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MINI-FOCUS ISSUE: PROCEDURAL COMPLICATIONS

ADVANCED

CASE REPORT: CLINICAL CASE

Synchronous Type 3 EVAR Endoleaks at Multiple Sites Following Transfemoral Transcatheter Aortic Valve Replacement

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ABSTRACT

We describe a complication following transfemoral transcatheter aortic valve replacement in a patient who underwent remote endovascular abdominal aortic aneurysm repair. This report highlights technical complications to be vigilant of when using intravascular catheterization in patients with previous aneurysm repair while also showcasing synchronous type 3 endoleaks at multiple sites. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2022;4:742–750)

HISTORY OF PRESENTATION

A 78-year-old man presented in 2012 with an expanding 4.7-cm abdominal aortic aneurysm (AAA) complicated by a 2.5-cm right common iliac artery aneurysm (CIAA) and a 3.8-cm internal iliac artery aneurysm (IIAA). He first underwent embolization of the inflow and outflow of the right IIAA, given the lethality if this were to rupture, followed by endovascular aneurysm repair (EVAR) of the AAA and the right CIAA. He was very compliant with surveillance follow-up and underwent serial biannual computed tomography (CT) angiography (CTA) scans for 24 months postoperatively, all of which revealed no evidence of endoleaks. Thereafter, he underwent annual noncontrast CT and duplex ultrasound examinations for the following 7 years that continued to show no endoleaks and sac regression to 3.8 cm (**Figure 1**), down from 4.7 cm.

A little over 8 years post-EVAR without complications, the patient experienced worsening of underlying aortic stenosis (AS) as detected on a transthoracic echocardiogram, which showed an aortic valve area of 0.93 cm^2 and a mean gradient of

LEARNING OBJECTIVES

- To recognize type 3 endoleaks as plausible complications occurring after transfemoral TAVR in patients with previous EVAR.
- To promote vigilance in providers who are performing intra-aortic catheter-based procedures in patients with previous EVAR.
- To highlight that transfemoral TAVR in patients with previous EVAR is a high-risk procedure and should be considered only with extreme caution when other routes of access are deemed unfeasible.

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38 mm Hg, in conjunction with worsened dyspnea and fatigue. Given his advanced age, history of coronary artery bypass graft (CABG), and development of concomitant end-stage renal disease dependent on peritoneal dialysis, the patient was deemed an ideal candidate for transcatheter aortic valve replacement (TAVR). He was sized appropriately for a 26-mm SAPIEN-3 valve (Edwards Lifesciences). He underwent pre-TAVR femoral cardiac catheterization to elucidate his coronary anatomy; the study showed a 2/2 patent CABG, along with persistent native 2-vessel coronary artery disease. Given underlying EVAR, alternate access was considered; however, because of our patient's unfavorable anatomy, transcarotid or transsubclavian access was not feasible (Video 1), and transapical access was considered but deemed too invasive in view of our patient's comorbidities. On the day of the TAVR procedure, difficulty in obtaining percutaneous access of the left common femoral artery (CFA) as a result of scarring from previous EVAR was encountered, and the case was terminated pre-emptively to arrange for vessel access by open exposure for uncomplicated sheath insertion. Later that day, open exposure of the left CFA and placement of the 14-F valve delivery system were performed without immediate complications (Video 2); the right CFA was percutaneously accessed with placement of a 7-F sheath. The procedure was successful, and his recovery was uneventful, with discharge <48 hours postoperatively.

The patient returned 5 months post-TAVR because of chronic cholecystitis and a symptomatic inguinal hernia with a malfunctioning dialysis catheter. He underwent placement of a new peritoneal catheter, but abdominal pain persisted; thus, noncontrast CT of the abdomen was performed (Figure 2). The outer diameter measurements of the residual AAA sac had increased to 4.5 cm (up from the previous duplex scan when the sac measured 3.8 cm). Follow-up duplex study of his aorta was performed, revealing 2 distinct areas of synchronous EVAR graft endoleaks. One area of obvious flow through the stent graft appeared to be involving the distal aspect of the main body (Figure 3), and the second area was 2 to 3 cm distal, located on the proximal right iliac limb (Figure 4). The size of the leaks on duplex examination (1.6 mm) correlated with the size of wires or catheters used during transfemoral cardiac catheterization and TAVR, both from the right-sided femoral access (Figure 5). CTA of the abdomen and pelvis was obtained, and this confirmed the presence of contrast extravasation at these same 2 sites during the arterial phase of the scan; no other sites of endoleak were present (Figure 6). We believe this to be the first presumed case of iatrogenic synchronous type 3b endoleaks to be reported in the literature.

PAST MEDICAL HISTORY

In addition to the AAA and symptomatic AS outlined earlier, the patient had a complicated medical history, including coronary artery disease after remote CABG, end-stage renal disease requiring peritoneal dialysis, paroxysmal atrial fibrillation (treated with warfarin), obstructive sleep apnea, monoclonal gammopathy of undetermined significance, sick sinus syndrome with pacemaker, and cholecystectomy.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis included the following: 1) type 3 endoleaks secondary to intra-arterial catheterization procedures performed 5 months previously, including transfemoral cardiac catheterization and transfemoral TAVR placement; 2) spontaneous endoleaks secondary to inadequate overlap or fabric breakdown over 7 years; and 3) possible perforation of EVAR graft during valve deployment.

INVESTIGATIONS

Serial CTA scans and duplex ultrasound examinations performed after the original EVAR in 2012 and until 2020 revealed stability and sac regression from 4.7 cm to 3.8 cm over the course of 7 years. A few months after TAVR and cardiac catheterization in early 2021, CT of the abdomen reveals an AAA sac measuring 4.5 cm, with an aortic duplex study confirming the presence of synchronous endoleaks.

MANAGEMENT

On finding progression of sac size along with endoleaks on the duplex study and CTA, the patient

ABBREVIATIONS AND ACRONYMS

AAA = abdominal aortic aneurysm

AS = aortic stenosis

CABG = coronary artery bypass graft

CFA = common femoral artery

CIAA = common iliac artery aneurysm

CT = computed tomography

CTA = computed tomography angiography

EVAR = endovascular aneurysm repair

IIAA = internal iliac artery aneurysm

TAVR = transcatheter aortic valve replacement

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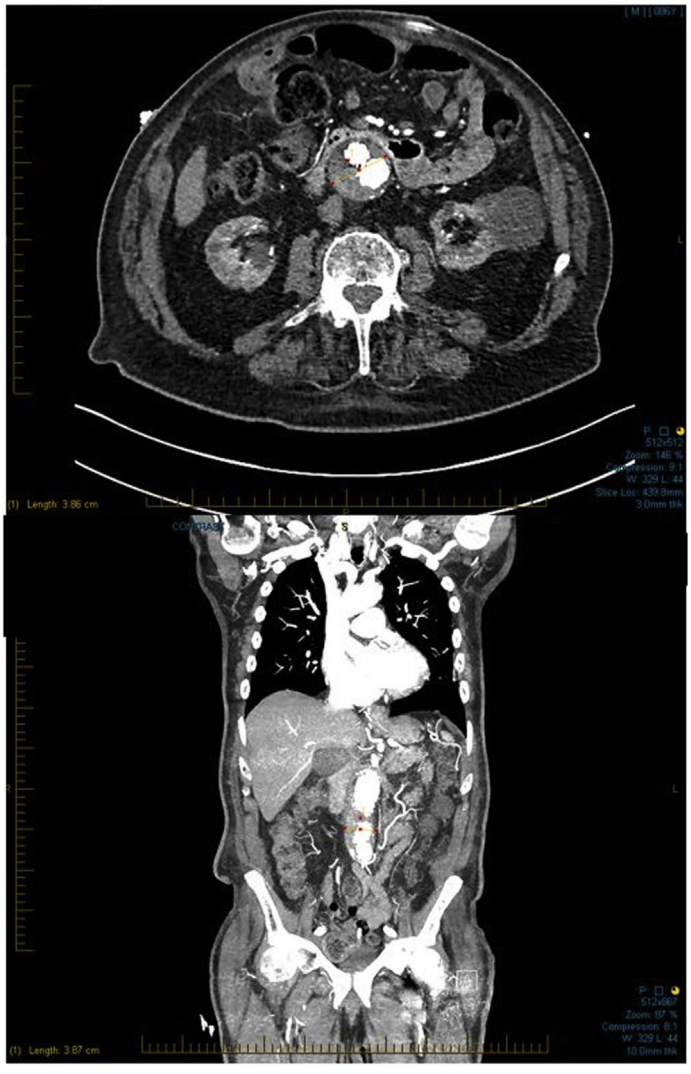
FIGURE 1 Pre-Transcatheter Aortic Valve Regurgitation Computed Tomography of the Abdomen With Contrast Revealing a 3.8-cm Abdominal Aortic Aneurysm in the Axial and Coronal Slices



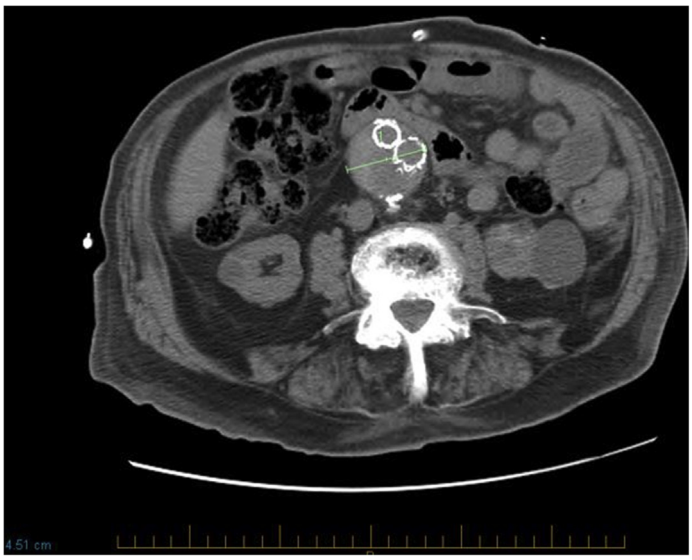
(Bottom left) Measurements of diameter.

underwent endoleak repair. Bilateral femoral access was obtained; a small, active area of extravasation in the distal main body of the graft and another area of contrast leak in first 2 cm of the right limb of the graft were visualized. These findings corresponded directly with sites on the duplex study and CTA. The main body of the graft was relined with a cuff extended down to the flow divider (28-28-49), with the right limb relined proximally with a new limb (16-16-82), with slight proximal overlap into the new cuff. Postprocedural views revealed significant improvement.

DISCUSSION

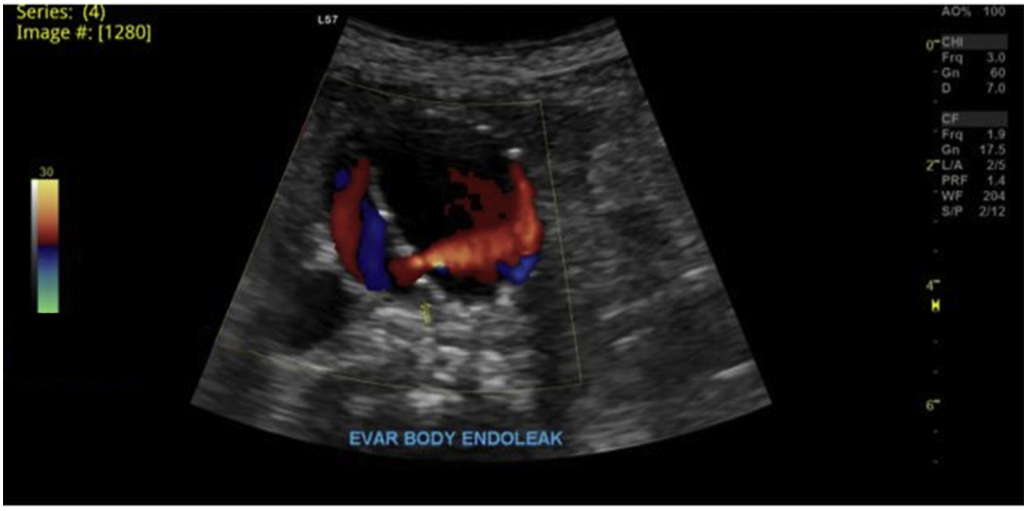
This case report highlights the rare complication of type 3b endoleaks secondary to a presumable iatrogenic cause. We perceive that the cause of the endoleaks was possibly a wire or catheter advanced from the right-sided access, given the size and

FIGURE 2 **Expansion of Previous Aneurysmal Diameter From 3.8 cm to 4.5 cm Within 6 Months**



laterality of the leaks found. The proximal right iliac limb graft approached the main body with a 45° to 50° angle in its course (Figure 7). This angle may have deflected a guidewire under a fold in the stent graft at the inner part of the bend, thus causing it to puncture the graft material. Following this trajectory, the wire would have either advanced along between the main body and native aortic neck or instead re-entered the

FIGURE 3 **Endoleak Depicted on a Duplex Study in the Main Body of the EVAR Graft**



EVAR = endovascular aneurysm repair.

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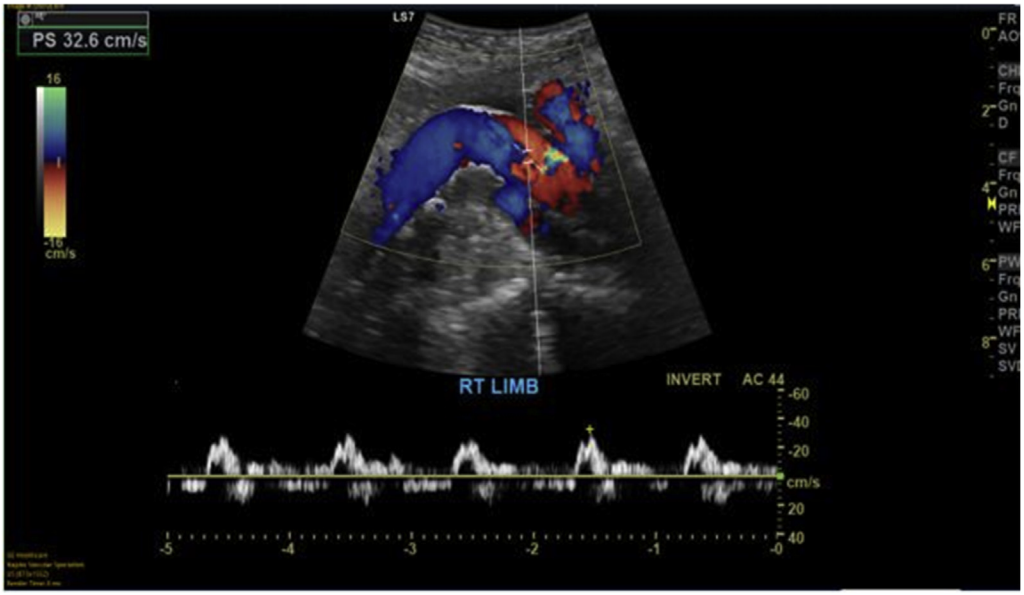
FIGURE 4 **Proximal Right Limb of the Graft Revealing a Second Endoleak**



RT = right.

main body, which it appears to have done (Figure 8). One suggested strategy, especially when advancing or maneuvering a wire within an endovascular device, is to advance a pig-tail catheter with partial wire support gradually while slowly spinning it to avoid puncturing a device or slipping between overlap sites. This maneuver is always done under live direct imaging, although this strategy is not supported by fortified data in this specific patient subset. The age of the graft material, nearly 8 years, may also have contributed to the ability of a wire to puncture the graft so readily.

Given the placement of the third-generation Endurant endograft in our patient, the reported incidence of experiencing type 3 endoleaks is <2%.[1,2] Type 3 endoleaks usually result in rapid aneurysm expansion, as evidenced in our patient's timeframe with expansion from 3.8 to 4.5 cm within 5 months. Once found, prompt intervention is required. Type 3b endoleaks, notoriously defined as fabric disruption of the actual endograft, are rare, especially in the endovascular graft placed in our patient; this subtype of endoleak can be further subdivided into holes >2 or <2 mm.[3] Definitive diagnosis of type 3b endoleak remains a challenge, with CTA confirming approximately 20%.[4]

Limited data currently exist regarding preprocedural planning in this subset of patients with previous EVAR who are undergoing transfemoral intravascular catheterization; nonetheless, the feasibility of performing specifically tailored duplex imaging of previously repaired aneurysms before proceeding with transfemoral TAVR should be further investigated where alternative access may pose hindrance. Through extensive literature review, we found no rigid recommendation on severity of vessel tortuosity or angulation that may preclude proceeding with a transfemoral approach in patients with previous EVAR; however, if alternate access is a possibility, it should be prioritized. In addition to limited guidance in place for preprocedural planning, minutiae of data exist supporting periprocedural and postprocedural monitoring as well. Perhaps more judicious use of contrast material, especially when passing wires or

sheaths through previous EVAR, is warranted, with more vigilant follow-up with vascular surgery in the outpatient setting after TAVR.

There are numerous cases in the literature of focal aortic perforation during TAVR that necessitated emergency EVAR[5,6]; nonetheless, rare in the literature are cases of transfemoral catheterization and TAVR contributing to a type 3b EVAR endoleak, let alone synchronous endoleaks. We hope our case serves to streamline further investigative efforts in hopes eventually to delineate a standardized protocol in patients with previous endovascular grafting as TAVR becomes a more favorable option for patients such as ours.

FOLLOW-UP

At 1-month follow-up, postoperative CTA was performed, confirming resolution of endoleaks and sac regression to 4.3 cm (**Figure 9**).

CONCLUSIONS

With the advent of novel transcatheter valve replacement methods, it is imperative to recognize the risk that intravascular catheterization can impose on previous endovascular stents or grafts for aneurysmal repair. The course of stent grafts used to treat thoracoabdominal aortic diseases can often be tortuous and steeply angled, with in-folding material and struts that can impede or redirect wire or catheter advancement. We hope to promote awareness of this complication and urge fellow clinicians to remain vigilant of previous endovascular grafts before proceeding with routine transfemoral catheterization procedures.

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

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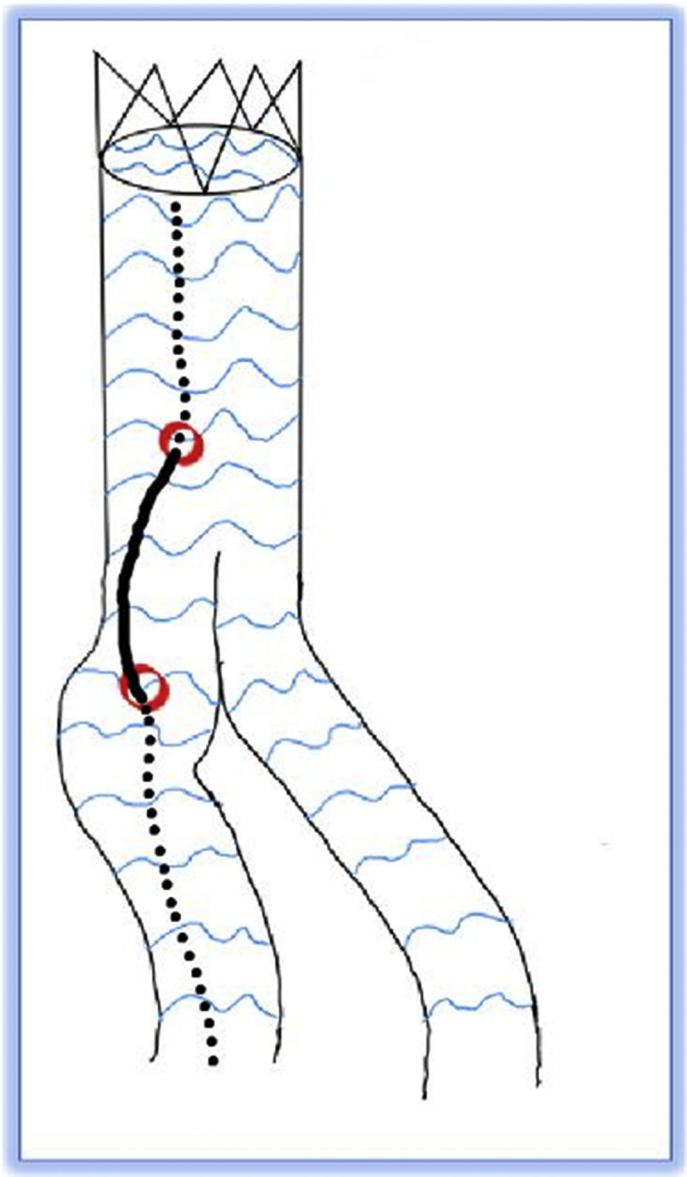
FIGURE 5 Depiction of Endovascular Aneurysm Repair Graft With Suspected Sites of Endoleaks Correlating With Sizes of Intravascular Catheters Used During Transcatheter Aortic Valve Regurgitation



The **dotted line** represents the transfemoral intravascular catheter within the graft, whereas the **solid line** represents where supposed graft perforations occurred. The **red circles** are the hypothesized entry and exit points of the wire.

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FIGURE 6 **Computed Tomography Angiography Depicting Contrast Extravasation From the Body and Proximal Right Limb of the Graft That Confirms the Presence of Synchronous Endoleaks**

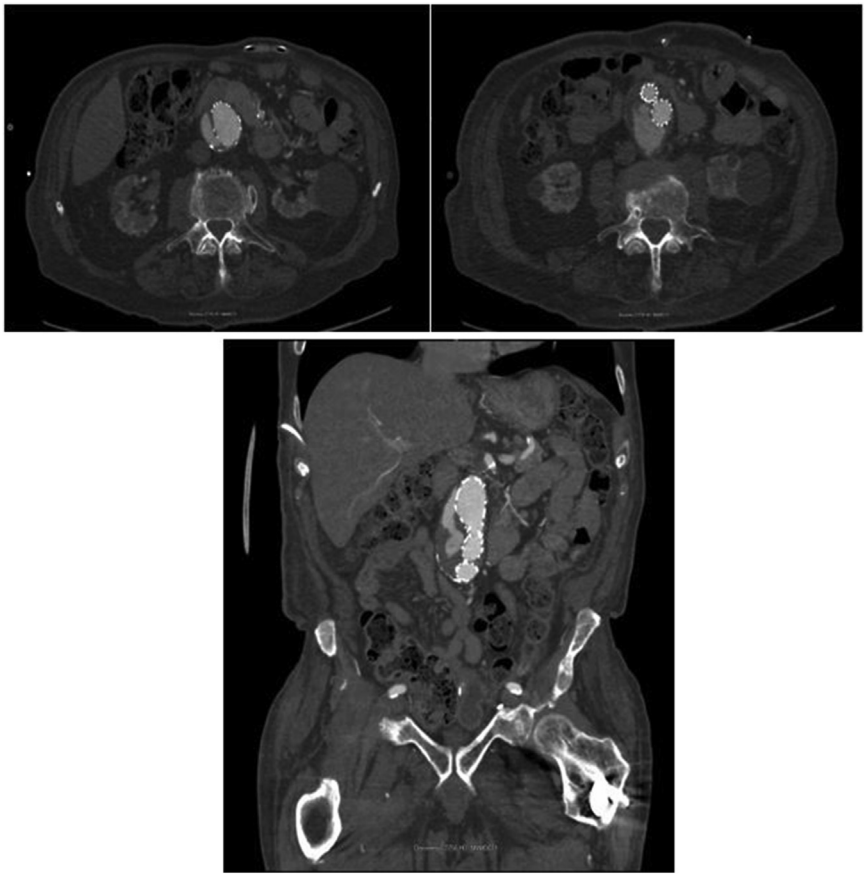


FIGURE 7 **The 3-Dimensional Renderings of Gated Computed Tomography Angiography Highlighting Tortuosity Within the Endovascular Graft**

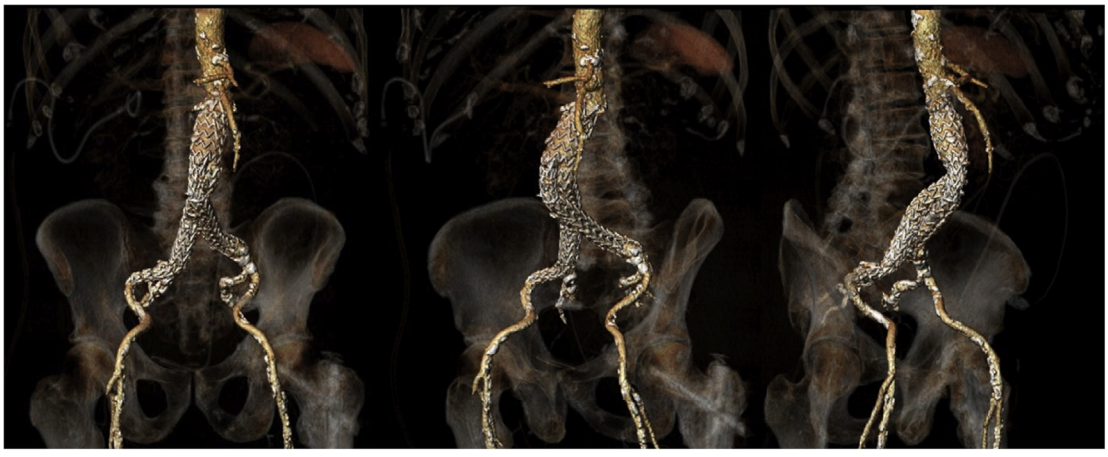
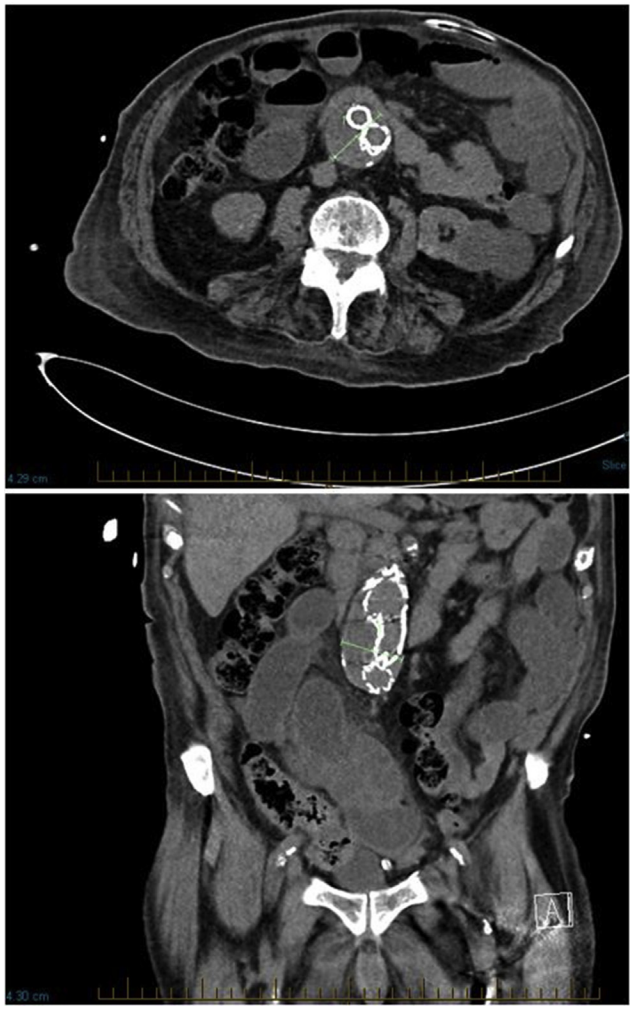


FIGURE 8 Computed Tomography Angiography Before Transcatheter Aortic Valve Regurgitation

Computed tomography angiography depicts a steep angulated curvature of the endovascular graft with a hypothesized pathway **(red)** for perforation resulting in synchronous type 3B endoleaks.

FIGURE 9 Computed Tomography Images of the Abdomen and Pelvis Performed After Endovascular Repair Revealing Aneurysmal Diameter Decreased to 4.3 cm From 4.5 cm



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KEY WORDS aneurysm, endoleak, complications, EVAR, TAVR

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