Published in final edited form as:

Ann Thorac Surg. 2020 October ; 110(4): e319–e321. doi:10.1016/j.athoracsur.2020.01.067.

Aortic Root Replacement for a TAVR-Induced Aortic Root-to-Right Ventricular Fistula

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Abstract

Aorto-right ventricular fistulae have been thoroughly documented as a rare but potentially serious complication of surgical aortic valve replacement. The risk factors and pathogenesis contributing to this complication with respect to transcatheter aortic valve replacement (TAVR), however, remain far less characterized. Here we describe a post-TAVR aortic root-to-right ventricular fistula with associated pseudoaneurysm requiring surgical aortic root replacement.

Keywords

Aortic Valve; Replacement; Fistula; Aortic Root Replacement; Surgery; Complications

Aortic root-to-right ventricular fistula (AoRoot-RV fistula) formation is a rare but serious complication of transcatheter aortic valve replacement (TAVR), for which both conservative medical management and percutaneous interventions have demonstrated safety and efficacy in previous case reports. With expansion of TAVR into low-risk patients and complex anatomies, early diagnosis and treatment of unique complications is necessary. Here we describe a post-TAVR AoRoot-RV fistula with associated pseudoaneurysm requiring surgical aortic root replacement (ARR).

A 76 year-old male with a past medical history significant for chronic atrial fibrillation, dyslipidemia, thyroid dysfunction, and severe aortic stenosis with a Society of Thoracic Surgeons Risk Score of 1.5% underwent an uncomplicated TAVR (#29 Sapien 3 valve, Edwards Lifesciences, Irvine, CA, USA) at our institution. A transthoracic echocardiogram (TTE) on post-operative day (POD) #1 revealed severe left atrial (LA) and moderate right atrial (RA) enlargement, moderately-increased right ventricular (RV) size with preserved systolic function, trace mitral regurgitation (MR), mild tricuspid regurgitation (TR), and mild-to-moderate pulmonary regurgitation (PR) without any radiographic abnormalities

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involving the aortic bioprosthesis, aortic root, or ascending aorta. The patient presented for routine follow-up on POD #9 with complaints of fatigue and mild exertional dyspnea since the procedure. A repeat TTE on POD #31 demonstrated progression of RA, and LA enlargement, a tethered tricuspid valve (TV) with severe TR, mildly elevated RV systolic pressure and a fistulous communication between the aortic root and RV with left-to-right shunting (vena contracta = 0.49–0.80 cm). Computed tomography (CT) imaging (Figure 1) and a transesophageal echocardiogram (TEE) on POD #45 further characterized the AoRoot-RV fistula (continuous flow, orifice area = 38 mm²) and associated aortic pseudoaneurysm, severe enlargement of the RV, and progression of the LA enlargement. Despite medical regimen optimization, the patient continued to complain of fatigue and exertional dyspnea at a clinic visit on POD #58. Given the clinical and radiologic evidence of persistent fistula patency, in conjunction with the large size and proximal location of the fistula within the aortic root and the significant, symptomatic shunting with severe TR, the decision was made to proceed with elective surgical repair.

Procedure in Detail

Following median sternotomy and initiation of cardiopulmonary bypass, aortotomy revealed a well-seated TAVR valve encased in calcified native leaflets; the TAVR valve and native leaflets were removed and debrided, respectively (See Video). The pseudoaneurysm opening was visualized underneath the right coronary artery. In order to safely delineate the surrounding anatomy, the decision was made to proceed with ARR. Dissection of the aortopulmonary window and entrance into the pseudoaneurysm facilitated visualization of a 6 mm right ventricular outflow tract (RVOT) fistula orifice, which was ligated with a pledgetted 4–0 prolene suture. A valve conduit fabricated with a 25 mm INSPIRIS valve (Edwards Lifesciences, Irvine, CA, USA) and a 28mm Valsalva graft (Terumo Corporation, Shibuya, Tokyo, JPN) was implanted without incident, and the coronary buttons were reimplanted. The TV then was repaired with a 30mm Cosgrove-Edwards annuloplasty ring (Edwards Lifesciences), the pulmonary veins were ablated using an AtriCure RFA clamp (AtriCure, Mason, OH, USA), and the left atrial appendage was ligated with a #35 AtriClip (AtriCure). The patient was extubated on POD#1. His post-operative course was notable for development of a large pericardial effusion necessitating pericardiocentesis on POD#9. He was discharged to a rehabilitation facility on POD#14, and was doing well at his 6-month follow-up visit without clinical or radiologic evidence of aortic valvulopathy or aortopathy.

Comment

TAVR has demonstrated safety and efficacy as an alternative to surgical valve replacement for high-, intermediate-, and low-risk patients with severe aortic stenosis [1]. Nevertheless, complications including but not limited to valve malpositioning resulting in paravalvular leak and/or coronary artery obstruction, conduction abnormalities, and the feared annular rupture have been reported [2]. In contrast to surgical aortic valve replacement, TAVR preserves calcified native valve leaflets which, upon valve deployment, are pushed against the adjacent, relatively soft aortic root. The presence of extensive native valve calcifications has thus been proposed as a putative source of aortic injury during both TAVR valve deployment and subsequent balloon dilation. In addition, rigid stent struts such as those

present in the Edwards Sapien (Edwards Lifesciences) and Medtronic CoreValve bioprostheses (Medtronic, Dublin, IRL) represent an additional source of iatrogenic aortic wall injury [3]. Such iatrogenic insults are hypothesized to result in linear tears of the aortic wall, which may predispose to pseudoaneurysm and fistula formation [4]. It is therefore unsurprising that oversizing of valves or balloons, as well as repetitive post-TAVR balloon dilations, have been proposed as risk factors for post-TAVR aorto-RV fistula formation. Of note, there has been one reported case of aorto-RV fistula formation following TAVR for management of bicuspid aortic valve disease (BAV), which may have been further complicated by pre-existing intrinsic aortopathy [5].

Previously-published accounts of TAVR-associated aorto-RV fistulae have demonstrated efficacy in conservative management and close echocardiographic surveillance of asymptomatic patients with small, low-flow fistulae [2, 4, 6]. Patients who fail to respond to conservative management as indicated by persistent or worsening or dyspnea or other symptoms of congestive heart failure, or those who are symptomatic at the time of initial assessment, however, warrant percutaneous or surgical intervention [3, 5, 7–8]. Percutaneous management is feasible in high-risk or inoperable patients with conducive anatomy, and can be achieved by passing a wire across the fistula tract to facilitate successful deployment of an Amplatzer device (St. Jude Medical, Saint Paul, MN, USA). Regarding our patient, progressive dyspnea despite conservative fistula management in the setting of significant left-to-right shunting with severe TR warranted further intervention. When considering percutaneous versus surgical management, it was determined that the large size of the fistula, in conjunction with the proximal location of the fistula orifice deep within the aortic root, compromised the safety and technical feasibility of a transcatheter approach. Intra-operatively, the presence of severely calcified native aortic valve leaflets and the location of the fistula orifice prevented adequate visualization, thus precluding any attempt at a valve-sparing procedure.

As the population of TAVR recipients inevitably continues to increase in size and complexity, surgeons and clinicians must be increasingly aware of possible post-procedural complications. Aorto-RV fistula formation is a rare but serious complication of TAVR and, although medical or percutaneous management is often feasible, proceduralists must remain cognizant of the role for surgical intervention.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Ann Thorac Surg. Author manuscript; available in PMC 2021 October 01.