

Combined approach of carotid endarterectomy and transcatheter aortic valve implantation as a minimally invasive one-step treatment of aortic stenosis: a case report

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Background

Despite the gold-standard approach for transaortic valve implantation (TAVI) remains transfemoral (TF), alternative approaches are needed in patients who present contraindications to transfemoral access.

Case summary

We report the case of a 79-year-old female with a symptomatic high-gradient severe aortic stenosis—mean gradient of 43 mmHg—and a significant supra-aortic trunk stenosis (left carotid artery: 90–99%; right carotid artery: 50–70%), and who was hospitalized for progressive dyspnoea New York Heart Association (NYHA) stage III. In this high-risk patient, it was decided to perform a TAVI. Because of a history of stenting of both common iliac arteries in a context of an arterial insufficiency of the lower limbs (Leriche classification stage III) and stenotic thoraco-abdominal aorta atheromatosis, an alternative approach to the transfemoral transaortic valve implantation (TF-TAVI) one was needed. It was decided to perform a combined transcatheter-TAVI (TC-TAVI) with EDWARDS S3 23 mm valve with a left endarterectomy during the same operating time.

Discussion

Our case illustrates an alternative approach to perform a percutaneous aortic valve implantation, despite supra-aortic trunk stenosis, in a high-risk surgical patient contraindicated to a TF-TAVI. Transcatheter transaortic valve implantation remains a safe alternative when TF-TAVI is contraindicated, and the combined approach of carotid endarterectomy and TC-TAVI offers a minimally invasive one-step treatment in high operative risk patients.

Keywords

TAVI • TAVR • Transcatheter-TAVI • Aortic stenosis • Minimally invasive • Case report

ESC Curriculum

4.2 Aortic stenosis • 7.5 Cardiac surgery

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Learning points

- Transcatheter aortic valve implantation (TC-TAVI) remains a safe alternative when transfemoral-TAVI is contraindicated.
- Transcatheter access is still safe after endarterectomy.
- The combined approach of carotid endarterectomy and TC-TAVI offers a minimally invasive one-step treatment in high operative risk patients.
- Transcatheter aortic valve implantation through a synthetic patch reduces the risk of vessel injury and facilitates vessel closure at the end of the procedure.

Introduction

Despite the fact that the gold-standard approach for transaortic valve implantation (TAVI) remains the transfemoral (TF) one, alternatives are needed in patients who present contraindications to transfemoral access. The TF-TAVI is not suitable in 10–15% of patients mainly because of ilio-femoral atherosclerosis, small or heavily calcified vessels, extreme tortuosity, or abdominal aortic aneurysms.¹ The transcervical approach allows an access to the aortic valve via the supra-aortic vessels (the brachiocephalic trunk, carotid artery, or subclavian artery) in those patients.

Timeline

Timeline	Event
April 2021—4 months before admission	Progressive dyspnoea appeared.
June 2021	Worsening of the dyspnoea, without other cardiac symptoms.
July 2021	Ergometry, echocardiography, and coronary angiography were performed for dyspnoea by her cardiologist.
August 2021	A diagnosis of severe aortic stenosis was made. Pre-transaortic valve implantation assessment was completed with an angio-computed tomography (angio-CT) and an angiological assessment. A diagnosis of significant supra-aortic trunk stenosis was made.
November 2021—Day 0	Patient was admitted to our hospital for heart failure and to perform TAVI.
Day 1	Vascular surgeons performed an endarterectomy of the left carotid bifurcation.
Day 1	Cardiac team performed the TC-TAVI through the endarterectomy.
Day 2	Patient developed a pulmonary embolism despite thromboprophylaxis.
Day 6	Patient was discharged home.
Until now	The patient remains asymptomatic, without dyspnoea.

Case report

Patient presentation

A 79-year-old female patient was referred to our hospital for severe aortic stenosis and progressive exertional dyspnoea (NYHA stage III).

She was known for hypertension, hypercholesterolaemia, bitroncular coronaropathy with a tight stenosis of the left anterior descending coronary artery, and non-significant stenosis of the circumflex artery, as well as for arterial insufficiency of the lower limbs (Leriche classification stage III) with stenting of both common iliac arteries a few years ago.

At admission, the physical examination revealed signs of cardiac failure with oedema of the lower limbs and basal crackles on pulmonary auscultation. The rest of the physical examination was notable for a desaturation at 88% while breathing ambient air, a blood pressure at 96/55 mmHg (mean pressure, 68 mmHg) with a resting heart rate at 86 b.p.m. Systolic aortic murmur (4/6) radiating on the carotid arteries was detected at cardiac auscultation. The neurologic examination was normal.

Laboratory findings are only relevant for an elevation of NT-pro-BNP at 2800 ng/L.

Before being referred to our institution, an ergometry was performed. The patient stopped after an effort of 25 W (21% of predicted) because of dyspnoea, that represented 2.1 metabolic equivalent, which confirmed the poor physical condition of the patient. The coronarography revealed a bitroncular coronaropathy with tight stenosis (70–90%) of the proximal left descending anterior artery and a B1 stenosis (50–70%) of the first marginal artery.

Diagnosis and management

The pre-TAVI assessment was complemented in our institution with an ECG, a transthoracic echocardiography, a computed tomography (CT) angiogram and an angiological assessment.

The ECG revealed a sinus rhythm without any repolarization disorder. PR were 150 ms, and QRS were thin.

The transthoracic echocardiography confirmed a severe high-gradient severe aortic stenosis with a mean gradient of 43 mmHg and valve area < 0.5 cm² (Figure 1). The left ventricular ejection fraction was preserved at 73% without any dyskinesia.

Computed tomography-angiogram was performed for TAVI-planning. It revealed a calcic score at 1625. The aortic ring size was 19 × 23 mm and the ring area 338 mm². The CT showed a major diffuse thoraco-abdominal aorta atheromatosis with potentially emboligenic plaques with two juxta-renal stenotic segments reducing the lumen to respectively 4 and 5 mm (Figure 2).

The angiological assessment revealed a significant supra-aortic trunk arteriopathy. The patient presented a 50–69% stenosis of the right internal carotid (peak systolic velocity 250 cm/s, end-diastolic velocity 50 cm/s, and ratio internal carotid artery/common carotid artery 2.5) and a 70–99% stenosis of the left internal carotid (peak systolic velocity 450 cm/s, end-diastolic velocity 150 cm/s, and ratio internal carotid artery/common carotid artery 6.5). There were moderate stenosis (>50%) of both external carotid arteries.

The patient's risk assessment demonstrated a EuroScore II of 7.67%. She was recused for a surgical aortic replacement by the Heart Team. It was decided to perform a TAVI for this asymptomatic high-gradient severe aortic stenosis in a patient with high intraoperative risk.

In patients with severe aorto-iliac disease or previous endografting, transfemoral access for TAVI can be challenging or even contraindicated. In the present case, the past medical history of stenting of

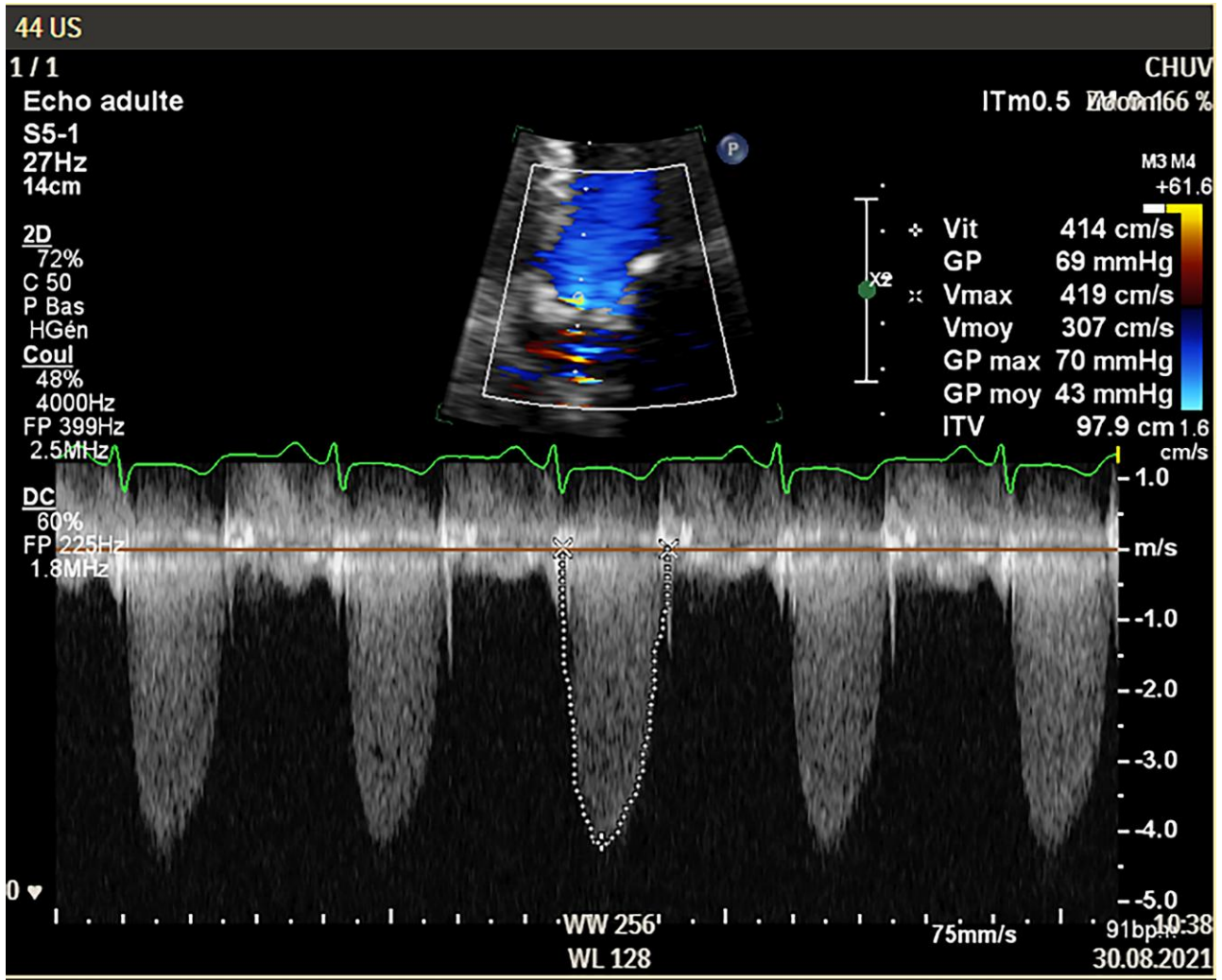


Figure 1 The transthoracic echocardiography confirmed a severe normal flow/high-gradient aortic stenosis with a mean gradient of 43 mmHg.

both common iliac arteries and the diffuse abdominal aorta atheromatosis were particularly challenging. An alternative approach to the conventional TF-TAVI was needed. It was decided to perform a transcervical TAVI after performing an endarterectomy of the left carotid bifurcation (Table 1).

An incision of 8 cm was made along the anterior border of the sternocleidomastoid muscle which was retracted to expose the left carotid bifurcation. After administration of heparin (100 units/kg), the vascular surgeons of our institution performed a classical carotid endarterectomy (CEA) of the left carotid bifurcation after clamping the common, the internal and external carotids. Great care was given to create a smooth distal transition in the remaining distal portion of the internal carotid artery to avoid the formation of an intimal flap. The arteriotomy was closed by an enlargement angioplasty polytetrafluoroethylene (PTFE) patch (Figure 3). The carotid was de-aired and unclamped according to the classical technique. Thereafter, the cardiac surgery team performed a direct arterial puncture in the middle portion of the PTFE patch. After a small incision with a size 11 blade, the device was easily inserted. At the end of the procedure, the patch was repaired with a 6/0 Prolene running suture. The rest of the procedure went uneventfully.

Follow-up

Two days after the TC-TAVI, the patient developed dyspnoea and a desaturation at 79% while breathing 3 L/min oxygen. The transthoracic echocardiography showed a D-shaping of the left ventricle, and the CT angiogram revealed a pulmonary embolism of the right lower lobe. The angiological assessment showed deep venous thrombosis. A diagnosis of secondary pulmonary embolism in the context of hospitalization was made, and therapeutic anticoagulation was instated for 3 months with favourable evolution.

The cardiac follow-up was good. The transthoracic echocardiography showed an improvement of the right overload with a decrease of the pulmonary artery pressures from 86 mmHg to 52 mmHg and a decrease of the D-shaping of the left ventricle. The aortic transvalvular gradient (max/mean) was 17/8 mmHg, and there was no paravalvular leakage.

The patient was discharged from hospital with clopidogrel 75 mg and apixaban 5 mg 2x/day at Day 6.

Until now, the patient remains asymptomatic and has well tolerated the TC-TAVI without any cardiac or neurological complications.



Figure 2 The computed tomography angiogram showed a major diffuse thoraco-abdominal aorta atheromatosis with emboligenic potential plaques, an uncalcified juxta-renal abdominal aorta stenosis of 4 mm, a calcified infra-renal abdominal aorta stenosis of 5 mm (panel A), and a 70–99% stenosis of the left internal carotid (panels B and C).

Discussion

Despite the fact that the gold-standard approach for TAVI remains the transfemoral one, alternatives are needed in patients who present contraindications to transfemoral access. The TF-TAVI is not suitable in 10–15% of patients mainly because of ilio-femoral atherosclerosis, small or heavily calcified vessels, extreme tortuosity, or abdominal aortic aneurysms.¹ The transcervical approach allows an access to the aortic valve via the supra-aortic vessels (the brachiocephalic trunk, carotid artery, or subclavian artery). The transcarotid-TAVI is a worthwhile substitute in otherwise inoperable patients. The 30-day safety of TC-TAVI and TF-TAVI is similar.^{2,3}

A very few cases of TC-TAVI in patients with bilateral supra-aortic trunk stenosis have been described.^{4,5} Sultan *et al.* described a case of CEA after performing the TC-TAVI as they estimated this sequence

to be safer. However, we feel that the hypotension resulting from rapid pacing during valve implantation might lead to critical cerebral hypoperfusion in case of bilateral significant carotid stenosis. Therefore, in our case, we preferred to alleviate the left carotid stenosis before performing TC-TAVI.

Similarly, Farge *et al.* performed CEA before TC-TAVI. They have reported three cases with excellent outcome. However, in contrast to our approach, they delivered the TAVI through the proximal native common carotid artery while we chose to implant the valve through the PTFE patch. In our opinion, this approach is probably simpler as a delivery through a synthetic patch reduces the risk of vessel injury and facilitates vessel closure at the end of the procedure.

Herein, we report a case of TC-TAVI delivered through an endarterectomy patch. This case confirms that it is a safe approach in well-selected patients.

Table 1 Advantages and disadvantages of the three potential options for the one-step treatment of carotid stenosis and TAVI

	Advantages	Disadvantages
1. TAVI before CEA	<ul style="list-style-type: none"> • Less thrombosis than option 2 because the endarterectomized segment is not clamped. 	<ul style="list-style-type: none"> • Risk of embolization because of atheromatosis on the native vessel. • Risk of critical cerebral hypoperfusion in case of bilateral significant carotid stenosis during valve implantation.
2. TAVI after CEA, through the proximal native artery	<ul style="list-style-type: none"> • Lower embolization risk than option 1. 	<ul style="list-style-type: none"> • Risk of patch thrombosis as endarterectomized artery is immediately clamped post-procedure during valve implantation. • Risk of native vessel injury during valve implantation. • Harder surgical exposure with longer incision needed, compared to option 3.
3. TAVI after CEA, through the patch	<ul style="list-style-type: none"> • Reduced risk of patch thrombosis due to the absence of clamping post-CEA. • Lower anatomic constraint with smaller incision, compared to option 2. • Reduced risk of critical cerebral hypoperfusion in case of bilateral significant carotid stenosis during valve implantation. • Reduced risk of vessel injury and easier vessel closure at the end of the procedure when TAVI delivery is performed through a synthetic patch. 	

TAVI, transaortic valve implantation; CEA, carotid endarterectomy.

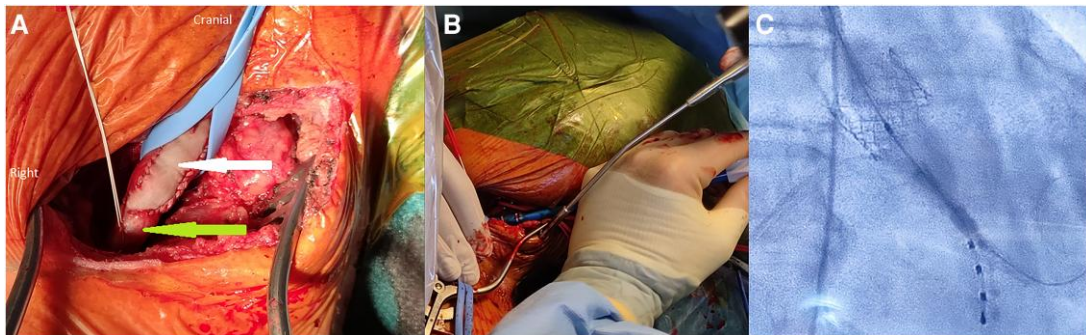


Figure 3 An incision of 5 cm was made along the anterior border of the sternocleidomastoid muscle to expose the left carotid bifurcation (panel A—green arrow). A classical endarterectomy of the left carotid bifurcation was performed. The arteriotomy was closed on an enlargement an angioplasty polytetrafluoroethylene (PTFE) patch (panel A—white arrow). The cardiac surgeon is holding a 6-Fr sheath (panel B), and an EDWARDS S3 23 mm was easily inserted (panel C).

Lead author biography



Dr Baudouin Bourlond is a junior Doctor in the Department of Cardiology in Lausanne University Hospital (CHUV) in Switzerland. He has a keen interest in the fields of interventional cardiology. Dr Bourlond obtained his bachelor's degree of Medicine at Namur University and completed his Doctor of Medicine degree at Catholic University of Louvain.

Supplementary material

[Supplementary material](#) is available at *European Heart Journal – Case Reports* online.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as [Supplementary data](#).

Consent: The authors confirm that written consent for submission and publication of this case report including images and associated

text has been obtained from the patient, in accordance with COPE guidelines.

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Data availability

The data underlying this article are available in the article and in its online [supplementary material](#).

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