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Case Report

Pannus-Induced Delayed Coronary Obstruction After TAVR

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Abstract

Transcatheter aortic valve replacement (TAVR) is now a well-established and widely employed minimally invasive alternative to open surgery for the definitive treatment of aortic valve stenosis. While TAVR avoids many risks inherent to open valve surgery, there are other complications unique to the TAVR procedure. One such risk is coronary obstruction, which can be attributed to several mechanisms. Examples include valve displacement and disruption of atherosclerotic plaques, which most commonly occur within seconds to minutes after initial valve deployment, and less commonly, delayed coronary obstruction (DCO), which can occur months or even years after valve replacement surgery as a result of fibrosis and pannus formation. Herein we report a case of left main coronary artery obstruction presenting as an ST-elevation myocardial infarction (STEMI), which occurred nearly five years after the initial TAVR implantation. The patient underwent an urgent surgical aortic valve replacement and coronary bypass grafting as both the preoperative imaging and intraoperative findings revealed organized pannus formation with near total occlusion of the left sinus of Valsalva. This case illustrates a rare case of DCO, the etiology of which may be influenced by several modifiable factors, including lifestyle and preemptive pharmacologic therapy, and anesthetic considerations when DCO is suspected. Pannus-Induced Delayed Coronary Obstruction After TAVR.

Keywords: TAVR; Pannus formation; Delayed coronary obstruction; Sinus of Valsalva; Granulomatous inflammation; Stent thrombosis

Introduction

TAVR is a minimally invasive alternative for open surgical replacement for calcific aortic stenosis, with numerous landmarks randomized controlled trials supporting its use in patients with intermediate and high surgical risk [1-6]. With the indications for TAVR expanding to the treatment of patients with low surgical risk, and as life expectancy in developed countries continues to grow, TAVR use has become more ubiquitous [1]. However, several life-threatening complications of TAVR have now been documented, one of which is delayed obstruction of the coronary ostia after valve placement [7-9].

Delayed coronary artery obstruction (DCO) after TAVR implantation is a rare complication occurring in fewer than 1% of implanted TAVRs and carries a 30-day mortality rate approaching 50% [10-12]. DCO has been previously classified into two broad categories

based on its time of presentation [11,13]. Early coronary obstruction occurs within seconds and up to seven days after TAVR due to obstruction from the calcified native valve leaflet, [10] whereas DCO presents any time after seven days of valve implantation [11]. Risk factors for early coronary obstruction include anatomical variations that predispose to occlusion after valve deployment, such as a narrow sinus of Valsalva, low coronary height, and/or excessive prior calcification of the stenotic aortic valve [5]. In contrast to early obstruction, the most common etiologies for DCO involve inflammatory-mediated thrombosis, endothelialization of the valve implant, and valve-in-valve procedures [11].

While multiple reports have been published regarding DCO in the span of months to years after implantation, information on DCO presenting multiple years after the initial operation is sparse [14,15]. Here, we present a case of a patient who experienced unstable angina for several months, which was ultimately attributed to DCO secondary to pannus formation within the stent of the valve prosthesis that had been implanted five years prior to presentation.

Case Report

A 62 year-old female with a BMI of 31.2 kg/m2 presented to the emergency department with chest pain and evidence of an ST-elevation myocardial infarction. She had undergone an implantation of a 20 mm Edwards Sapien 3 TAVR five years prior to admission for severe symptomatic aortic stenosis. Other relevant medical history included hypertension, hyperlipidemia, right bundle branch block (RBBB), and chronic obstructive pulmonary disease (COPD), and an active 80-pack-year smoking history. Aortic valve replacement was recommended and offered to the patient, but she declined to pursue an evaluation for TAVR.

Initially, the patient presented with shortness of breath after climbing one flight of stairs. Her pulmonary function testing (PFT) baseline was an FEV1 of 1.39 L, FVC of 2.05 L, and an FEV1/FVC ratio of 67.8%. On ECG, ST elevations were noted in a VR with diffuse ST depressions in the anterior and inferior leads. Troponins the next day were elevated to 4.15 ng/mL (normal range 0-0.04 ng/mL). Subsequent cardiac catheterization revealed 80% stenosis of the first diagonal branch for which a drug-eluting stent (DES) was deployed. Residual stenosis was 0%. The patient was discharged 2 days later on aspirin 81 mg daily and ticagrelor 90 mg twice daily for at least one year.

Eight months after her coronary stent placement, the patient presented with complaints of daily anginal symptoms. During cardiac catheterization, initial attempts to cannulate the left main orifice were unsuccessful because the catheter would not traverse the cells of the stent of the TAVR prosthesis. Once the catheter was within the valve stent, the patient experienced transient episodes of diffuse ST elevation that resolved upon withdrawal of the catheter, but no evidence of significant coronary obstruction was noted. Further evaluation included a transeophageal echocardiogram (TEE), which revealed a high velocity color flow Doppler jet at the left main coronary ostium, supporting the diagnosis that the TAVR leaflet may be responsible for occlusion of the coronary artery. Since the patient had been taking ticagrelor, surgery was deferred by one week to minimize bleeding risks.

One week after cardiac catheterization, the patient was brought to the operating room. General anesthesia was induced with judicious use of midazolam, fentanyl, propofol, rocuronium, and phenylephrine. Intraoperative TEE confirmed the presence of a high velocity color flow Doppler jet directed towards the left main coronary ostium (Figure 1). After initiation of cardiopulmonary bypass, an intraoperative assessment demonstrated chronic organized pannus with near total occlusion of the metal TAVR scaffold overlying the left sinus of Valsalva (Video 1). A slit-like opening was noted in which blood could flow through the stent into the left coronary sinus, but the sinus was otherwise completely obstructed. The TAVR had also been heavily incorporated into the right sinus of Valsalva (Figure 2). The sinotubular junction down to the aortic annulus was noted to be of narrow caliber and able to accommodate a 19 mm valve. An Edwards Inspiris Resilia 19 mm aortic valve bioprosthesis was implanted. At the time of valve replacement also underwent a single vessel coronary artery bypass graft of the left anterior descending artery utilizing the left internal mammary artery. Surgical pathology of the explanted bioprosthesis revealed three pale, yellow, partially calcified valve leaflets in the lumen.

The patient had a benign postoperative course, as she was extubated on post-operative (POD) 0 and subsequently discharged on POD 7. At her three-month post-operative visit, she was recovering well and ambulating around the home without difficulty. She continues to smoke 0.5 packs per day, decreased from her previous smoking history of 2-2.5 packs per day.

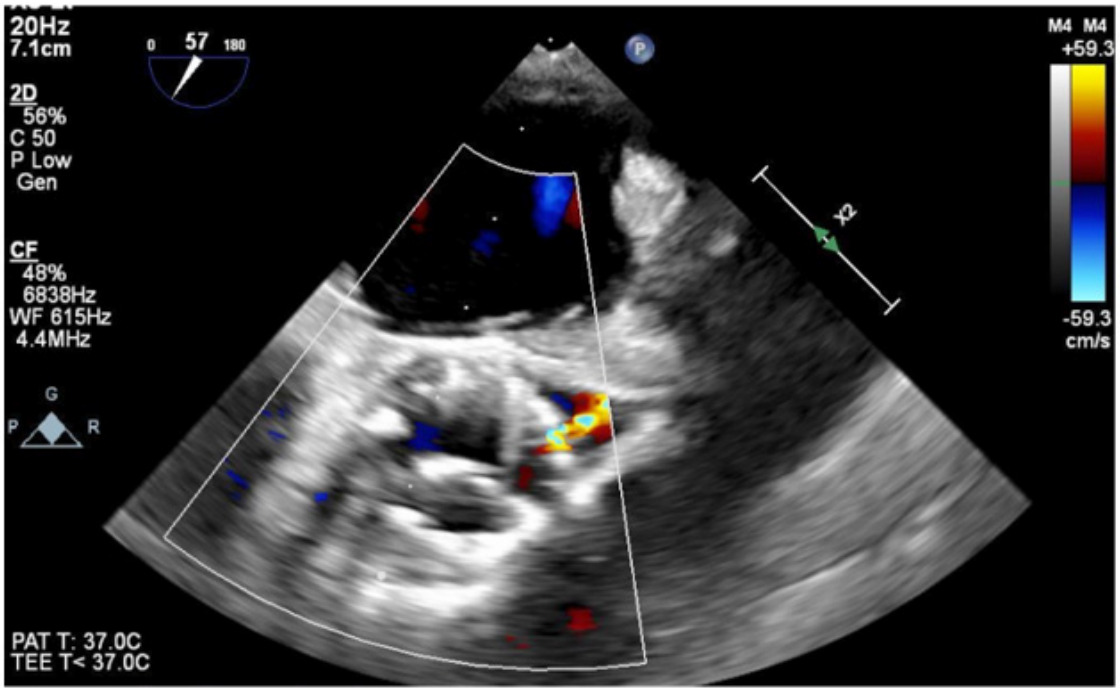


Figure 1: 2D TEE view of mi esophageal right ventricular inflow-outflow with color flow Doppler demonstrating a high velocity systolic color flow jet directed to the ostium of the left main coronary artery (Philips X8-2t probe, Philips Healthcare, Andover, MA).

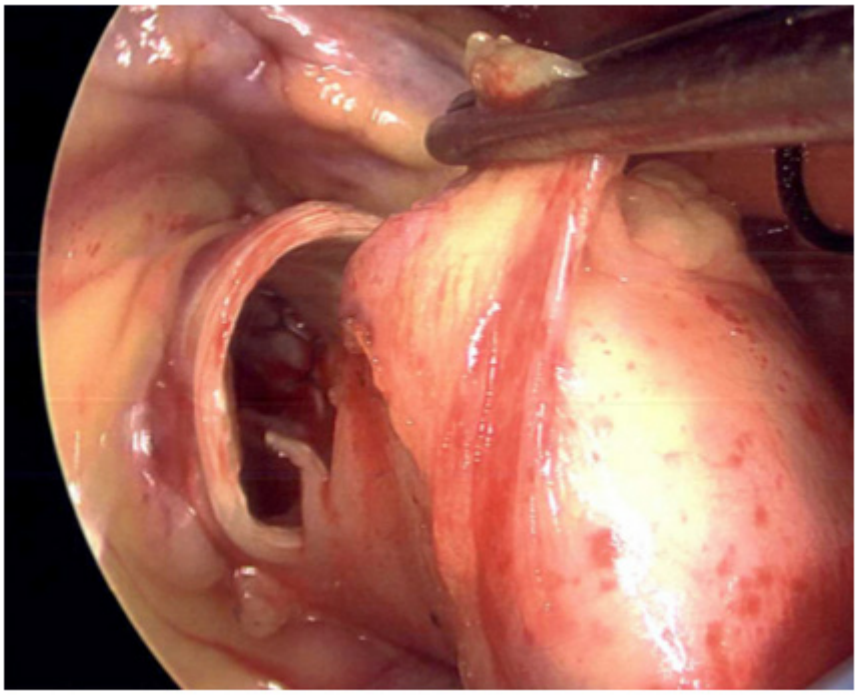
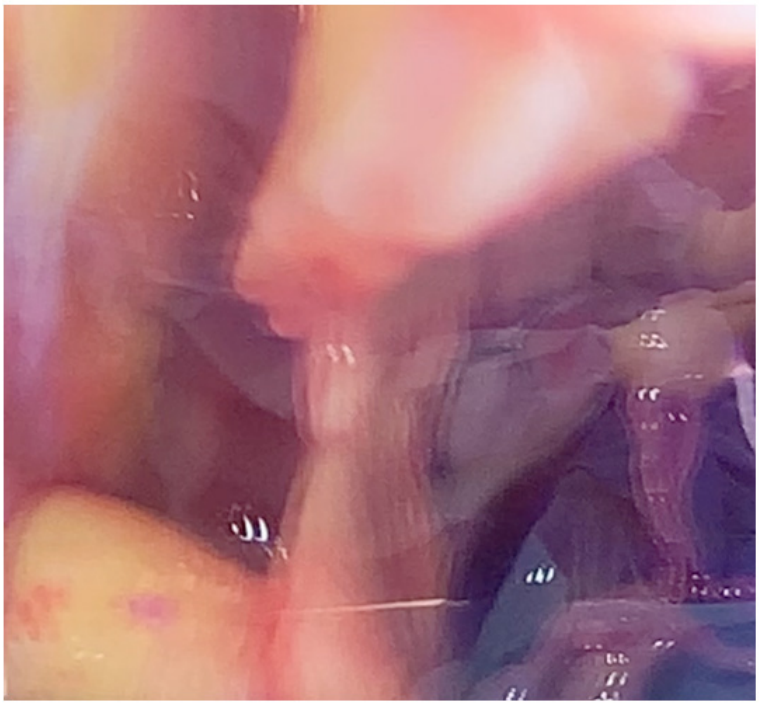


Figure 2a

Figure 2b

Figure 2: Intraoperative images of A) the prior TAVR implant in situ and B) the explanted TAVR (20 mm Edwards Sapien S3).



Video 1: Intraoperative video of pannus overgrowth of TAVR causing near total occlusion of left sinus of Valsalva.

Discussion

Minimally invasive structural heart techniques to address aortic valve diseases have grown significantly in the past decade [1,2,5,16,17]. The indications have now expanded to moderate and low-risk cases of aortic stenosis.16 Coronary obstruction is a critical complication that requires greater attention given the increasing frequency of TAVRs that are performed today [10]. The main causes include immediate coronary ostia obstruction due to valve deployment and native valve leaflet displacement, with longer-term complications resulting from thrombus and fibrous plaque development [11,12,17,18]. This case illustrates how pannus formation can be a significantly delayed cause of coronary ostia obstruction several years after the initial TAVR deployment.

Pannus formation is described as a proliferation of fibroelastic tissue usually organized at the valve annulus [19]. Chronic inflammatory processes to the prosthetic valve result in proliferation of myofibroblasts with upregulated TGF-β-R1 and other growth factor receptors, leading to deposition of collagen and elastic fibrous tissue [19].

Strategies to reduce the likelihood of late DCO may be directed towards post-operative anticoagulation regimens and TAVR design. The optimal post-operative anticoagulation regimen after TAVR implantation remains unknown and guidelines are conflicting [20,21]. Indeed, it is critically important to balance the risk of stroke against increased risk of bleeding when anticoagulating patients after TAVR. Overall, the most effective therapy focuses on mitigating patient-specific risk factors with newer evidence favoring single antiplatelet therapy over dual antiplatelet therapy as a safer and noninferior approach [22].

Another possible approach to reduce the occurrence DCO would focus on the metal scaffold employed in TAVR design. Currently, antiproliferative medication is used in DES design but is not utilized in TAVR design. Antiproliferative medication such as sirolimus and everolimus are widely used to coat coronary stents and serve to inhibit endothelial fibrosis and rethrombosis [23-28]. It is possible that the use of these medications in TAVR metallic scaffolding could mitigate the late pannus formation seen in this case report.

This case highlights a rare and potentially devastating mechanism for developing DCO several years after TAVR implantation. Optimizing post-implantation anticoagulation and exploring the use of anti-thrombotic materials in TAVR design may help mitigate and minimize such complications. Lastly, although cases are fortunately rare, anesthesiologists should be aware of DCO. DCO should be considered when patients with prior TAVR implantation present with symptoms of unstable angina and are found to have non-obstructive coronary disease. Not surprisingly, the hemodynamic parameters for DCO mirror that of flow-limiting coronary obstruction by minimizing the oxygen demands of the heart. Specifically, the anesthesiologist should aim to reduce preload, heart rate, and contractility, while increasing afterload and maintaining sinus rhythm.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author Contributions

Steven Chen: Investigation, Writing–Original draft preparation. Daniel Mattimore: Investigation, Writing–Original draft preparation. Jonathan Price: Investigation, Validation. Jeremy Poppers: Conceptualization, Investigation, Writing–Review and Editing.

Patient Consent

Consent for publication was obtained from the patient before submission. This manuscript adheres to the applicable EQUATOR guidelines. Pannus-Induced Delayed Coronary Obstruction After TAVR.

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