (TV) repair for severe regurgitation is a surgical challenge with several proposed techniques\(^1\). The ideal operation should result in a competent and durable trileaflet TV with longitudinal growth potential. Cusp resection and annular reduction is one proposed technique advocated by some centers\(^2\),\(^3\). However, we have not adopted this technique due to concerns for asymmetric cusp creation, potential aortic root undersizing, and need for coronary artery relocation. Standardization of pericardial leaflet creation with Ozaki templates\(^4\) has reinvigorated interest in surgical valve repair. We present a case of rudimentary cusp resection and single leaflet implantation therapy creating symmetric tricuspidization of a regurgitant quadricuspid TV. The Institutional Review Board at our institution does not require review for isolated case reports that do not contain patient-specific protected health information.

Informed consent was obtained from the parents to publish this report.

Case Summary

Nine month 6.5 kilogram female with truncus arteriosus underwent neonatal surgical repair. At initial operation, a quadricuspid TV with severe regurgitation was found. Valve inspection demonstrated two dysplastic posterior leaflets with a shared commissure below the left coronary (LCA) os, and two remaining adequately sized leaflets. Temporizing valve repair was performed by side-to-side apposition of the two rudimentary leaflets with reduction of TV regurgitation from severe to moderate. As anticipated, after 9 months, her TV regurgitation worsened, with associated left ventricular (LV) dilation and mild dysfunction. Imaging revealed deficient
posterior leaflet tissue at the site of her prior valve repair with a large eccentric regurgitant jet (Figure 1). She was scheduled for more definitive TV repair.

After redo sternotomy, a large autologous pericardial patch was prepared in 0.6% glutaraldehyde solution for six minutes. After institution of cardiopulmonary bypass and cardioplegic arrest, examination of the quadricuspid TV demonstrated two small posterior leaflets with a shared commissure below the LCA joined side-to-side from her initial repair with a large area of non-coaptation. The remaining two anterior leaflets were adequate size. Valve repair began by shaving thickened tissue at the leading edge of the anterior leaflets. Due to the small size and dysplastic tissue, the posterior leaflets were deemed non-repairable and were excised (Figure 2A). To reconstruct a left coronary cusp, a single leaflet was constructed from glutaraldehyde-treated autologous pericardium. A #19 Ozaki sizer and template (Japanese Organization for Medical Device Development, Inc., Tokyo, Japan) was used to create a slightly oversized pericardial leaflet to ensure a large area of coaptation and accommodate future aortic root growth. The newly constructed leaflet was sutured to the aortic root with running technique with initial bites deep in the LV outflow tract to create a large sinus of Valsalva and prevent LCA occlusion (Figure 2B). Commisural height was tailored to match native leaflet commissures. The commissures were further reinforced with figure-of-eight commissuroplasty. The valve was tested and the aortotomy closed. The previously placed right ventricle-to-pulmonary artery conduit was replaced with a homograft due to moderate stenosis and regurgitation.

Cardiopulmonary bypass was successfully weaned with excellent hemodynamics. Transesophageal echocardiography demonstrated trivial TV regurgitation with a large area of leaflet coaptation (Figure 3). The newly constructed sinus of Valsalva was robust with unobstructed LCA flow. Postoperative course was unremarkable and she was discharged home.
on day six following surgery. At one year follow-up, the patient was asymptomatic, leading an active lifestyle with excellent growth. Transthoracic echocardiography demonstrated mild-to-moderate TV regurgitation with normal LV size and function.

Discussion

Severe regurgitation of a quadricuspid TV presents a difficult challenge to surgeons with limited repair options and no universally accepted technique. While valve competence is the major goal of any repair, durability and implications for future interventions must also be considered. We believe that the commonly cited technique of tricuspidization with cusp resection and annulus reduction does not result in a symmetric trileaflet valve and may distort the geometry of the aortic root complex. Moreover, in the series by Naimo et al\(^2\) one patient required subsequent annular enlargement due to resection of truncal root annulus during tailoring. To avoid these pitfalls, we prefer techniques that spare the aortic annulus and avoid coronary artery relocation, thereby preserving the aortic root for future interventions. Our novel approach for valve reconstruction in a quadricuspid TV with severe regurgitation respects widely held principles of valve repair. Replacing deficient leaflet tissue with autologous pericardial tissue creates a symmetric trileaflet valve with significant coaptation area that will persist despite aortic root growth. In addition, the size of autologous pericardium needed for single leaflet construction is limited, therefore it can be available despite the redo nature of most of these operations. Finally, replacing the TV with aortic homograft sets the child for lifelong root replacements, which should be avoided when possible in all young patients. As is the case with the Ozaki procedure in the growing child, the durability of our technique is unknown and may be potentially limited by patient growth and biologic tissue degeneration\(^5\). Although future interventions will most certainly be required, we believe that over-sizing the pericardial leaflet to create a large area of
coaptation will delay reoperation and position patients well for repeat valve surgery within the native aortic root.
References


Video Legend

Intraoperative video demonstrating key steps in surgical procedure.

Figure 1

Preoperative echocardiogram. (A) Short-axis view of quadricuspid truncal valve with dysplastic posterior leaflets joined side-to-side with large regurgitant orifice. (B) Color doppler with large eccentric regurgitant jet.
Figure 2

Illustration of operative technique. (A) Valve examination followed by excision of the small, dysplastic posterior leaflets below the os of the left coronary artery. (B) Newly constructed pericardial leaflet secured to the aortic root well below the attachment of the excised leaflets with a figure-of-eight commissuroplasty (inset).
Figure 3

Postoperative echocardiogram. (A) Long-axis view of truncal valve following repair with large area of leaflet coaptation, robust sinus of Valsalva, and unobstructed coronary flow (arrowhead). (B). Short-axis view demonstrating slightly oversized pericardial leaflet coapting native leaflets and obliterating the regurgitate orifice.