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Trans-Frame Aortic Regurgitation of New-Generation Aortic Bioprosthesis

Michael Timothy Simpson[1], Kasmir Ramo[2], Vinayak Bapat[3], Andrea Miltiades[2], Isaac George[1]

[1]Division of Cardiothoracic Surgery, New York-Presbyterian Hospital, Columbia University Medical Center, New York, USA
[2]Division of Cardiothoracic Anesthesia, New York-Presbyterian Hospital, Columbia University Irving Medical Center, New York, USA
[3]Division of Cardiothoracic Surgery, Abbott Northwestern Hospital, Minneapolis Heart Institute, Minneapolis, USA
Email: ig2006@cumc.columbia.edu

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Abstract

A widely used aortic valve bioprosthesis is susceptible to regurgitation between the sewing ring and the frame of the valve due to its relatively thin fabric coverage. In some cases this leak has been shown to resolve with administration of protamine, however, tension on this area from annular sutures placed in an asymmetric bicuspid valve annulus may exacerbate the defect.

Keywords

Aortic Valve Replacement, Bicuspid Aortic Valve, Paravalvular Leak

1. Introduction

Bioprosthetic valves have demonstrated excellent long term durability, but are susceptible to failure through structural valve degeneration (SVD) [1]. Several companies are investigating technologies that can counteract the mechanisms of SVD, such as the RESILIA tissue of the INSPIRIS valve (Edwards Life Sciences LLC, Irvine CA), which incorporates V-Fit design that may facilitate future valve-in-valve interventions [2]. Although similar to the Perimount Magna Ease frame, there are notable changes to the Inspiris valve design, including less fabric at the sewing ring commissure posts. Here we describe a case of aortic regurgitation located between the sewing ring and commissure post requiring valve removal.

2. Case Presentation

The patient is a 62-year-old woman with a history of bicuspid aortic valve (BAV), followed with serial echocardiograms. Prior to referral for surgical eval-

uation, she developed dyspnea on exertion and light-headedness. Transthoracic echocardiogram (TTE) showed BAV, Sievers type 0 with severe aortic stenosis and valve area of 0.6 cm^2. Given her low surgical risk and BAV she was referred for surgical aortic valve replacement; she chose a tissue bioprosthesis.

Intraoperative transesophageal echocardiography (TEE) confirmed the findings of the preoperative TTE however suggested Sievers type 1 BAV with fusion of the left and right coronary cusp leaflets. After median sternotomy, activated clotting time-guided heparinization was instituted and cardiopulmonary bypass was commenced via the ascending aorta and right atrium, with venting via the right superior pulmonary vein. The cross clamp was applied and one liter of Del Nido cardioplegia was infused via the aortic root. Upon opening the aorta, the leaflets and annulus were debrided of calcium. The annulus accommodated a size 23 Inspiris valve. Interrupted pledgeted mattress 2-0 braided sutures were placed around the annulus, conforming to the asymmetric commissures and raphe of the BAV. The sutures were equally distributed around the sewing ring; the valve was then parachuted into place and tied down.

After closure of the aorta and removal of the cross clamp, the heart regained normal sinus rhythm. TEE revealed an abnormal, horizontally-oriented regurgitant jet above the aortic annulus near the left-right stent frame commissure. The heart was re-arrested; upon inspection there was concern that the leak was occurring through the frame from a defect in the surrounding fabric just above the sewing ring at the commissure post. A pledgeted suture was placed. Upon removal of the cross clamp, TEE re-demonstrated persistence of the jet. The heart was arrested again and the valve was re-replaced. Now, annular sutures were placed symmetrically to distribute the sutures following the three posts of the prosthesis and corresponding to the natural scallop of the annulus, passed through a new 23 mm Inspiris valve, and tied down. TEE after cross clamp removal demonstrated no abnormal jets. Bypass was weaned, protamine was administered, the patient was decannulated, and the chest was closed in the standard fashion. The postoperative course was routine. TTE on the day of discharge showed no aortic insufficiency and a mean gradient of 8 millimeters of mercury across the valve.

3. Comment

Here we describe a case of aortic regurgitation after aortic valve replacement due to a fabric defect in a newer-generation bioprosthetic valve. We hypothesize this defect was revealed this patient with a congenital BAV when attempting to conform the prosthesis to the existing asymmetric annular geometry, leading to tension on the defect and allowing blood flow. In tricuspid aortic valves, the aortic annulus has 3-dimensional, crown-shaped structure with three commissures oriented approximately 120˚ from one another. In a BAV annulus, the sinuses of two fused leaflets may occupy less than the expected 240˚ (**Figure 1**). Regardless of annular geometry, the tissue prosthesis has symmetrically-oriented commissures that are scalloped. Thus, placing annular sutures according to the native

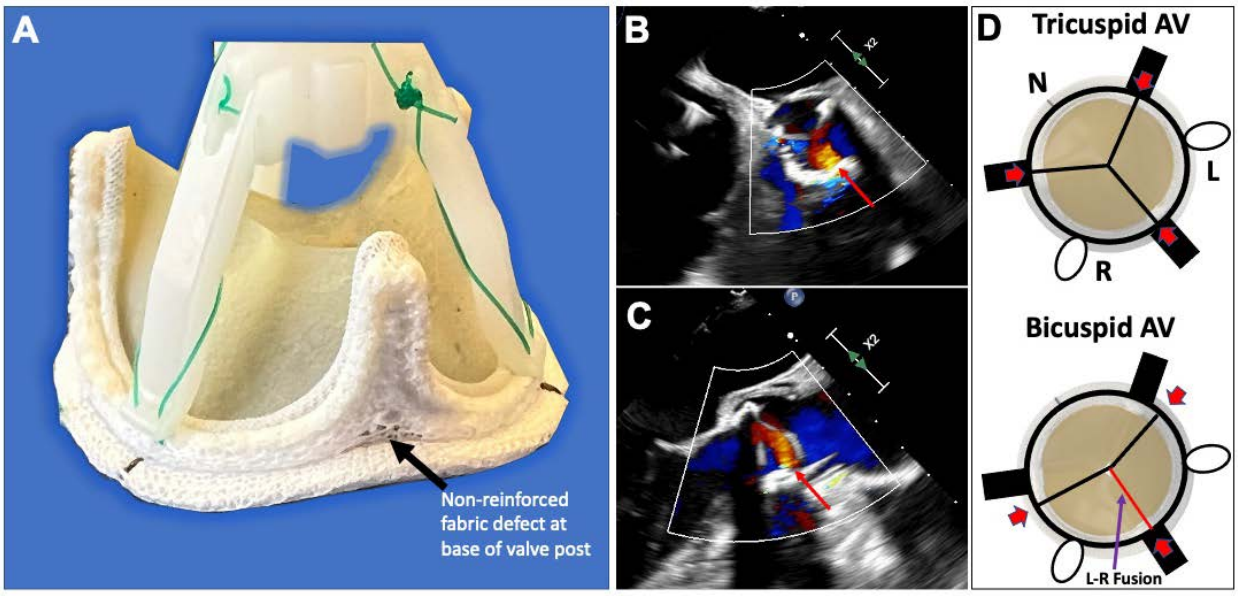

Figure 1. (a) Showing bare fabric at stent post of Inspiris valve (black arrow). (b), (c) Demonstrating the horizontally-oriented regurgitant jet on TEE intraoperatively (red arrow). (d) Graphical depiction of changes in annular and commissural geometry between normal tricuspid aortic valve and bicuspid aortic valve (Sievers type 1 shown here with raphe in red). Thick tick marks demonstrate location of posts on the Inspiris valve and bold red arrows show commissures and raphe distributed around the annulus.

annular geometry, which may be asymmetric and non-scalloped, instead of according to the scalloped location of the valve commissural posts, may create tension in the area of the fabric defect, resulting in blood flow through the stent frame (Figure 1). Redistribution of the annular sutures through the sewing cuff according to the native valvular geometry may have alleviated this tension, preventing the leak.

The Inspiris valve has been widely adopted in the cardiac surgical community due to its anticalcification leaflet technology and excellent early- and mid-term results. Aortic regurgitation of this type has been previously reported with the Inspiris valve [3] [4], however, in these cases the leak resolved after administration of protamine. This may have held true in our case, however protamine was not administered until after the second valve replacement. Given the severity of the jet seen on TEE, the valve was revised immediately. Previous reports do not comment on the effect that a BAV might have; this mechanical difference may create a fixed defect that would not resolve with protamine.

4. Conclusion

Surgeons and anesthesiologists should be aware of the possibility of aortic regurgitation through the stent frame after aortic valve replacement when an Inspiris valve is implanted. In bicuspid aortic valve patients with especially asymmetric annuli, care should be taken in placing annular sutures in order to minimize this possibility. Future research on this mechanism and the likelihood of reversibility with protamine administration are warranted.

Ethical Statement

The Institutional Review Board (IRB) or equivalent ethics committee of Columbia University did not approve this study due to its nature as a case report. Patient written consent for the publication of the study was not received as there are no identifying data to risk patient privacy.

Conflicts of Interest

The authors have no conflicts of interest to disclose.

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