

Case Report

Novel Treatment of Iatrogenic Annular Rupture and Cardiac Tamponade during TAVR

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ABSTRACT

In this case presentation, we discuss a novel therapy to treat cardiac tamponade caused by annular rupture during a transcatheter aortic valve replacement (TAVR) procedure. The patient underwent successful percutaneous implantation of an Edwards 29-mm Sapien 3 Ultra valve after which a substantial drop in blood pressure was noted. Intraprocedural post-implant aortic angiogram showed an iatrogenic annular rupture (IAR) outside the non-coronary cusp with transthoracic echocardiography confirmation of an expanding pericardial effusion. Immediate pericardiocentesis was performed, however, extraction of sanguineous product and hemodynamic instability continued. At this time, injectable gelatin thrombin hemostatic matrix was delivered to the annular rupture site at the non-coronary cusp side of the left ventricular outflow tract. Shortly after, there was stabilization of the pericardial effusion with improvement in hemodynamics. The patient was discharged home safely on hospital day four and continued to do well in follow up appointments.

Keywords: Transcatheter aortic valve replacement, TAVR, aortic annular rupture, iatrogenic annular rupture, IAR, pericardial effusion, cardiac tamponade, injectable absorbable porcine gelatin matrix with human thrombin.

Introduction

Transcatheter aortic valve replacement (TAVR) is an increasingly utilized modality for intervention in patients with severe aortic stenosis. Overall, the risks of major complications are small but not insignificant. In this case presentation we will discuss one of these life-threatening complications, aortic annular rupture, and present a novel and potentially life-saving management strategy.

Aortic annular rupture is a broad term used to describe iatrogenic injury to the aortic annulus or left ventricular outflow tract (LVOT) during procedural interventions, most commonly balloon aortic valvuloplasty and TAVR [1,2]. It has a known incidence of 0.4-2.3% during TAVR procedures with moderate or greater subannular calcification, especially in the area of the muscular LVOT between the left fibrous trigone and left/right commissure,

increasing the risk of annular rupture during TAVR [1,3,4]. The degree of injury varies and may be associated with contained hematoma, fistula formation with the ventricle or atria, extension to the aortic root and/or pericardium with the latter commonly leading to cardiac tamponade [1].

Thankfully, improvements in imaging and operator technique have shown a noticeable decline in this complication [2]. The management of this complication is largely preventative by utilizing careful case selection to safely work around high-risk anatomy. If it does occur, strategies to manage associated hemodynamic compromise include rapid recognition, reversal of anticoagulation, pericardial drainage, judicious transfusion of blood product, and if necessary, surgical intervention.

Fortunately, annular rupture is not a common occurrence, however it is associated with high

30-day mortality rates ranging between 49-67% [1,2,5-8]. In this case presentation, we will discuss an aortic annular rupture associated with cardiac tamponade and a novel management strategy using percutaneous injection of absorbable porcine gelatin matrix with human thrombin.

Case Presentation

The patient is an 87-year-old male with a history significant for severe symptomatic aortic stenosis with New York Heart Association (NYHA) class III symptoms with American College of Cardiology/American Heart Association (ACC/AHA) stage D1 valvular heart disease. Additionally, he has a history significant for essential hypertension, dyslipidemia, right bundle branch block, and left anterior fascicular block. He was considered at least intermediate risk for surgical aortic valve replacement (SAVR) due to his advanced age and co-morbidities and thus felt to be a suitable candidate for TAVR.

Pre-procedural transthoracic echocardiogram showed an ejection fraction of 60-65%, with severe non-rheumatic trileaflet degenerative aortic stenosis by qualitative assessment. The peak aortic valve gradient was 65 mmHg, mean gradient 44 mmHg, and peak velocity of 4.05 cm/s. The aortic valve area (AVA) was determined to be 0.8 cm² by measuring the velocity time integral and using the continuity equation. Computed tomography showed aortic valve leaflet calcium score of 3369 Agatston units with heavy calcification noted in the LVOT. The short-term risk (STS) risk was determined to be 1.28%.

The patient underwent percutaneous placement of an Edwards 29-mm Sapien 3 Ultra valve after which a substantial drop of blood pressure was noted. Intraprocedural post-implant aortic root angiography demonstrated an iatrogenic annular rupture (IAR) on the non-coronary cusp side (Figure 1). Heavy calcification at the left ventricular outflow tract (LVOT) likely served as the culprit of this complication. The hypotension was initially managed with fluids and inotropic medications. Full anticoagulation reversal was performed with protamine, the patient was then intubated, and a transesophageal echocardiography (TEE) probe was placed.

TEE showed peri-aortic hematoma with extension into the pericardial space which was noted to be enlarging visually (Figure 2). There was no evidence of extension into the ascending aorta. Immediate pericardiocentesis was performed, removing 125 mL of blood. Despite this, there was

continuous extraction of sanguineous product and hemodynamic instability. At this time, 8 mL's of injectable gelatin thrombin hemostatic matrix (Surgiflo®) was delivered but clotting of the 8 French pericardial drain quickly occurred. The drain was removed over a stiffened 0.035-inch wire for an 11 French drain. This allowed for successful injection of 8 mL's of the injectable gelatin thrombin hemostatic matrix near the IAR site. Shortly after, there was stabilization of the pericardial effusion and improvement in hemodynamics. The pericardial drain was left in place and the patient was transitioned in stable condition to the cardiac intensive care unit.

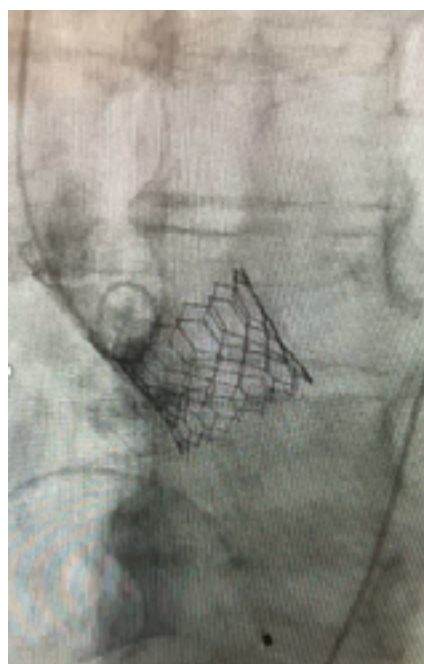


Figure 1: Fluoroscopic aortogram in the coplanar view showing contrast dye extravasation beyond the non-coronary cusp into the pericardial space.

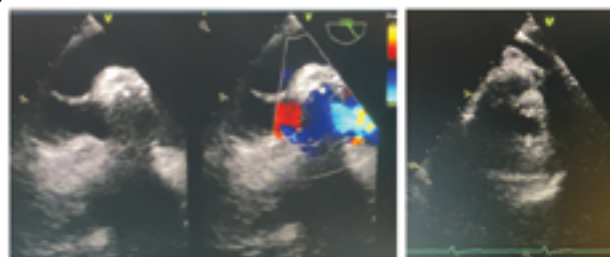


Figure 2: Left: TEE mid-esophageal long axis view showing hematoma formation on the non-coronary cusp side of the aortic annulus. Right: TEE transgastric mid short-axis view showing circumferential mild to moderate pericardial effusion.

The pericardial drain was removed two days later with follow up transthoracic echocardiogram (TTE)

showing stable pericardial hematoma without evidence of constrictive pericardial behavior. The ejection fraction remained normal and the implanted bioprosthetic valve demonstrated normal functionality. The patient was discharged to home safely on hospital day four and continued to do well in follow up appointments.

Discussion

Annular rupture is a known complication of TAVR associated with a high mortality rate. This case demonstrates a novel and potentially lifesaving technique to manage refractory iatrogenic cardiac tamponade using injectable absorbable porcine gelatin matrix with human thrombin.

Development of early or late constrictive pericarditis (CP) is of concern given the degree of hematoma left in the pericardial cavity. Early screening with post procedural echocardiography prior to discharge should be utilized to assess for signs of CP. Cases of CP following pericardial injection of absorbable human thrombin matrixes have not yet been described, however, this a novel therapeutic choice with little evidence published regarding its use in this manner. We know CP is a rare complication in patients following cardiac surgery with an incidence of 0.2-0.4% with most clinically relevant cases presenting after one month [9]. Therefore, it would be reasonable to consider close monitoring and echocardiography beyond one month for patients managed with this strategy.

The literature currently is sparse with information on this technique. Further research will be needed to determine its true efficacy. However, for patients in extremis who are unable to undergo adjunctive treatments such as open exploration and repair, this minimally invasive technique may supply a feasible alternative.

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Conflicts of Interest

The authors declare they have no conflict of interest.

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