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Case Report

Staged Hybrid Treatment of Acute Type B Complicated Aortic and External Iliac Artery Dissection and Femoral Occlusion after Transcatheter Aortic Valve Implantation

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Abstract: Percutaneous aortic valve replacement (TAVI) has become the treatment of choice for elderly patients with severe aortic valve stenosis because of its less invasive nature compared to surgery. As TAVI is increasingly offered, issues such as vascular lesions, access site problems, paravalvular leaks, and aortic dissection (AD) are a few associated complications, needing consideration. AD after TAVI is rare but serious, occurring in 0.2% to 0.3% of cases, with both intraprocedural and late cases reported. This case study concerns a 68-year-old woman who developed Stanford B AD, external iliac artery dissection, and right common femoral artery occlusion after TAVI. Treatment included the stenting of the iliac and common femoral arteries, followed by a staged procedure: debranching, thoracic endovascular aortic repair (TEVAR), and endovascular aneurysm repair (EVAR), with satisfactory results. This case underscores the importance of vigilance in the management of TAVI-related complications to optimize patient care and outcomes.

Keywords: vascular surgical procedures; aortic dissection; postoperative complications

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1. Introduction

Aortic stenosis (AS) is one of the most common cardiovascular diseases in the Western world [1,2]. This condition can be treated by traditional cardiac surgery or by catheter-based interventions. One of the most advanced methods is percutaneous aortic valve implantation (TAVI), a minimally invasive procedure to replace the aortic valve. Over the past two decades, TAVI has revolutionized the treatment of aortic stenosis, becoming the standard of care, regardless of the patient's level of surgical risk [3]. The first procedure was in 2002 in France by Cribier, and since then, more than 500,000 TAVIs have been performed in more than 70 countries [4,5]. In Germany, more than 100,000 TAVIs have been performed since 2008, with more than 12,000 procedures annually, and in the U.S., 54,782 TAVIs were registered in 2016 in the Transcatheter Valve Therapy Registry.

Among the potential complications, local vascular events are the most common after cardiac catheterizations such as TAVI. Hemorrhages and hematomas typically occur within 12 h after the procedure, whereas pseudoaneurysms may develop over days or weeks [6]. The risk of iatrogenic aortic dissection (IAD) during TAVI ranges from 0.6% to 1.9%, often caused by manipulations of the guidance/delivery system or by valve repositioning, retrieval, or retraction. Dissections occur mainly in the aortic root, although they can also affect the ascending and descending aorta due to catheter or guidewire injuries [7,8].

2. Detailed Case Description

A 68-year-old patient with a history of open aortic and mitral valve replacement surgery, in addition to coronary artery bypass revascularization, presented with severe aortic valve stenosis requiring TAVI. Prior to the procedure, a EuroSCORE III was calculated, which reported a predicted mortality of 4.91% and operative mortality risk of 5.83% and 10.3% morbidity and mortality according to the STS score. During the procedure, the patient experienced acute limb ischemia due to the occlusion of the right common femoral artery following the use of the ProGlide™ 55 device (Abbott, Bangkok, Thailand), likely caused by suture-induced vascular narrowing, which required femoral stent placement (Figure 1).

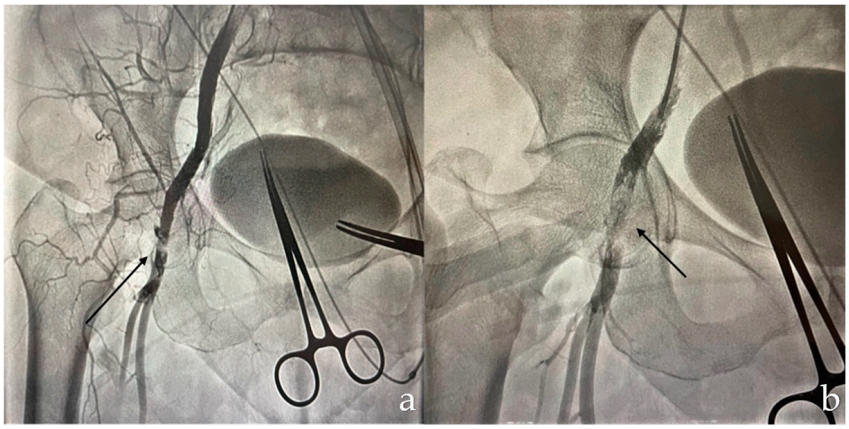


Figure 1. (**a**) Femoral artery occlusion. (**b**) Femoral artery stent placement.

On postoperative day 8, the patient reported pain in the right lower extremity, prompting computed tomography angiogrsaphy (CTA). This revealed a Stanford B-type AD extending into the abdominal aorta and right external iliac artery (Figure 2).

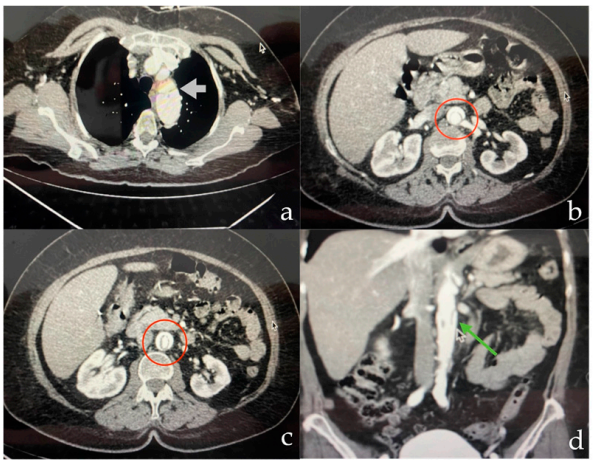


Figure 2. Stanford B aortic dissection. (**a**) Thoracic aortic dissection. (**b**–**d**) Abdominal aortic dissection.

Consequently, the patient was transferred to the operating room for staged hybrid management. It was decided to perform zone 1 coverage (zone 0: ascending aorta and brachiocephalic trunk outflow; zone 1: left carotid artery outflow; zone 2: left subclavian outflow; and zone 3: proximal descending aorta) starting with a cervical debranching procedure that included a carotid–carotid bypass. Access was gained through a retropharyngeal route and space was created for the tunnel by blunt dissection medial to the common carotid artery and retroesophageal. After completing the carotid–carotid bypass, the anterior scalene muscle was divided to access the subclavian artery. A lateral arteriotomy

was performed on the left common carotid artery and an end-to-end anastomosis was performed using a 6 mm polytetrafluoroethylene (PTFE) ringed graft (Gore-Tex) with 5/0 prolene sutures (Figure 3). Hemostasis was ensured and the revascularization of the left subclavian artery was achieved before the removal of the vascular clamp. After the procedure, the patient was transferred to the Intensive Care Unit (ICU).

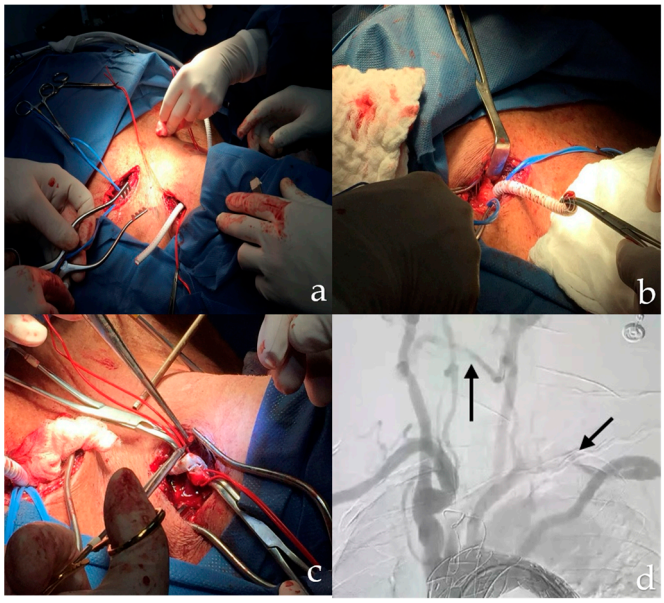


Figure 3. Cervical debranching. (**a**) Carotid artery bypass. (**b**,**c**) Bypass of carotid and subclavian artery. (**d**) Cervical debranching arteriography.

For endovascular treatment, a left femoral and right brachial approach was used. A hydrophilic guidewire was introduced through a pigtail catheter, navigating the area of abdominal and thoracic AD. The wire was positioned in the ascending aorta and replaced with a high-support LUNDERQUIST wire through the left approach. Through this guidewire, a Medtronic Valiant VAMF3834C150TE aortic stent graft was placed and released in zone 1. After securing the thoracic aortic stent graft, the pigtail catheter was removed via femoral approach and aortography was performed to verify adequate flow and patency of the brachiocephalic trunk.

A pigtail catheter was then introduced into the abdominal aorta for further aortography, identifying the visceral vessels and the area of dissection. A guide wire was passed and an ABRE AB9-20 x 100 aortic endograft was deployed below the ostium of the superior mesenteric artery. Once the endograft was in place, another aortogram was performed confirming the resolution of the AD and the patency of all aortic branches. A coda balloon was then used to secure the position of the endograft, removing the devices and closing the arteriotomy with 7/0 prolene sutures.

The patient tolerated the procedure without complications and was transferred to the Intensive Care Unit (ICU), from where she was subsequently discharged.

3. Discussion

AD is a rare but serious vascular complication [8]. In most cases, it occurs in the ascending aorta and is usually related to trauma caused by medical instruments such as catheters, guidewires, and vascular sheaths used during procedures such as TAVI [9]. In contrast, TAVI-related descending AD is even rarer. In these cases, the main mechanisms involved are usually associated with the improper handling of the instruments during valve repositioning or during the retraction of the devices used in the procedure [10], as in our case, where the complication was probably due to the incorrect manipulation of the guidewire from the beginning of the procedure, which caused valve malpositioning. Given

the high mortality associated with complications such as AD in procedures such as TAVI, it is crucial to implement meticulous evaluation and preventive measures at all stages of treatment [11].

In the preoperative phase, it is crucial to perform a thorough clinical examination, analyze the patient's medical history in detail, and consider any variables that may increase the risks associated with the surgical procedure, such as the individual's frailty. Frailty is defined as a "reduced ability to recover from iatrogenic or pathologic stressors due to aging-related deficits". However, it is important to note that frailty is not directly linked to age, as major adverse cardiovascular events and in-hospital mortality do not show a significant influence with age in patients undergoing TAVI [12]. Similarly, it is essential to perform an exhaustive diagnostic imaging study not only at the access point, but also in the entire aorta, to detect possible anomalies that could predispose to complications. It is essential to avoid injury to the vascular system during catheter placement and manipulation, to maintain sheath stability and to correctly position the guidewire under fluoroscopic control to ensure safe and accurate navigation. In our institution, where the procedure was performed, this is the norm, and there were no calcifications at the access site or an aortic root hostile anatomy. On the other hand, in the postoperative phase, when any complications associated with the procedure are suspected, a follow-up transesophageal echocardiogram (TEE) allows an accurate assessment of both the anatomy and function of the prosthesis and other important factors of cardiac function, thus improving the patient's prognosis [13–15].

Historically, chronic aortic dissections were defined as those older than 14 days [16]. However, current classifications categorize aortic dissections as hyperacute, acute, subacute, or chronic based on their timing: within the first 24 h, 1 to 14 days, 15 to 90 days, and beyond 90 days, respectively. Both type A and type B aortic dissections are diagnosed as either acute or chronic. Acute dissections present with severe symptoms and require urgent medical intervention, while chronic dissections are less critical but still need treatment.

Acute aortic dissections are marked by sudden chest or back pain and require immediate surgical attention to prevent aortic rupture. In contrast, chronic aortic dissections may present with vague symptoms that can go unnoticed until they lead to more specific signs like sweating, shortness of breath, or fainting. These symptoms or imaging results indicating the condition's presence will prompt further investigation. In this case report, the patient developed limb symptoms that made an uncomplicated AD go unnoticed until the CT scan was performed.

At present, there are no specific guidelines for the treatment of iatrogenic descending AD probably due to its low incidence [17]. However, conservative treatment may be appropriate for limited and uncomplicated dissections and is usually the most recommended treatment. In complicated cases, such as impending rupture, uncontrollable pain, poor perfusion, early aortic expansion, or unstable blood pressure, TEVAR should be considered to reduce mortality, morbidity, and the risk of paraplegia compared with conventional open repair. In this specific case, the early expansion of the descending AD led us to opt for TEVAR instead of a conservative approach [18]. Traditionally, TEVAR has been the main treatment for complex Stanford B dissections, although, in specific cases, hybrid repair is required. Ideally, at least 2 cm of healthy aorta should be secured above the entry point of the tear to ensure an adequate proximal sealing zone and prevent retrograde propagation into the ascending aorta. However, achieving this 2 cm landing zone may not always be feasible without partially or completely covering one or more branches of the aortic arch. Therefore, hybrid repair presents itself as a suitable option in these circumstances [19].

Iliac artery dissections can occur during the passage of wires or devices. It is crucial to identify and adequately treat these dissections, even if they do not cause significant clinical problems during the procedure. We recommend a final angiography of the iliac arteries. The usual treatment consists of implanting bare nitinol stents, or covered stents if thrombus formation is suspected. On the other hand, common femoral artery occlusions often occur following the use of vascular closure devices, especially when needle-based systems such as Perclose ProGlide™ (Abbott) are used in combination with collagen-based systems such

as AngioSeal (Terumo Corporation, Tokyo, Japan). In addition, the advancement of large lumen devices can dislodge plaques and lead to the occlusion of the vessel lumen. This occlusion presents as acute or subacute ischemia, which should be identified before the patient leaves the catheterization laboratory. The clinical monitoring of the foot of the punctured leg and a Doppler ultrasound on the following day are crucial.

4. Conclusions

AD is a serious but uncommon complication associated with procedures such as TAVI. It most commonly occurs in the ascending aorta, but can also occur in the descending aorta, often due to errors during valve manipulation or hostile calcified root. This case underscores the importance of preventive measures, meticulous preoperative planning, the implementation of precise procedural protocols, and rigorous postoperative follow-up to detect complications early. Treatment options range from conservative approaches for simple cases to TEVAR for complex dissections, highlighting the need for careful patient selection and procedural expertise to minimize risks and improve clinical outcomes.

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