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Case report

ENDOVASCULAR REPAIR OF THORACO - ABDOMINAL AORTIC ANEURYSMS IN A PATIENT WITH SEVERELY CALCIFIED ILIAC ARTERY ACCESS AND ACUTE CORONARY SYNDROME: A CASE REPORT

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ABSTRACT

Abstract: *Thoracic and abdominal aortic aneurysms in patients with acute coronary syndrome present a rare and complex condition that remain significant diagnostic and management challenges. However, advancements in endovascular technology allow for the treatment of severe cases with minimal invasiveness, even in patients with unfavorable vascular access. In a patient presenting with acute chest pain and diagnosed with a large thoracic aortic aneurysm, abdominal aortic aneurysm, severely calcified iliac artery stenosis, and acute coronary syndrome, three critical management questions must be addressed: (1) whether to prioritize the treatment of the aortic aneurysms or acute coronary syndrome; (2) determining and optimizing the vascular access strategy for thoracic aortic Stent Graft deployment; and (3) the optimal approach to managing the abdominal aortic aneurysm with significant unilateral iliac artery stenosis. We report the successful endovascular repair of a patient with both thoracic and abdominal aortic aneurysms, severely calcified bilateral iliac artery access, and acute coronary syndrome.*

Keywords: *Thoracic aortic aneurysm, thoracic endovascular aortic repair, abdominal aortic aneurysm, endovascular aneurysm repair, acute coronary syndrome, percutaneous coronary intervention.*

I. BACKGROUND

Both coronary artery disease and aortic aneurysms share common risk factors. Thus, thoracic and abdominal aneurysms can coexist with acute coronary syndrome (ACS). Both conditions are life-threatening without prompt treatment. Historically, coronary artery bypass grafting (CABG) combined with aortic replacement was standard, though these complex surgeries required lengthy recovery [1, 2]. Advances in interventional cardiology now favor minimally invasive treatment for descending thoracic and abdominal aneurysms in elderly patients with comorbidities. However, success in endovascular repair relies on favorable vascular anatomy, with calcified, tortuous iliac arteries posing significant challenges [3, 4]. We report a successful endovascular repair for thoracic and abdominal aneurysms with severely calcified iliac access in a patient with acute coronary syndrome

II. CASE PRESENTATION

A 73 - year - old male with hypertension and dyslipidemia presented with two weeks of chest pain (radiating to the back and left arm), dysphagia, intermittent abdominal pain, and right-predominant leg weakness. The patient was hemodynamically stable with clear heart sounds and no abdominal tenderness. ECG showed negative T waves (D2, D3, aVF, V1-V3) without ST changes, while hs-Troponin T rose from 0.23 to 0.34 ng/ml, indicating high-risk NSTEMI. Echocardiography revealed mild anterior and posterior wall hypokinesis with an EF of 50%. Computed tomography angiography (CTA) was performed, revealing: (i) A fusiform thoracic aortic aneurysm (TAA) measuring up to 60 mm in the widest diameter, with upper and lower neck diameters of 32 mm and 27 mm, respectively, extending 14 cm with scattered atherosclerosis and an intramural hematoma measuring 15 mm in

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thickness, without dissection (Figure 1A, Figure 1B, and Figure 1C); (ii) An infrarenal fusiform abdominal aortic aneurysm (AAA) to bifurcation measuring 63 mm at its widest diameter with an upper and lower neck diameters of 18 mm and 13 mm, respectively, extending 7 cm with scattered atherosclerosis and an intramural hematoma measuring 33 mm in thickness, without dissection (Figure 1A and Figure 1D); (iii) Severe calcification and stenosis (≥ 70% left, ≥ 85% right) of the iliac arteries (Figure 1E).

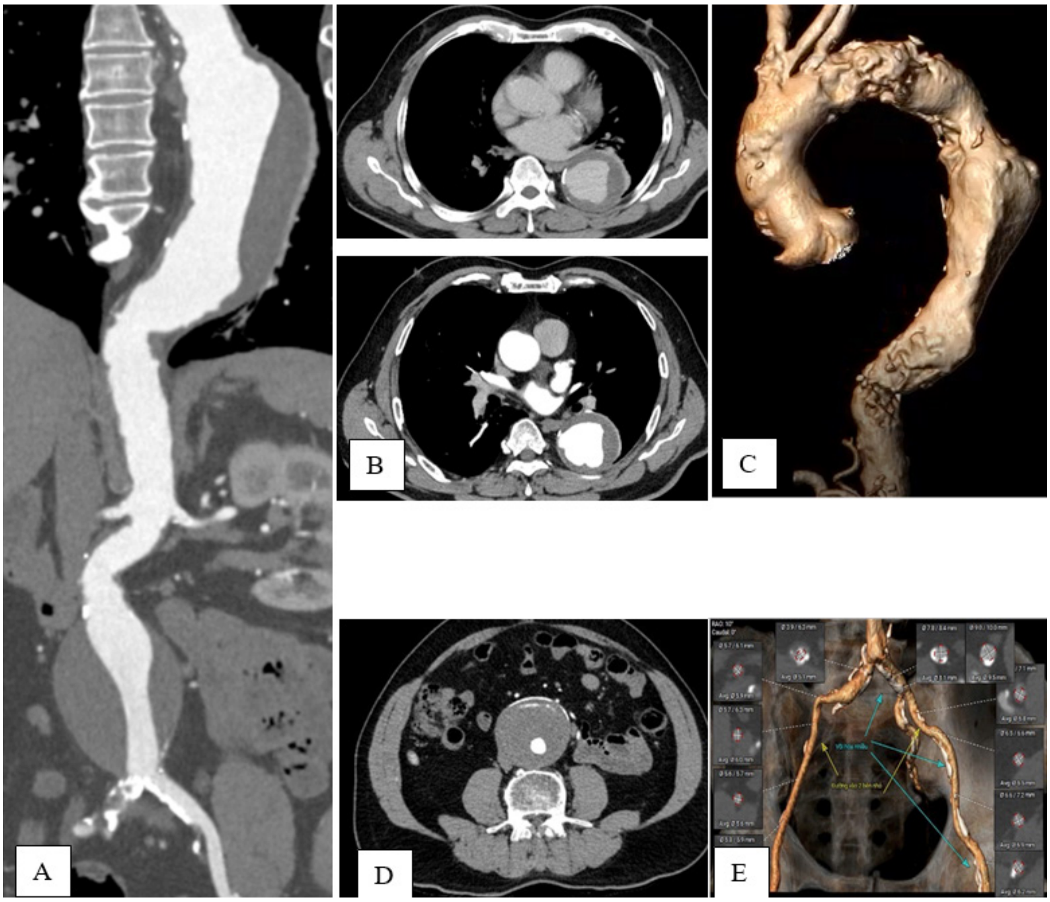

Figure 1: A-Both aneurysms. B- Thoracic aortic aneurysm. C-3D-reconstruction showing TAA. D- Abdominal aortic aneurysm. E- Severely calcified bilateral iliac arteries

In case presentation, the patient presented with chest pain that could be attributed to both underlying conditions. However, myocardial infarction (MI) was identified as the most acute and life-threatening condition requiring immediate intervention. Coronary angiography was performed via the right radial artery, revealing the following findings: (i) Right Coronary Artery (RCA): severe stenosis extending from the distal D1 segment to the end of the D2 segment (Figure 2-A); (ii) Left Anterior Descending Artery (LAD): severe stenosis in the D2 segment with TIMI II flow (Figure 2-C). Percutaneous coronary intervention (PCI) was successfully performed with stent placement: a 3.0 x 32 mm stent and a 3.5 x 24 mm stent were placed from the proximal segment to the end of the middle segment of the RCA (Figure 2-B); and a 3.0 x 24 mm stent was placed in the mid-segment of the LAD (Figure 2-D)

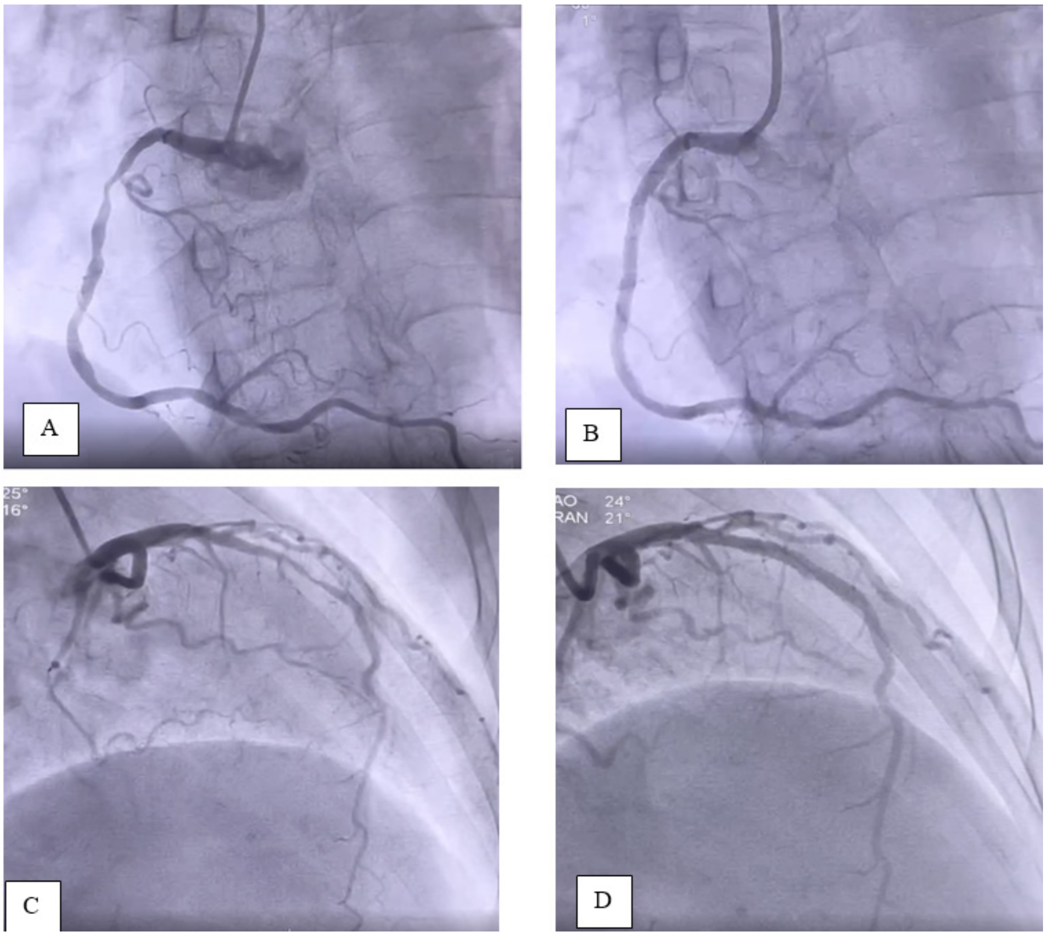

Figure 2: A-Severe stenosis of 90 - 95% of the RCA. B-Successful revascularization of the RCA. C-Severe stenosis of 90% of the LAD. D-Successful revascularization of the LAD

Following PCI, the patient experienced significant improvement in chest pain, although mild residual pain persisted, accompanied by recurrent episodes of dysphagia. Two days post-PCI, thoracic endovascular aortic repair (TEVAR) was performed to address a TAA. The left femoral artery was used as the access site; gradual dilation of the common iliac artery was achieved using a 7x40 mm peripheral balloon, followed by the placement of a 20F sheath to facilitate the procedure. A stiff wire was advanced through the iliac artery into the thoracic aorta (Figure 3-A) and a Pigtail catheter was inserted into the ascending aorta via the right radial artery to precisely locate the TAA. Stent Graft Placement: using a bottom-up approach: An auxiliary Stent Graft (32x32x200 mm) was positioned above the celiac trunk; The main Stent Graft (38x34x150 mm) was deployed in the thoracic aorta, just distal to the left subclavian artery, effectively covering the aneurysm (Figure 3-B).

Post-TEVAR imaging confirmed proper positioning of the Stent Graft and effective exclusion of the aneurysm, with no evidence of dissection, thrombosis, or endoleak. All lateral branches remained intact (Figure 3-C). The patient's chest pain resolved immediately following TEVAR. The patient was discharged three days later, symptom-free, on long-term dual antiplatelet therapy (aspirin and ticagrelor) and optimal blood pressure and heart rate management.

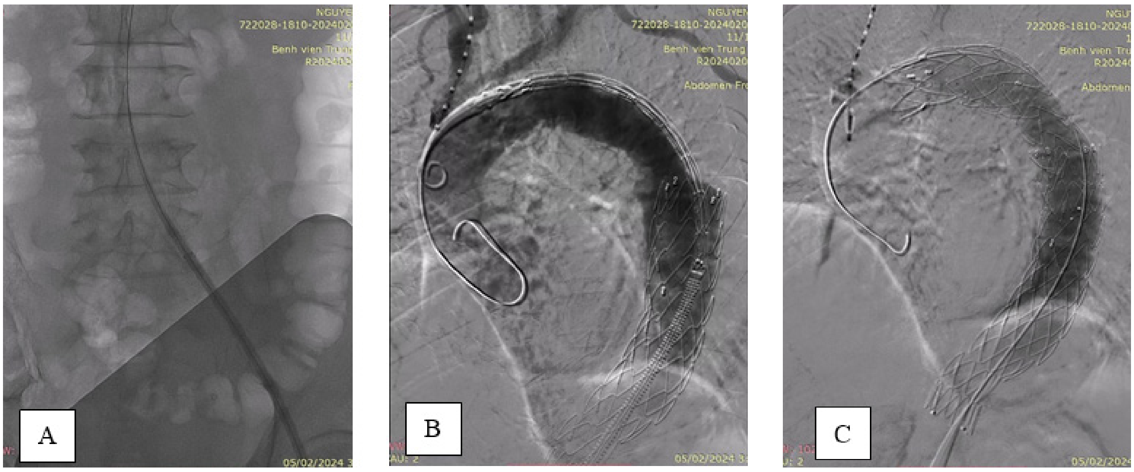

Figure 3: A-Gradual dilation of the iliac artery to establish vascular access;
B-Placement of the Stent Graft using a bottom-up approach;
C-Post-TEVAR imaging demonstrating proper positioning of the Stent Graft

One month later, EVAR combined with hybrid femoral-femoral bypass was performed. The left femoral artery served again as access for stent deployment and the right brachial artery for pigtail catheter insertion (Figure 4-A). An aorto-uni-iliac (AUI) Stent graft was deployed with a 22x14x102 mm main graft in the infrarenal aorta and an auxiliary piece 16x10x93 mm iliac extension on the left side (Figure 4-B).Post-EVAR imaging confirmed proper stent placement from the abdominal aorta to the left iliac artery without endoleak (Figure 4-C). A day later, successful femoral-femoral bypass surgery was performed, with no signs of right leg ischemia during hospitalization or follow-up.

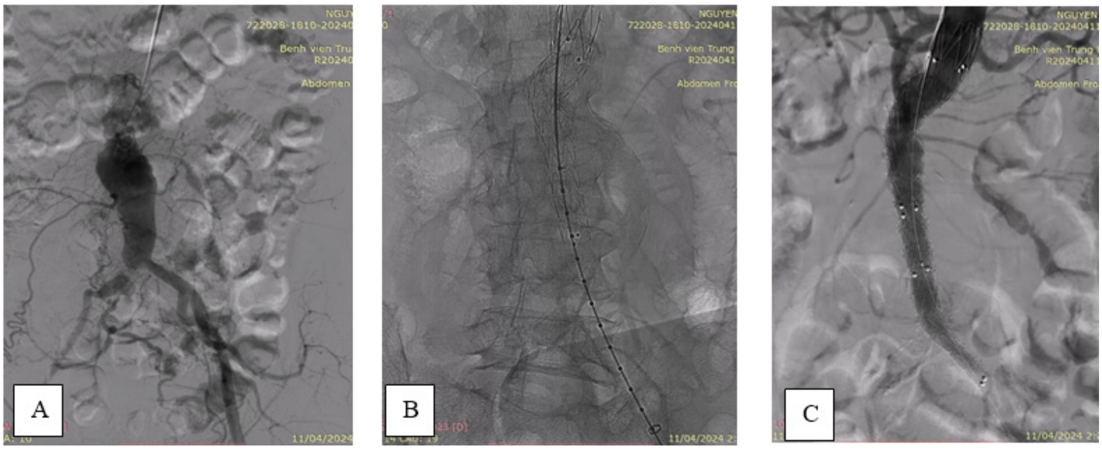

Figure 4: A-An AAA with very severe calcification and semi-occlusion of the right iliac artery;
B- Successful placement of the AUI Stent Graft infrarenal arteries;
C-Successful placement of the Stent Graft.

At six months, CTA showed stable stent position without endoleak and an intact bypass. The patient remained symptom-free with strong, symmetric lower limb pulses and no claudication

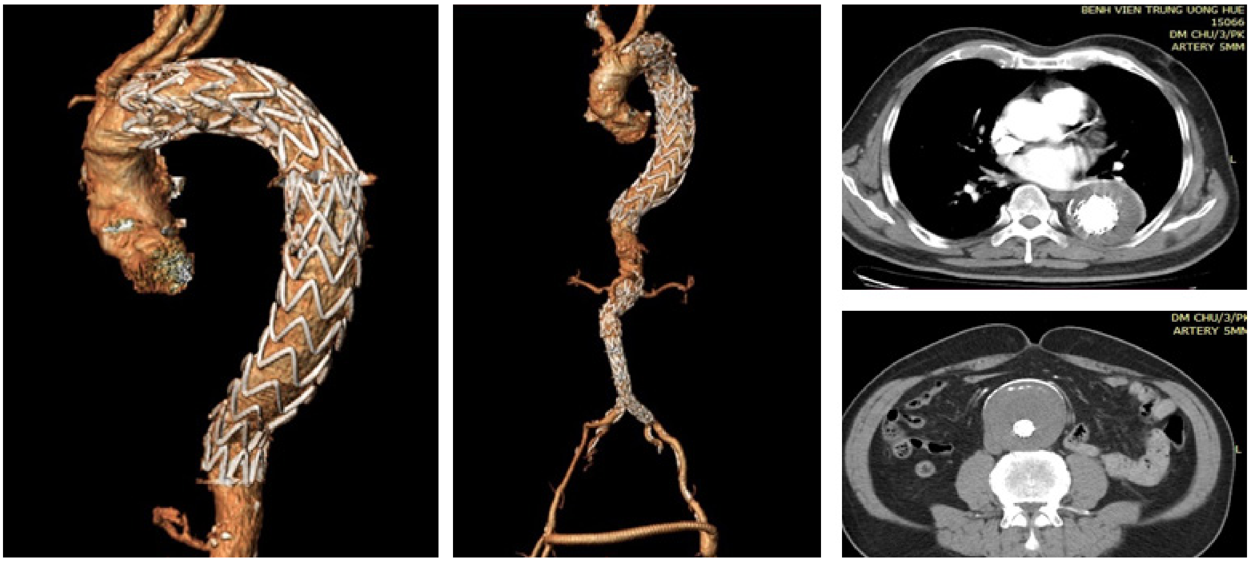

Figure 5: Six-month follow-up of the Stent Graft demonstrated favorable results.

III. DISCUSSION

Both coronary artery disease and aortic aneurysms share degenerative and inflammatory processes, often coexisting in the same patient [5, 6]. As life expectancy increases, procedures addressing multiple lesions, such as ACS coexisting with thoracic and abdominal aneurysms, have become more common [7]. A review of repair cases for thoracic and abdominal aortic aneurysms reported a myocardial infarction (MI) incidence of 3% [5]. Although ACS is readily identified via symptoms and biomarkers, atypical presentations (e.g., back pain, dysphagia) can mask coexisting aortic aneurysms, making CTA essential for diagnosis [8].

Type A aortic dissection with MI is more common, whereas descending aortic aneurysm with MI is relatively rare. A critical question in cases of aneurysm combined with ACS is deciding which lesion to treat first. While an aneurysm is a chronic condition that may progress to an acute rupture, especially when symptomatic, ACS represents a life-threatening acute condition with risks of arrhythmias, cardiogenic shock, or death if not treated promptly. The decision-making process is therefore challenging.

While combined CABG and aortic replacement is viable. This approach is generally reserved for cases involving aneurysms or dissection of the ascending aorta. Furthermore, simultaneous surgery for both conditions is complex, especially in severe cases requiring double bypass, leading to extended surgery and increased risk.

A more commonly adopted strategy is to first perform anterior coronary artery revascularization, followed by staged management of the aortic aneurysm [9]. For MI patients, cardiologists should assess the safety of delaying elective aortic surgery. The decision-making process should align with standard indications and approaches for coronary revascularization, regardless of the presence of an aortic aneurysm [5]. If surgery is chosen, hemodynamic instability during the postoperative period may cause systemic blood pressure fluctuations, potentially worsening the aneurysm [1, 9]. This increases the risk of rupture, with rates reported as high as 33% within four weeks following heart surgery [1].

We prioritized PCI for anterior MI due to its feasibility and rapid execution, while initially managing the aneurysm medically with plans for later repair (Figure 1). Residual chest pain indicated contributions from both coronary and aortic pathology, underscoring the need for prompt aneurysm treatment - preferably via endovascular repair in patients with favorable anatomical features [3, 5].

As the average age of the population increases, the prevalence of vascular diseases and aneurysms rises correspondingly. While most aneurysms progress chronically, a sudden rupture can result in fatal outcomes. Approximately 10 - 20% of patients with AAA have concurrent TAA, most commonly involving descending thoracic aortic pathologies and infrarenal AAA [10, 11]. In cases where AAA and TAA coexist, a multi-stage surgical approach is frequently considered. However, such an approach may pose significant challenges, including the need for repeated anesthesia and an elevated risk of complications, such as aneurysm rupture, during the waiting period for subsequent surgeries.

For this patient, several treatment approaches were proposed. The first option involves simultaneous surgical repair of both TAA and AAA in a single stage; however, this is a highly challenging surgery requiring separate surgical incisions. The second option is a staged surgical approach, where the priority is determined based on the size and symptoms of the aneurysms, with symptomatic and larger aneurysmal segments addressed first [12]. Although studies reveal that 30% of deaths following the repair of a descending thoracic aneurysm are associated with the rupture of an untreated infrarenal aortic aneurysm at the same time [2]. Based on this data, Crawford advocated for concurrent surgery in patients who remain hemodynamically stable after the initial aortic replacement surgery. This approach has a reported mortality rate of 10%. However, the number of patients meeting the criteria for such a procedure is limited, with only 24 out of 191 patients with multiple aortic aneurysms being eligible [12]. In the present case, the patient's advanced age significantly increases the perioperative risk. Consequently, surgical intervention on both aneurysms, whether performed in a single stage or through a staged approach, also carries significant risks.

Since the first TAA endovascular repair in 1992, TEVAR has become a valuable alternative to open surgery [2]. An alternative strategy involves performing an abdominal surgical approach to establish access for subsequent TEVAR. However, this approach is associated with significant risks, especially in patients who have recently undergone coronary stent placement and are on anticoagulant therapy, as is the case with this patient [2]. Furthermore, the patient's increasing chest pain necessitates prioritizing the treatment of the TAA. Current evidence supports managing TAA first, as secondary or residual aneurysms can rupture unexpectedly before the planned staged intervention. Rupture of a TAA is often catastrophic, leading to rapid exsanguination and mortality within minutes. By contrast, rupture of an AAA typically provides a longer therapeutic window, with patients frequently surviving for hours or even days, allowing for timely intervention Additionally, AAAs are more amenable to surveillance for potential rupture due to their easier palpation and more pronounced pre-rupture symptoms compared to TAAs [12].

In recent decades, endovascular repair of aortic pathologies, including aneurysms, has emerged as an acceptable alternative to open surgery for the treatment of TAAs and AAAs, particularly in cases meeting specific anatomical criteria favorable for endovascular repair. Endovascular therapy offers a safe and effective treatment option for high-risk surgical patients and has demonstrated comparable outcomes to open surgery over a 10-year follow-up period [13]. It is also possible to repair coexisting TAAs and AAAs by deploying both thoracic and abdominal Stent Grafts. This can be performed either simultaneously or in a staged manner, representing a viable alternative for patients with elevated surgical risk [2].

Following multidisciplinary consultation, we prioritized endovascular TAA repair. However, due to stenosis at point of the iliac artery acess, thoracic stent deployment posed certain risks. These included difficulties in advancing the delivery system through the narrowed access route to the thoracic aorta and the potential for the delivery system to become stuck at the iliac entry point during withdrawal.

A tailored approach using gradual dilation of the less stenotic left iliac artery enabled successful stent graft delivery (Figure 2-A). A pigtail catheter introduced via the radial artery facilitated aortic imaging. After multiple dilations, the Stent Graft system was successfully advanced into the aorta.

The deployment followed a bottom-up approach, starting with an auxiliary piece (Figure 2-B). This strategy was chosen for two main reasons: the auxiliary piece, with a diameter of 22F, was smaller and helped further dilate the iliac artery, facilitating the subsequent passage of the main body (26F) through the narrowed segment; the anatomical mismatch between the proximal neck diameter of 32 mm (below the left subclavian artery) and the distal neck diameter of 27 mm (above the celiac artery) necessitated placing the main body later. This ensured that the distal end of the main body would fit securely inside the proximal end of the auxiliary piece, preventing any endoleaks. Using a pigtail catheter, the aneurysm was visualized, and the stent was successfully deployed just distal to the left subclavian artery (Figure 2-C).

Post-TEVAR, the patient experienced significant pain relief, suggesting that the AAA could be managed medically through blood pressure and heart rate control. AAA repair was scheduled one month later to allow for de-escalation of dual antiplatelet therapy, reducing hemorrhagic risks while minimizing coronary thrombosis [6].

One month of outpatient follow-up revealed continued improvement in abdominal pain. However, the aneurysm remained large, accompanied by iliac artery stenosis. Numerous studies have shown that iliac stenosis is a risk factor for rapid aneurysm growth. From an anatomical perspective, the patient remained a suitable candidate for EVAR, given the favorable landing zones and optimal aneurysm neck angles. Thus, the indication for Stent Graft placement was confirmed. Additionally, this decision aligned with the family's wishes after comprehensive explanation of the condition and treatment options.

Severe calcification of the left pelvic artery posed a significant risk of stent fracture during the placement of a standard bifurcated Stent Graft at the iliac bifurcation. To address this challenge, a single aortic-unilateral iliac (AUI) Stent Graft was selected, followed by posterior femoral-femoral bypass surgery (Figure 4-ABC). This hybrid technique is minimally invasive and has demonstrated both medium- and long-term efficacy. It is particularly favored in cases with extensive pelvic artery calcification [14]. In Vietnam, Uoc N.H, and et al reported a successful case of AUI Stent Graft placement in a patient with 75% stenosis of the right pelvic artery, further supporting the viability of this approach in similar anatomical conditions [15]. In a study by Smit involving 33 patients, the combination of a AUI Stent Graft and femoral-femoral bypass yielded positive outcomes, with all participants successfully avoiding limb ischemia [16]. This approach demonstrates that a femoral-femoral bypass can facilitate EVAR in patients with challenging pelvic or femoral artery anatomy. Conditions such as stenosis, occlusion, tortuosity, severe calcification, thrombosis, or arterial dissection were successfully managed using this technique, achieving comparable efficacy to standard bifurcated Stent Graft placement [17].

IV. CONCLUSION

The treatment of thoracic-abdominal aortic aneurysm in patients with coronary artery disease should be individualized based on severity and life-threatening risk. Balloon dilation or large sheaths facilitate safer thoracic Stent Graft placement, particularly in cases with calcified femoral arteries. For large abdominal aortic aneurysms with severe iliac stenosis, an AUI Stent Graft combined with femoral-femoral bypass is an effective alternative.

Competing interests

The authors declare that they have no competing interests.

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