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Case Report

One-stop transcatheter aortic valve replacement and fenestrated endovascular aortic aneurysm repair: A case report ☆

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ABSTRACT

The management of patients with severe aortic valve stenosis and an abdominal aortic aneurysm is a real therapeutic challenge. Minimally invasive treatment is more beneficial than open surgery for treating both aortic valve stenosis and abdominal aortic aneurysm. We present a case of a 77-year-old male initially treated with a 26 mm Sapien 3 transcatheter aortic valve replacement. Subsequently, using the same femoral access points, a custom fenestrated endoprosthesis and stents in digestive trunks and renal arteries were implanted. Follow-up imaging revealed no dysfunction of the valve, endoprosthesis, or stents.

This is the first reported successful concomitant management of significant aortic valve stenosis and infrarenal abdominal aortic aneurysm through transcatheter aortic valve replacement and fenestrated endovascular aortic aneurysm repair.

Introduction

The prevalence of significant aortic valve stenosis (AV) and abdominal aortic aneurysm (AAA) is increasing, particularly among elderly patients [1] and represents a real therapeutic challenge. There are several options available, including concurrent or sequential treatment, either through open or endovascular surgery. It is currently understood that minimally invasive treatment is more beneficial than open surgery for treating both AV stenosis [2,3] and AAA [4,5], particularly in the case of a high-risk patient. In this case report,

Abbreviations: AV, aortic valve; AAA, abdominal aortic aneurysm; TAVR, transcatheter aortic valve replacement; FEVAR, fenestrated endovascular aortic aneurysm repair; CTA, computed tomography angiography; TEE, transesophageal echocardiography; TTE, transthoracic echocardiography.

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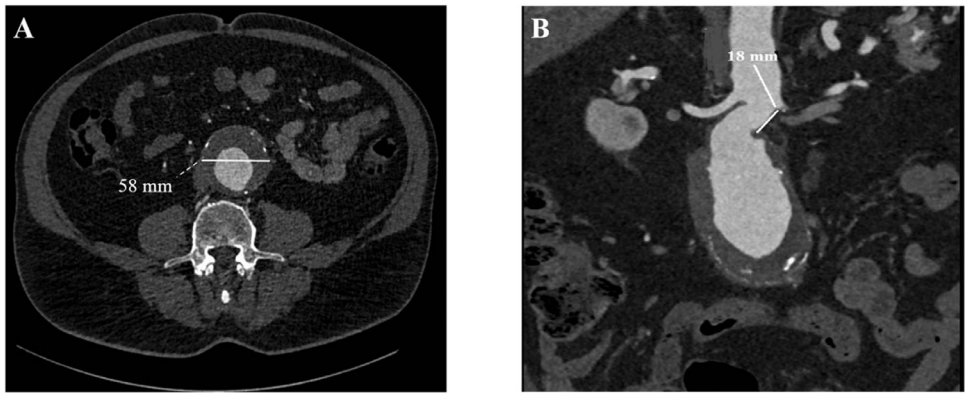

Fig. 1 – (A) Computed tomography angiography showed the therapeutic-size infrarenal abdominal aneurysm of 58 mm (B) with the short infrarenal neck of 18 mm.

we present the concomitant management of significant AV stenosis by transcatheter aortic valve replacement (TAVR) and therapeutic-sized infrarenal AAA by fenestrated endovascular aortic aneurysm repair (FEVAR). This innovative approach not only reflects the evolving landscape of cardiovascular and vascular interventions but also addresses the pressing need for tailored and efficacious treatments in this growing demographic.

Case presentation

A 77-year-old male was referred to our institution for percutaneous treatment of a large infrarenal AAA and AV stenosis. The patient's medical history is notable for arterial hypertension, dyslipidemia, atrial fibrillation, and a previous non-disabling stroke. The only surgical intervention recorded is an appendectomy. The patient's current pharmacological regimen includes antihypertensive medications (Lercanidipine 10 mg twice daily and Bisoprolol 2.5mg once daily), an anticoagulant (Apixaban 5 mg twice daily), an antiplatelet agent (acetylsalicylic acid 80 mg once daily), and a hypolipidemic (Ezetimibe 10 mg once daily). At the time of evaluation, the patient was completely asymptomatic, and the cardiovascular and thoracic physical examination revealed no abnormalities.

Preoperative laboratory analyses indicated that the patient's biological parameters were within normal limits for the values analyzed.

Computed tomography angiography (CTA) disclosed an infrarenal AAA of 58 mm with a short infrarenal neck of 18 mm and suitable femoral arteries for percutaneous TAVR (Figs. 1 and 2). Preoperative cardiac assessment by transesophageal echocardiography (TEE) showed a calcified bicuspid AV with significant stenosis (AV area 0.9 cm^2, mean gradient 42 mmHg, Vmax 4.6 m/s) and preserved left ventricular function. A decision was made to perform a one-stop procedure combining first transfemoral TAVR followed by placement of a FEVAR. The procedure was performed in a hybrid operating room, under general anesthesia and with a mixed team of invasive cardiologists and vascular surgeons. Due to previous stroke history and the presence of a bicuspid AV, a Sentinel embolic protection device (Boston Scientific, Massachusetts, USA) was placed from the right radial artery to decrease the risk of procedural-related stroke. Echo-guided puncture of right and left femoral arteries was performed with pre-closing of the right femoral artery by 2 Proglides (Abbott Vascular, Illinois, USA). A 26 mm Sapien 3 TAVR valve (Edwards Life Science, California, USA) was advanced through a 14Fr E-Sheath and successfully implanted using rapid pacing. Procedural transthoracic echocardiography (TTE) control showed a mean AV gradient of 6 mmHg and no aortic regurgitation. Using the same transfemoral access, insertion of a custom-made fenestrated endoprosthesis (Cook, Indiana, USA) was then attempted. First, several peripheral Bentley stents grafts (Innomed, USA) were implanted in right and left renal arteries (6 × 28 mm), the superior mesenteric artery (7 × 37 mm) and the celiac trunk (8 × 27 mm). The intervention was then completed by the placement of a bifurcated aorto-bi-iliac endoprosthesis (Cook, Indiana,

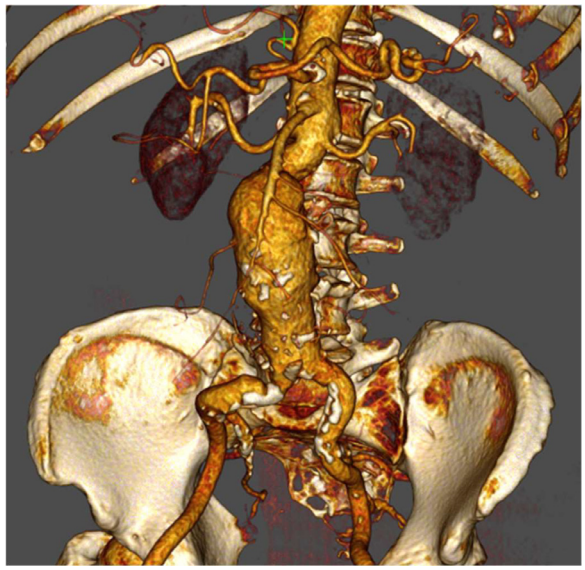

Fig. 2 – Preoperative 3D imaging of the infrarenal abdominal aneurysm.

Fig. 3 – Final angiography: correct deployment and perfect permeability of the endoprosthesis and stents.

USA). Control angiography showed excellent prosthesis and stents permeability (Fig. 3). There was an uncomplicated type 2 endoleak in the lumbar region supplying the aneurysmal sac. The postoperative course was unremarkable and the patient could be discharged 6 days after the procedure. A control CTA was carried out at 3, 6, and 12 months demonstrating a significant reduction in the size of the aneurysmal sac and the perfect positioning of the prosthesis, stents, and aortic valve (Fig. 4). Control TTE at 3 months showed no sign of TAVR valve dysfunction (mean gradient 18 mmHg, Vmax 2.9 m/s).

Discussion

The management of patients with severe AV stenosis and an AAA is a real therapeutic challenge and requires the adoption of a well-considered strategy.

Treatment of an aortic aneurysm in a patient with severe AV stenosis increases surgical risk due to fluctuations in systolic and diastolic pressure. Likewise, the management of AV stenosis in a patient with an aortic aneurysm increases the risk of rupture due to the increase in pressure and therefore the increase in tension in the aneurysmal sac [6].

Traditionally, the treatment of AV stenosis and AAA is performed in two stages by open AV replacement followed by surgical treatment of the AAA.

However, it is currently demonstrated that the treatment of these pathologies by a minimally invasive approach reduces morbidity and mortality linked to surgery, particularly in the most fragile patients [3,7].

Consequently, an increasing number of centers are opting for concurrent care.

In 2012, Smith et al. [8] published the first case of simultaneous transcatheter aortic valve implantation (TAVI) and endovascular infra-renal aneurysm repair. Subsequently, many other similar cases have been described [9–11].

Painchaud-Bouchard et al. [12] reported a case in 2022 involving TAVI followed by concurrent deployment of a thoracic

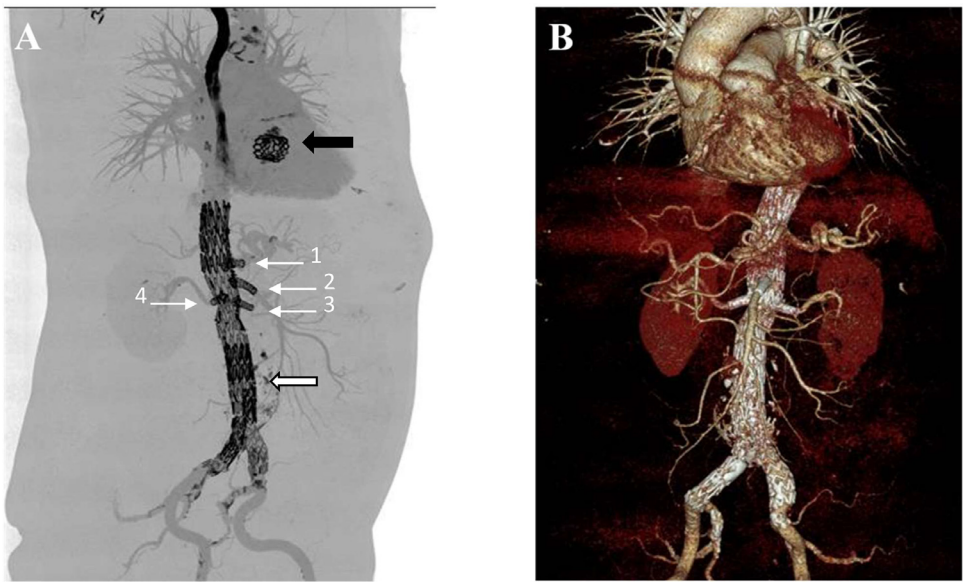

Fig. 4 – (A) Postoperative computed tomography angiography reconstruction showing the fenestrated endoprosthesis (white arrow), the aortic valve (black arrow), the stents in celiac trunk (1), superior mesenteric artery (2), left renal artery (3), and right renal artery (4). (B) Postoperative 3D reconstruction.

endoprosthesis. The fenestrated endoprosthesis having been placed 38 days after the first stage.

These procedures, unlike that described in our study, do not require catheterization or the placement of stents in the digestive trunks and renal arteries. These additional steps significantly complicate the procedure. They are associated with a longer operating time, higher blood loss, an increased risk of limb ischemia and nephropathy induced by the contrast product [13]. Our study therefore contributes to the expanding landscape of minimally invasive cardiovascular and vascular interventions. Despite the added procedural complexities, this approach holds promise for optimizing patient outcomes, particularly in cohorts with heightened surgical risks.

Conclusion

To the best of our knowledge, this is the first reported successful concomitant utilization of TAVR and FEVAR as a one-stop procedure. This innovative convergence, executed as a single, seamless procedure, not only exemplifies the steadfast commitment to innovation but also underscores the growing impact of multidisciplinary collaboration.

Patient consent

I declare that I have obtained written and informed consent from the patient for the publication of his case.

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