TRANSCATHETER AORTIC VALVE-IN-VALVE IMPLANTATION IN A PATIENT WITH PROHIBITIVE VASCULAR ACCESSES

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Abstract

We present the case of a severely symptomatic patient with a malfunctioning aortic bioprosthesis and severe multidistrict atherosclerosis that was addressed to our unit for transcatheter valve-in-valve implantation. The imaging and clinical assessment that led to the selection of the access route is discussed.

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ABSTRACT

We present the case of a severely symptomatic patient with a malfunctioning aortic bioprosthesis and severe multidistrict atherosclerosis that was addressed to our unit for transcatheter valve-in-valve implantation. The imaging and clinical assessment that led to the selection of the access route is discussed.

HISTORY OF PRESENTATION

An 84 year old man was addressed to our outpatients' clinic for treatment of a degenerated aortic bioprosthesis. The patient had severe aortic stenosis and quickly ingravescent dyspnea (NYHA class III). He had multiple major comorbidities with an STS score of 12.043%, but he was active and heavily symptomatic.

PAST MEDICAL HISTORY

The patient had type 2 diabetes and hypertension. He had had a transient ischemic attack in 1998 and a stroke with mild residual hemiparesis in 2001. After the stroke he underwent several investigations that led to the diagnosis of paroxysmal atrial fibrillation, severe aortic stenosis and single vessel disease of the right coronary artery. In 2002 he underwent aortic valve replacement with a 23 mm Carpentier Edwards Magna bioprosthesis plus CABG.

The patient had multiple comorbidities:

Major functional limitation due to poor mobility. The patient had had poliomyelitis with residual hypoplasia of the left lower limb. In 2019 he underwent orthopaedic surgery for a fracture of the right leg, and since then he was on a wheelchair.

Severe multidistrict atherosclerosis, including severe stenosis of the right and left iliofemoral axes (Figures 1-4).

Left ventricular dysfunction and pulmonary hypertension.

Chronic renal failure.

Chronic lung disease.

Severe calcific atherosclerosis of the ascending aorta and aortic arch with a pseudoaneurysm of the ascending aorta at the level of the previous aortotomy (Figure 5).

Despite the functional limitation and the important comorbidities, the patient was active and had a rich relational life. He was heavily symptomatic and had experienced a sudden worsening of the dyspnoea. After in-depth multidisciplinary discussion, the heart team decided for transcatheter valve in valve implantation.

INVESTIGATIONS

At echocardiography, the aortic valve area was 0.7 cm2, and the mean transprosthetic gradient was 53 mmHg. At CT, the prosthesis was severely calcified. There was pulmonary hypertension (PAP 65 mmHg).

The patient underwent pneumologic evaluation including high resolution chest CT and right heart catheterisation. The conclusion was that he had a moderate chronic obstructive pulmonary disease, and that his dyspnea was mainly cardiac in origin.

At CT, the right and left iliofemoral access were considered not feasible (Figure 1-3). The left subclavian artery showed a moderate atherosclerotic involvement with a focal stenosis at the thoracic outlet (residual lumen < 5 mm, Figure 4). The right subclavian and trans-carotid access were discarded for the presence of major tortuosity and calcification of the innominate artery, left carotid artery and aortic arch. The transapical and transaortic accesses were feasible, but they were considered a poor option for this delicate patient, that would have hardly tolerated the general anesthesia and the surgical trauma related to the thoracotomy. Also, chest re-entry was at risk for to the presence of an aortic pseudoaneurysm (Figure 5, Movie 1).

MANAGEMENT

The patient underwent lithoplasty assisted trans-axillary valve-in-valve implantation with a 26 mm Medtronic Evolut prosthesis. Under loco-regional anaesthesia, the left axillary artery was isolated and exposed with a soft tissue retractor. A 4/0 prolene purse string was prepared and an 8F vascular sheet was inserted, through which a 6.5 x 60 mm lithoplasty balloon (Shockwave Medical, Freemont, CA, USA) was advanced across the lesion and inflated to 4 atm. Pulse pressure waves were delivered for 30" x 4 cycles (Movie 2). Two additional cycles were delivered at the main curvature of the left subclavian artery to facilitate the navigation of the transcatheter valve (Movie 3). The malfunctioning bioprosthesis was crossed and a 26 mm Evolut valve was successfully advanced and deployed on a pre-shaped stiff wire. The control angiography showed a patent left subclavian artery with no dissection or extravasation. The aortic pseudo-aneurysm was not affected by the procedure (Movie 4, 5). A pace-maker was implanted for a prolonged pause at ECG monitoring. The patient returned to the general ward and was discharged on postoperative day 7 after an uncomplicated recovery. At the 12-months follow up the patient was alive and well. The symptomatic status had improved to NYHA class II and the echocardiography showed a normo-functioning trans-catheter valve.

DISCUSSION

Vascular lithoplasty -disruption of calcium within vascular plaques with circumferential pulse pressure waves- has been used to treat different conditions, including peripheral artery disease (1) and coronary artery disease (2). Recently, vascular lithoplasty has been used to facilitate vascular access during transfemoral TAVI (3) or EVAR (4), To our knowledge, lithoplasty assisted trans-subclavian TAVI has not been previously reported.

TAVI can be performed through several routes - trans-femoral, trans-subclavian, trans-carotid, trans-aortic, trans-apical, and trans-caval. However the surgical approaches requiring general anaesthesia and chest opening are more invasive, and there is evidence that they expose the patient to higher 30-day and 1 year mortality rates (5). Our patient was not a candidate for open heart surgery. Moreover, he had several relative contraindications to general anaesthesia and intubation, including moderate COPD, moderate left ventricular dysfunction and poor mobility, that precluded the trans-aortic and trans-apical approaches. The right and left iliofemoral axes were severely diseased: the left iliac and femoral artery were hypoplastic (<5mm) as a consequence of previous poliomyelitis, with a diffuse calcific atherosclerotic involvement. The right external iliac artery was occluded, and a previous ilio-femorale bypass was also nearly occluded at the distal anastomosis, were a bulky calcification of the native vessel was present.

As the transfemoral approach, the trans-axillary approach can be performed under loco-regional anaesthesia. In our patient the left subclavian artery was diffusely atherosclerotic and calcific, but had a single focal stenosis less than 2 cm long. We therefore decided to attempt a lithoplasty assisted trans-subclavian approach under loco-regional anaesthesia. Although the advancement of the device required some manoeuvre, the stenosis was crossed and the procedure was successful. Pulse pressure waves were delivered also at the curvature of the subclavian artery, to soften the calcific plaques. This allowed to straighten the vessel, and facilitated the navigation of the transcatheter valve.

CONCLUSIONS

The lithoplasty assisted trans-axillary access is a feasible option for patients with prohibitive trans-femoral accesses and major contraindications to general anaesthesia and/or thoracotomy. The application of pulse pressure waves to the calcific plaques allows to cross focal calcific stenoses and facilitates the navigation through tortuous calcific vessels.

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FIGURE LEGENDS

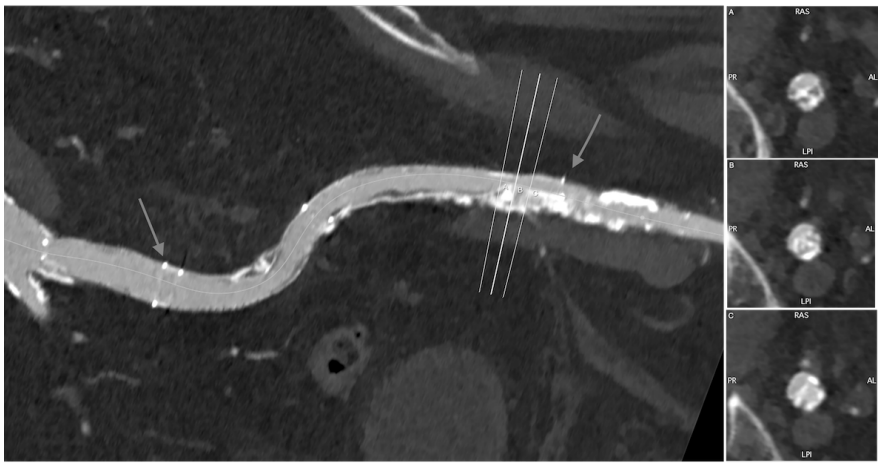
Figure 1. The right iliac artery was chronically occluded, and an ilio-femoral bypass (arrows) was nearly occluded at the distal anastomosis.

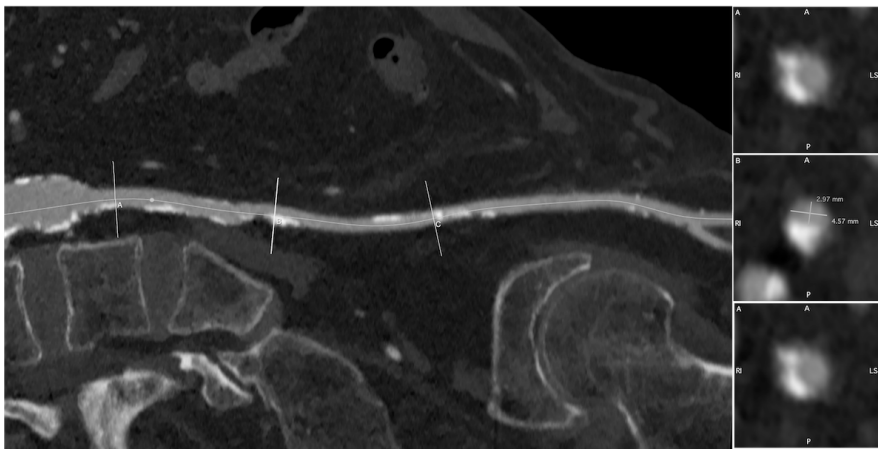
Figure 2. 3D reconstruction of the iliofemoral axes, demonstrating the hypoplasia of the left axis and massive calcific involvement of the right axis.

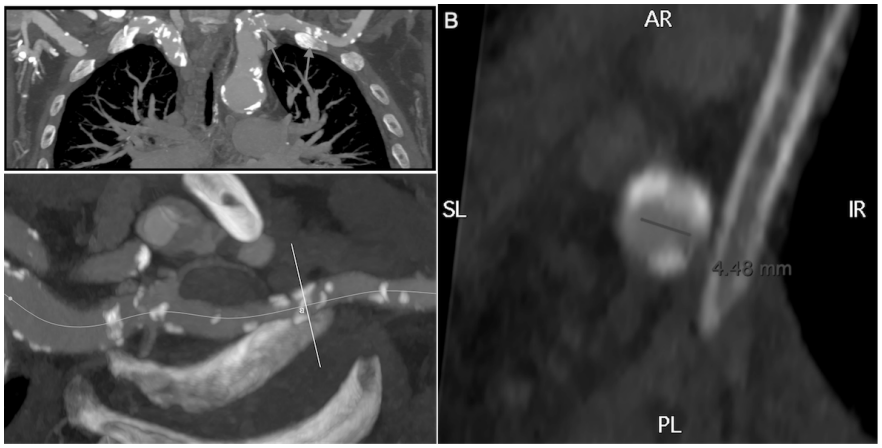
Figure 3. The left Ilio-femoral axis was diffusely hypoplastic (< 5 mm), with multiple calcific stenoses.

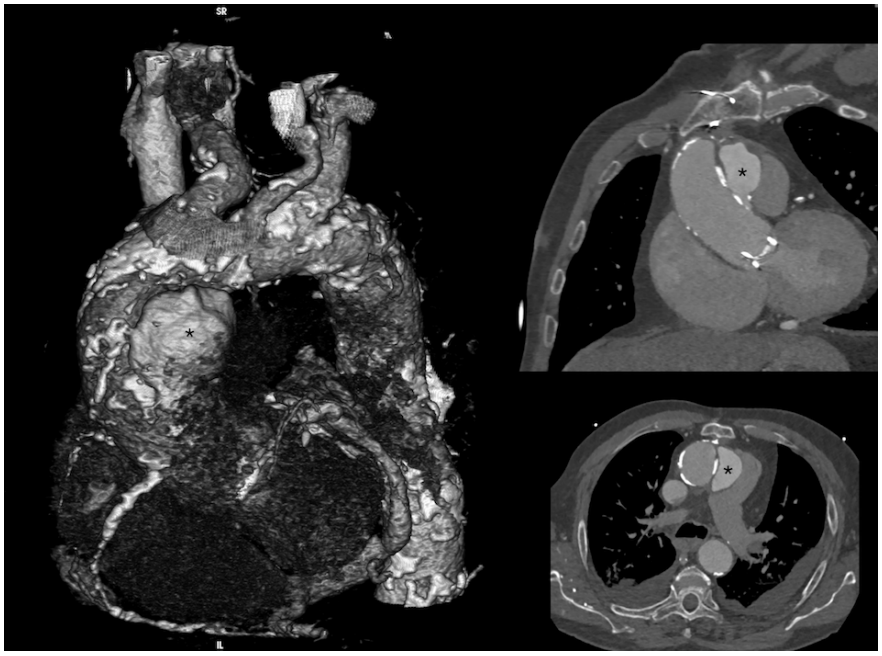
Figure 4. 3D multiplanar reconstruction of the left subclavian artery, demonstrating moderate calcifications and a focal stenosis with a residual lumen of < 5mm. The arrows indicate the target lesions of the lithoplasty.

Figure 5. Volume rendering and 3D MPR images of the ascending aorta and aortic arch, demonstrating the presence of severe calcific atherosclerosis and a big aortic pseudoaneurysm (*).









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Movie 2. Shockwave at stenosis.mp4 available at https://authorea.com/users/334360/articles/710236-transcatheter-aortic-valve-in-valve-implantation-in-a-patient-with-prohibitive-vascular-accesses

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Movie 3. Shockwave at curvature.mp4 available at https://authorea.com/users/334360/articles/710236-transcatheter-aortic-valve-in-valve-implantation-in-a-patient-with-prohibitive-vascular-accesses

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Movie 4. TAVI.mp4 available at https://authorea.com/users/334360/articles/710236-transcatheter-aortic-valve-in-valve-implantation-in-a-patient-with-prohibitive-vascular-accesses

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Movie 5. Final Check.mp4 available at https://authorea.com/users/334360/articles/710236-transcatheter-aortic-valve-in-valve-implantation-in-a-patient-with-prohibitive-vascular-accesses