

Transcatheter aortic valve implantation in a patient with interventricular membranous septal aneurysm resulted in cardiac tamponade of unclear etiology

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Abstract

An 86-year-old lady with severe aortic stenosis and interventricular membranous septal aneurysm underwent transfemoral transcatheter aortic valve implantation (TAVI). A balloon-expandable valve was deployed after a difficult native valve crossing. Transesophageal echocardiography showed a rapidly accumulating pericardial effusion, with pericardial thrombus and subsequent cardiac tamponade. The angiographic views raised suspicion of aortic root perforation. Median sternotomy was performed because of sudden hemodynamic collapse.

The report presents the uncommon association between severe aortic stenosis and interventricular membranous septal aneurysm in an octogenarian and discusses its impact on the development of a post-TAVI major complication.

Keywords: transcatheter aortic valve implantation; cardiac tamponade; intrapericardial thrombus; aortic root injury

Introduction

Transcatheter aortic valve implantation (TAVI) has become the standard treatment for patients with symptomatic severe aortic stenosis and increased surgical risk [1]. Due to the infrequent association, little is known about specific procedural steps and outcomes in the presence of concurrent congenital heart defects.

An aneurysm of the interventricular membranous septum (AMS) is a rare condition with an unknown in-

cidence and an incompletely understood etiology [2]. It has been rarely diagnosed as an isolated finding and it is usually associated with other congenital heart defects [3]. Patients with AMS are usually asymptomatic, possible complications related to the AMS presence including arrhythmic and thromboembolic events [3,4].

The presence of structural defects in the sub-annular area could cause prosthesis malposition resulting in significant paravalvular leaks or device embolization. There are only three previous reports about the association between AMS and transfemoral TAVI [5-7].

Case report

An 86-year-old lady with severe aortic stenosis and NYHA class III heart failure was proposed for transfemoral TAVI. Echocardiography showed a hypertrophic left ventricle, with a 36% ejection fraction. Moderate mitral regurgitation and severe pulmonary hypertension were noticed. The aortic valve area measured 0.6 cm². An AMS was identified both on echocardiography and

Received 20.07.2020 Accepted 26.09.2020

Med Ultrason

2020;0 Online first, 1-3

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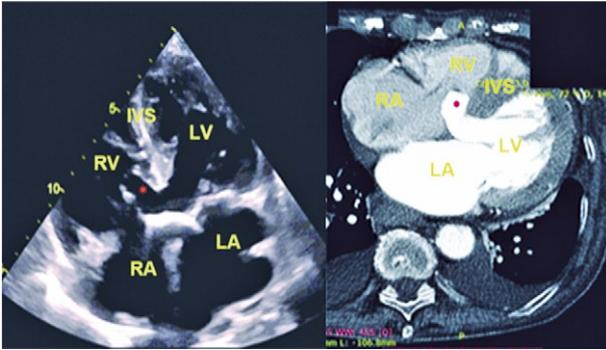


Fig 1. Aneurysm of the interventricular membranous septum. Panel a – Transthoracic echocardiography five-chamber view showing the presence of an aneurysm of the membranous septum (asterisk). Panel b – Cardiac computed tomography transverse view which confirms the presence of the sub-annular congenital anomaly (asterisk). IVS = interventricular septum; LA = left atrium; LV = left ventricle; RA = right atrium; RV = right ventricle.

computed tomography, but no interventricular shunting was present (fig 1). A balloon-expandable 26 mm Edwards Sapien 3 valve (Edwards Lifesciences Corp., CA, USA) was implanted under general anesthesia. Predilatation was avoided because of the unknown impact of this procedural step on the sub-annular structural anomaly. The native valve was crossed with difficulty. The Edwards Commander Delivery System was retracted in the ascending aorta several times and the flex wheel was used to change the angle of annulus approach. After several pushing maneuvers the prosthesis was successfully positioned and deployed. Following deployment, transthoracic and transesophageal echocardiography showed a rapidly accumulating pericardial effusion, with cardiac tamponade. Pericardial thrombus was identified next to the left ventricular posterior wall (fig 2, Video 1, on the journal site). Although the angiographic views showed a

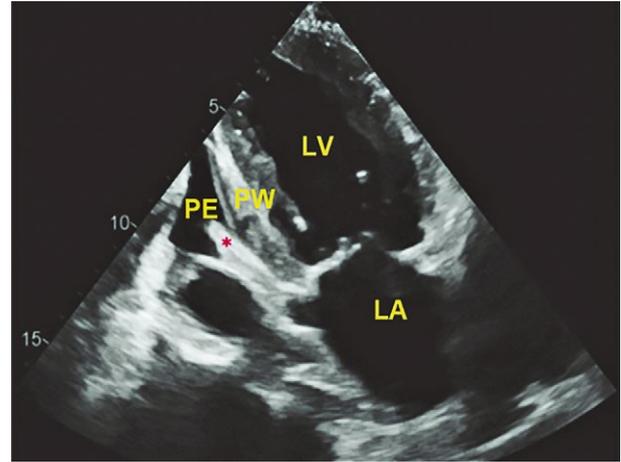


Fig 2. Intraprocedural transthoracic echocardiography modified two-chamber view identifies the pericardial thrombus in contact to the left ventricular posterior wall (asterisk) and shows the presence of pericardial effusion. LA = left atrium; LV = left ventricle; PE = pericardial effusion; PW = posterior left ventricular wall.

short limited aortic sinus perforation (fig 3), the finding was not identified on the transesophageal echocardiographic examination.

Median sternotomy was performed because of the sudden hemodynamic collapse and 800 ml of arterial blood and fresh thrombus were evacuated. A posterior aortic root hematoma was identified, but no active bleeding was noticed. Surgicel Absorbable Hemostat (Johnson&Johnson, NJ, USA) was applied. Two units of packed red blood cells were administered and the patient left the operating room with stable hemodynamics. Postoperative evolution was influenced by the development of a large left plural effusion. Thoracentesis was attempted but the procedure was complicated by a massive pneumothorax, which required emergency drainage.

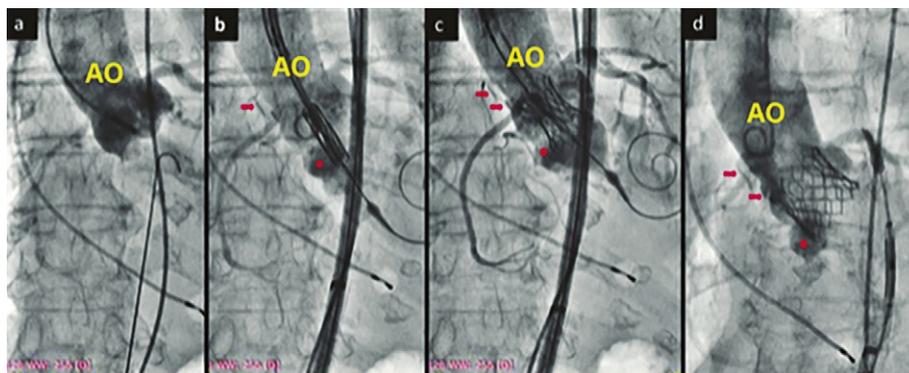


Fig 3. Angiographic views. Panel a – Angiography view showing the initial integrity of the aortic walls. Panels b-d – Angiography views showing the development of aortic root injury. Contrast extravasation is seen following native valve crossing (arrows). The aneurysm of the membranous septum is filled with contrast (asterisk).

The patient made a slow recovery and after a four weeks hospitalization she was discharged home. At the one-year follow-up she was in good clinical condition.

Discussion

Aortic dissection and perforation are rare complications of TAVI, with an incidence of 0.2% [8]. Several mechanisms are incriminated in the development of an aortic tear: stiff wire maneuvering in the ascending aorta, balloon valvuloplasty injury, valve catheter injury to the aortic wall, system retraction in balloon-expandable devices, or postdilatation balloon interaction with the aorta [9,10]. In our case, the aortic tear was most probably produced by the leading edge of the prosthesis pusher during the prolonged native valve crossing maneuvers. Predilatation would have probably prevented the event by facilitating prosthesis advancement through the calcific native valve. However, the avoidance of this procedural step was related to the presence of the AMS and to the negative impact it might have had on the anomalous sub-annular structures.

The management of an aortic perforation depends on the patient's clinical status and on the site of the perforation [8]. In our case, the aortic injury occurred at the level of the non-coronary sinus and was incriminated in the etiology of the pericardial effusion. Although the presence of pericardial thrombus in close proximity to the left ventricular posterior wall could have raised suspicion of an earlier, guidewire induced left ventricular wall perforation, the angiographic images suggestive of an aortic root lesion led to an invasive, surgical approach. During TAVI procedures, the incidence of cardiac tamponade reaches 4.3%, the most common cause being right ventricular perforation due to pacemaker leads [9]. Perforations of the left-sided structures are almost equally divided between annular/supra-annular ruptures and left ventricular wall perforations [9]. Although less common, tamponade caused by arterial perforations is associated with higher mortality rates [8,9]. In the frail, high-risk TAVI patients, pericardiocentesis is the preferred strategy, surgery being restricted to the rare cases of aortic root injury [8]. Although better outcomes were recorded in patients who underwent percutaneous pericardial drainage, the presence of hemodynamic instability mandates open surgical exploration and repair [8].

Last but not least, the presence of the AMS had an indirect role in the development of the complication. Predilatation was avoided in order to prevent trauma to the sub-annular interventricular septum. As a result, native valve crossing became a challenging step of the procedure and a major factor involved in the development of

aortic root injury. Three previous reports offered data on this uncommon association in TAVI patients. Concerns about the procedure were raised in all three cases, but valve deployment was uneventful [5-7].

Despite significant improvements in technology and operator experience, TAVI remains a complex and technically demanding procedure that requires advanced skills and intensive training. Major complications like cardiac tamponade negatively influence the procedural outcome and need to be further reduced. The etiology of the pericardial effusion may sometimes be uncertain, but quick decision making is mandatory in case of hemodynamic instability. When perforation of the left-side structures is suspected open surgical exploration is the preferred approach.

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