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PROCEDURAL COMPLICATIONS: PART 1

INTERMEDIATE

CASE REPORT: CLINICAL CASE

Don't Trust the Imaging

Necrotic Bowel Following Transcatheter Aortic Valve Replacement Through Aortic Stent Graft

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ABSTRACT

Mesenteric ischemia is a rare but lethal complication of transcatheter aortic valve replacement (TAVR). We present a challenging case of an 80-year-old man who had abdominal pain few hours following TAVR. Repeated abdominal and pelvic imaging showed no vascular obstruction, but exploratory laparoscopy revealed a necrotic bowel. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2020;2:2339–43) © 2020 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

An 80-year-old man with a past history of endovascular aortic repair (EVAR) was admitted for planned transcatheter aortic valve replacement (TAVR) because of symptomatic severe aortic stenosis. Initial evaluation revealed severe aortic stenosis that had been diagnosed 8 months earlier, with marked progression of transvalvular gradients along with worsening of New York Heart Association functional class caused by heart failure symptoms. A Society of Thoracic Surgeons Predicted Risk of Mortality score of 5.13% was calculated, and the heart team recommended TAVR.

LEARNING OBJECTIVES

- To recognize mesenteric ischemia as an early and life-threating vascular complication of TAVR.
- To understand the diagnostic challenges of mesenteric ischemia following transcatheter aortic interventions.
- To realize specific complications of TAVR in the subgroup of patients who underwent EVAR.

PAST MEDICAL HISTORY

The patient had a medical history significant for the following: long-standing hypertension; severe peripheral vascular disease, including abdominal aortic aneurysm that was treated by endovascular aneurysm repair (EVAR) using an Endurant II stent graft (Medtronic, Minneapolis, Minnesota) extending from below the renal arteries to both common iliac arteries (**Figures 1A to 1C**, Video 1); end-stage renal failure treated with hemodialysis; and a history of heavy smoking with chronic obstructive pulmonary disease.

INVESTIGATIONS

Transthoracic echocardiography showed a normal left ventricular ejection fraction, a mean aortic valve

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ABBREVIATIONS AND ACRONYMS

CT = computed tomography

CTA = computed tomography angiography

EVAR = endovascular aortic repair

NOMI = nonocclusive mesenteric ischemia

SMA = superior mesenteric artery

TAVR = transcatheter aortic valve replacement

gradient of 31 mm Hg, peak velocity 3.46 m/s, and an aortic valve area of 0.87 cm^2. Pre-procedural cardiac computed tomography (CT) was performed, and it demonstrated a trileaflet aortic valve with a high calcium score of 2,871 Agatston units, an annulus perimeter of 78.9 mm, and an area of 471 mm^2 (**Figures 2A to 2C**).

The patient underwent successful and uneventful TAVR using local anesthesia and an Evolut Pro 34-mm device (Medtronic, Minneapolis, Minnesota) (Videos 2, 3, and 4) with a right femoral approach (Video 5). There were no difficulties in delivering the Evolut system through the aortic graft (Videos 6 and 7), and the access site was closed with 2 ProGlide closure devices (Abbott Vascular, Santa Clara, California). The procedure was complicated by new left bundle branch block, but otherwise, the patient was clinically and hemodynamically stable and reported no pain. No vascular complications occurred. During his stay in the post-operative recovery unit, the patient complained of vague and mild lower back pain. Vital signs and the complete blood count were all normal. A couple of hours later, his pain exacerbated and required analgesics. The patient localized his pain to the lower abdomen. His abdominal examination showed a soft and lax abdomen with no tenderness or signs of peritonitis. Nonetheless, urgent abdominopelvic computed tomography angiography (CTA) was performed.

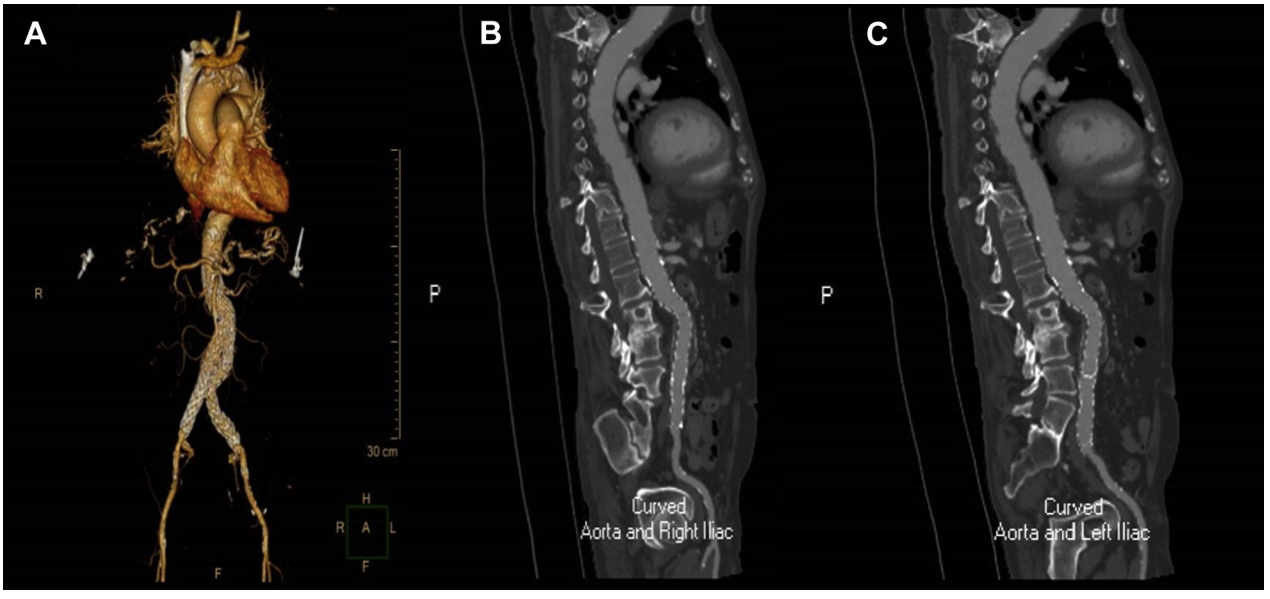
DIFFERENTIAL DIAGNOSIS

The differential diagnosis included exacerbation of chronic lower back pain, aortic dissection, retroperitoneal bleeding, acute mesenteric event, and urinary retention or obstruction.

MANAGEMENT

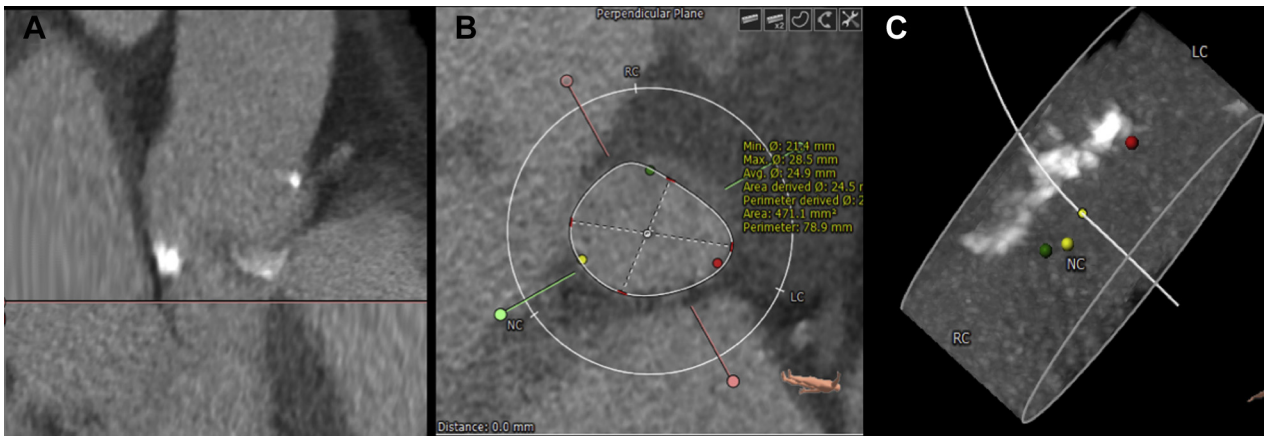
Initial abdominopelvic CTA showed no evidence of aortic dissection, retroperitoneal bleeding, or occlusion in abdominopelvic aortic branches, but it did show a new splenic infarct. Although the study identified no signs of obvious bowel ischemia, dilatation of the small bowel was noticed, along with a mildly distended gallbladder with no increase in wall thickness (**Figures 3A and 3B**). At that time, the patient was treated conservatively by rehydration and analgesics as needed together with close monitoring of blood count and serum lactate levels. Surgical consultation was obtained, and frequent clinical assessment was recommended. The patient reported pain improvement, but on the next day, he again reported abdominal pain, with further localization to the right upper and lower abdomen. A point-of-care

FIGURE 1 Pre-Procedural Computed Tomography



(A) A 3-dimensional reconstruction of the aorta. **(B)** Sagittal plane of the aorta showing the right common iliac artery and **(C)** the left common iliac artery. F = foot; P = posterior; R = right.

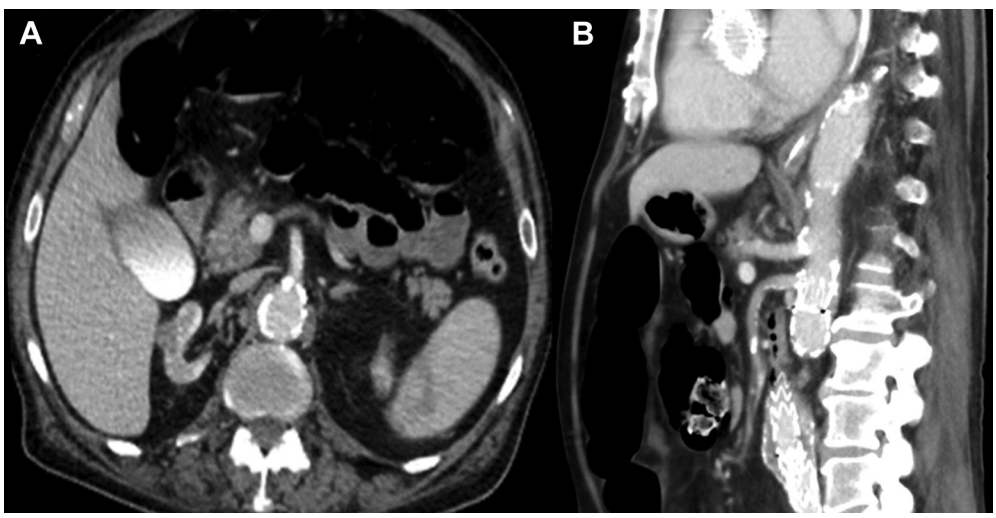
FIGURE 2 **Aortic Valve Annulus Measurements**



(A) Aortic valve annulus. **(B)** Annular diameter 21.4 × 28.5 mm; area, 471.1 mm^2; perimeters, 78.9 mm. **(C)** Calcium score of 2,871 Agatston units. LC = left coronary cusp; NC = noncoronary cusp; RC = right coronary cusp.

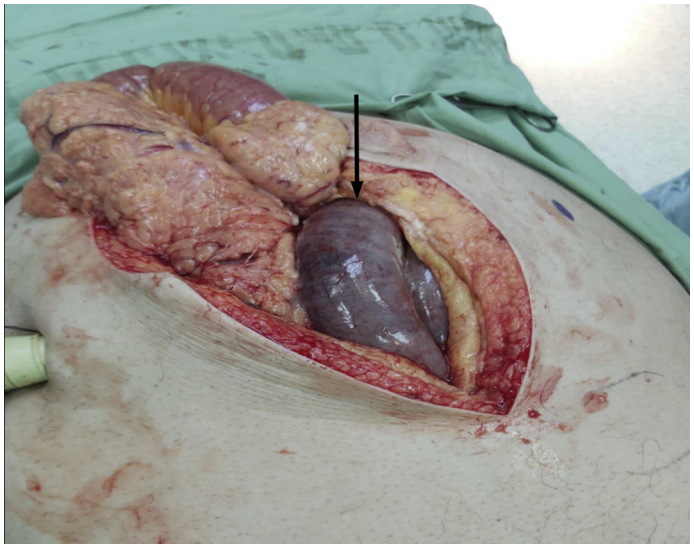
clinical assessment showed a distended tympanic abdomen and decreased bowel sounds on auscultation, in addition to tenderness during deep palpation over the right side of his abdomen. His white blood cells count was found to be elevated (15,000/μl [reference: 4,000 to 10,800/μl), and his C-reactive protein increased from 13 to 236 mg/l (reference: 0 to 5 mg/l), but lactate levels remained normal. He was taken for further abdominopelvic CTA, which showed no evidence of vascular occlusion in the mesenteric arteries or signs of bowel ischemia. Given his worsening abdominal pain, along with marked elevation of inflammatory markers, the patient was taken to the operating room for exploratory laparotomy, which revealed a necrotic small bowel (Figure 4) and a gangrenous gallbladder. Subsequently, the patient

FIGURE 3 **Post-Procedural Computed Tomography**



(A) Axial plane and **(B)** sagittal plane of post-contrast, portal-phase abdominopelvic computed tomography exhibiting a patent superior mesenteric artery.

FIGURE 4 Exploratory Laparotomy



Necrotic small bowel **(arrow).**

underwent cholecystectomy, small bowel resection of 1-m length, and diverting ileostomy.

DISCUSSION

Mesenteric ischemia following TAVR is considered a possible vascular complication in the Valve Academic Research Consortium-2 list of possible complications (1). Blood supply can be interrupted as a result of mesenteric branch occlusion either by thromboembolism or by direct aortic injury with subsequent extension to the adjacent bowel vascular bed (2); or, to lesser extent, it may manifest as nonocclusive mesenteric ischemia (NOMI) (3). Early thromboembolic events, especially cerebrovascular events, are well-recognized complications of TAVR, with a reported incidence of approximately 4%, and they are mostly related to device manipulation, valve deployment, and post-deployment valvular balloon dilatation (4). Although the exact mechanism of mesenteric ischemia following TAVR remains unknown, embolic events in the mesenteric arteries have mechanisms similar to those of cerebrovascular events.

This case underscores the importance of establishing alternative access options for TAVR programs. These options include transapical, direct aortic, transsubclavian, transaxillary and transcaval strategies. Although all of these alternatives have some risks, this case demonstrates how the retrograde femoral approach can also be dangerous for high-risk patients with a pre-existing aortic stent graft. Oliveira et al. (5) reported an endograft mural thrombus incidence rate of 16% following EVAR. Therefore, the aortic stent graft could have contributed to the increased embolic risk because the delivery of the valve system in retrograde fashion through the stent graft could have dislodged existing mural thrombus and tissue debris. This is especially true in our case of an older adult patient with peripheral vascular disease, a history of heavy smoking, and end stage renal disease treated with hemodialysis.

Despite the high probability of an occlusive cause in our reported case that was further supported by splenic infarct shown on CTA, 2 serial CTA studies revealed a patent superior mesenteric artery (SMA), a finding suggesting NOMI as a potential cause in our case. NOMI accounts for 20% of cases of mesenteric ischemic events, mostly attributed to SMA vasoconstriction along with reduced splanchnic blood flow, which usually coexists with predisposing conditions such as in critically ill patients with a low cardiac output state and vasopressor therapy (3). Noguchi et al. (6) described NOMI following successful TAVR, as confirmed by mesenteric angiography showing vasospasm of the SMA that was successfully treated by an intra-arterial papaverine infusion (6).

Our patient presented several diagnostic challenges, including the absence of serum lactate elevation and the lack of vascular occlusion on CTA. Thus, the diagnosis was based on a high index of suspicion, meticulous physical examination, and elevated markers of inflammation. Although 88% of established cases of mesenteric ischemia are associated with elevated lactate levels, our case clearly demonstrated how the lack of serum lactate elevation does not rule out mesenteric ischemia, and high index of suspicion is critical for a timely diagnosis (3). Moreover, this case exemplifies the importance of considering diagnostic laparoscopy sooner than later if inflammatory markers and physical examination findings are highly suggestive of ischemia even in the absence of clear vascular features on imaging studies.

FOLLOW-UP

Following the surgery, the patient was discharged to the surgical ward after a 1-week stay in the intensive care unit, and he will be transferred to a rehabilitation unit soon.

CONCLUSIONS

Mesenteric ischemia is rare but potentially fatal complication of TAVR. A high index of suspicion is mandated, especially for a NOMI diagnosis, which could be existing despite patent abdominal aortic branches noted on CTA and a normal serum lactate level. Given that the numbers of TAVR procedures in patients with aortic stent grafts are expected to increase, interventional cardiologists should be aware of this rare and potentially fatal complication, and alternative access strategies should be reviewed and discussed.

AUTHOR DISCLOSURES

The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS aortic valve, complication, necrosis, stenosis, thrombosis, thrombus, valve replacement

APPENDIX For supplemental videos, please see the online version of this article.