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CASE REPORT

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Successful management of acute left main coronary occlusion following transcatheter aortic valve implantation: a case report

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Abstract

Background Transcatheter aortic valve implantation is an established, highly effective procedure in selected patients with severe degenerative aortic valve stenosis at high risk for conventional surgery.

Case presentation We report a case of a 74-year-old Caucasian man who had an acute left main occlusion after transcatheter implantation of balloon-expandable valve prosthesis, followed by coronary intervention with successful recanalization.

Conclusions Acute coronary occlusion is a rare life-threatening complication of transcatheter aortic valve implantation that is poorly predictable and requires immediate diagnosis and treatment.

Keywords TAVI, Complication, LM occlusion, Coronary intervention

Background

Transcatheter aortic valve implantation (TAVI) has rapidly evolved in the last decade to become the treatment of choice for most patients with severe aortic stenosis [1]. The widespread use of this treatment has prompted advances in transcatheter heart valve prostheses and TAVI-enabling devices, leading to the simplification of the procedure, reduction of the risk of complications, and improved short- and long-term outcomes [2]. Nevertheless, TAVI procedures have potential severe complications, and one of them is coronary ostium obstruction, which could be a fatal, life-threatening complication that needs urgent diagnosis and treatment [3]. We report a rare case of a transfemoral aortic valve implantation complicated by acute left main coronary artery (LMCA) occlusion cardiac arrest and hemodynamic collapse, which was successfully treated with immediate stent implantation.

Case presentation

A 74-year-old Caucasian man presented to our cardiology department with symptoms of advanced heart failure (New York Heart Association IV Functional Class), cardiac asthma at rest, bilateral pleural effusions, peripheral edema, and symptoms of syncope. The accompanying diseases were anemia and previous stroke. The following is a timeline of his clinical course and interventions:

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Date/time	Event/intervention	Details
Patient background	Initial presentation	74-year-old Caucasian man with advanced heart failure, severe aortic stenosis, and LVEF of 35%
Pre-procedure	Pre-procedure diagnostics	ECG showed left bundle branch block; echocardiogram confirmed severe aortic stenosis.
Pre-procedure	Pre-procedure assessment	CT angiography revealed severe calcification of the aortic valve and coronary arteries.
TAVI	TAVI procedure	Successful implantation of the aortic valve.
Immediately post-TAVI	Detection of acute coronary occlusion	ECG showed ventricular fibrillation; angiography revealed LM coronary occlusion.
Immediately post-TAVI	Emergency coronary intervention	Percutaneous coronary intervention performed; implantation of a drug-eluting stent in LM.
1 week post-procedure	Follow-up assessment	Patient stabilized; ECG and echocardiogram showed improved function.
1 month post-procedure	Routine follow-up	Patient reported no angina; echocardiogram showed LVEF improved to 45%.
6 months post-procedure	Long-term follow-up	Patient remained asymptomatic with no cardiac events; continued medical therapy.

CT, computed tomography; ECG, electrocardiography; LVEF, left ventricular ejection fraction

Electrocardiography (ECG) showed sinus rhythm, and left ventricular hypertrophy (LVH) with chronic repolarization abnormalities. The transthoracic echocardiogram revealed severe aortic valve stenosis (maximum transvalvular gradient 108 mmHg, mean gradient 74 mmHg, aortic valve area 0.6 cm^2), moderate mitral regurgitation, moderate tricuspidal regurgitation, elevated pulmonary artery systolic pressure, and left ventricular ejection fraction (LVEF) of 31%. A coronary angiogram displayed two vessel coronary artery disease with significant right coronary artery and obtuse marginal artery 1 stenosis.

We calculated a Society of Thoracic Surgeons (STS) risk score of 6.85% and a EuroSCORE II of 7.73%, and after a heart team discussion, he was referred to TAVI. A transesophageal echocardiogram showed a calcified tricuspid aortic valve and bulky calculus on and between the leaflets. The aortic annular size was 26 mm, and the sinus of Valsalva was 34 mm. Multi-slice computed tomography (CT) showed an aortic annulus size of 29.7/25.5 mm; sinus of Valsalva size of 34.1 mm; annulus area of 579.1 mm^2; bulky, heavily calcified leaflets; high LMCA at 16.4 mm; and right coronary artery (RCA) at 17.8 mm.

CT imaging of lower extremity arteries (ilio-femoral arterial segment) revealed the following: right side: external iliac artery without significant stenoses, and common femoral artery at 8.3/7.9 mm without stenoses; left side: tortuous common iliac artery without significant stenoses, and common femoral artery at 8.6/8.6 mm without stenoses (Fig. 1).

On the basis of the CT data, we chose the transfemoral approach.

After complete interventional coronary revascularization, a TAVI procedure was performed: Under general anesthesia, a 16F sheath was inserted in the right femoral artery, and a temporary pacing electrode was positioned into the right ventricle via the right femoral vein. After passing with a guidewire through the stenotic aortic valve, an inflation with a balloon 23/40 mm was done under rapid ventricular pacing. Then a 29 mm Edwards Sapien 3 valve (Edwards Lifesciences, CA, USA) was implanted promptly in position (Fig. 2a, b).

Immediately after the valve implantation, ventricular fibrillation resistant to multiple shock defibrillations occurred. Chest compressions were started. An urgent angiogram was performed, and an LMCA obstruction was apparent in the angiogram: thrombolysis in myocardial infarction (TIMI) I flow in left anterior descending (LAD) and circumflex artery (Cx; Fig. 3).

A 6F 4 Judkins left (JL) guiding catheter was promptly positioned in the LMCA. Then, a floppy guidewire was advanced across the occlusion, and a 4.0/12 mm drug eluting stent (DES) was directly implanted in the LM (Fig. 4a). The procedure was completed by postdilatation with a 4.5/15 mm balloon. This resulted in the restoration of TIMI grade 3 flow in LMCA, LAD, and Cx (Fig. 4b).

After recanalization, sinus rhythm was restored, and stable hemodynamic conditions were rapidly obtained. An intra-aortic balloon pump (IABP) in assist ratio 1:1 was implanted. IABP was removed on the second day and catecholamines on the third day.

The patient was discharged on day 7, without signs of heart failure, without angina, and with medical therapy: aspirin, clopidogrel, eplerenone, an angiotensin-converting enzyme (ACE) inhibitor, a statin, a beta blocker,

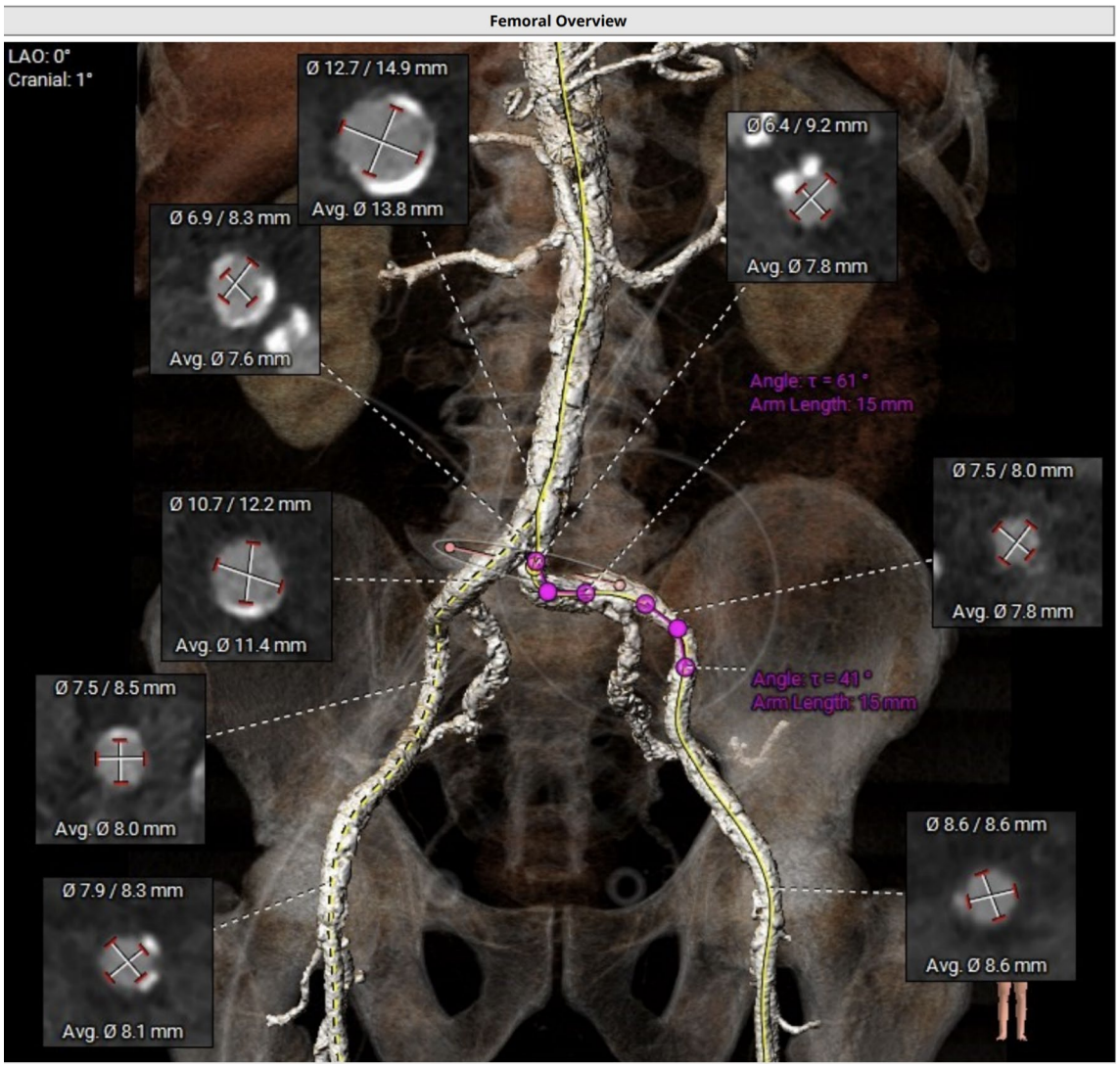

Fig. 1 CT imaging of lower extremity arteries

a diuretic, and a proton pump inhibitor. The echocardiogram at discharge showed mild apical hypokinesia with LVEF 35%, mild mitral regurgitation, a maximum transvalvular gradient of implanted aortic valve of 12 mm/Hg, a mean of 5 mm/Hg, no aortic regurgitation, moderate tricuspidal regurgitation, and a decrease of pulmonary systolic pressure in comparison with the state before the procedure. The clinical course after this procedure was uneventful. A total of 6 months later, the patient was stable without any complaints.

Discussion and conclusions

Transcatheter aortic valvular implantation (TAVI) is considered a mainstream interventional procedure for patients with severe aortic valve stenosis, in either symptomatic patients or those who are asymptomatic but have a left ventricular ejection fraction less than 50% [4, 5]. It is even associated with a lower risk of all-cause mortality and cardiovascular death in 1 year when compared with surgery in patients with low surgical risk [6].

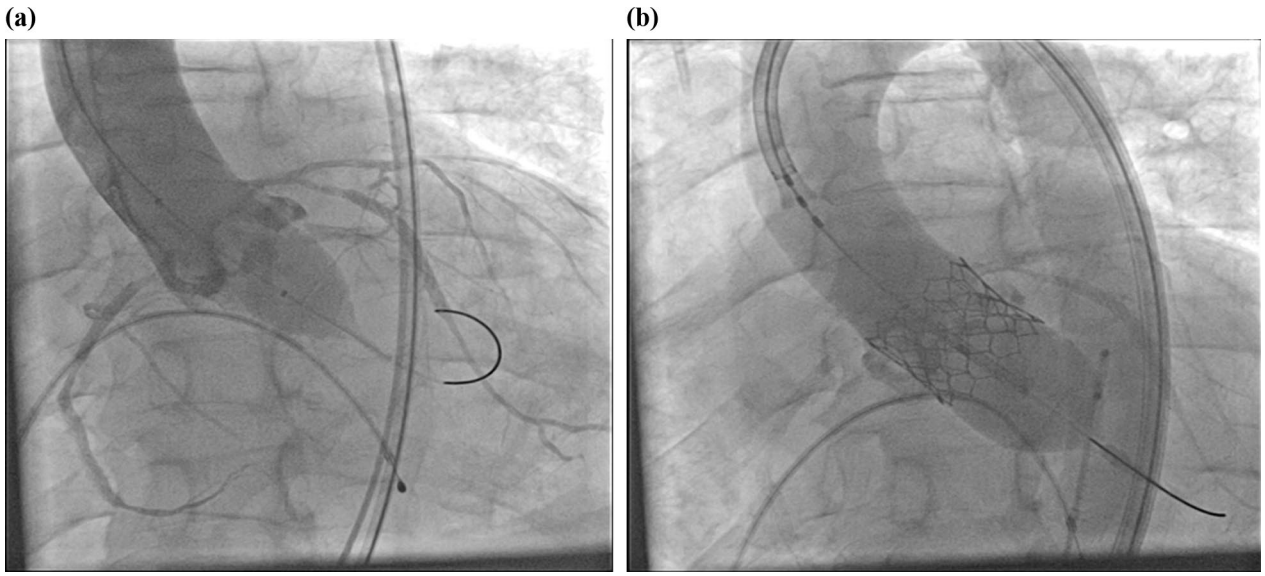

Fig. 2 **a**. Balloon predilation of the aortic valve. **b**. Implantation of the Edwards Sapien 3 Valve

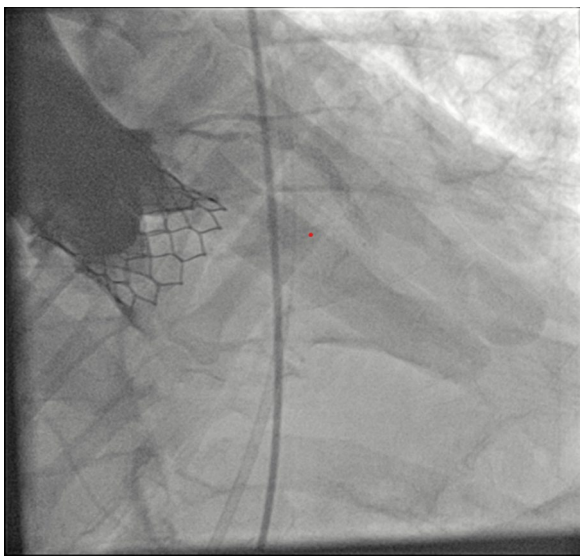

Fig. 3 LMCA obstruction after the valve implantation

Although TAVI is reported as less invasive than open cardiac surgery, different severe complications can occur. Some of them, because of their relatively high frequency (conduction disturbances, vascular complications, cerebrovascular events, paravalvular regurgitation, and so on), are largely described. Coronary obstruction is an infrequent complication of TAVI with an incidence of less than 1% [7]. Coronary occlusion was described for the first time in 2006 by Webb *et al*. [8]. In a large multicenter registry, Ribeiro *et al*. [9] reported frequency of coronary occlusion in about 0.6% of patients. The 30-day mortality rate after coronary artery occlusion remained very high—about 40.9%. Risk factors for coronary obstruction following TAVI include female sex, a previous prosthetic aortic valve *in situ*, a distance of < 10 mm between the coronary ostia and the aortic annulus, and < 28 mm diameter at the sinuses of Valsalva [9–11]. Operator-related factors are high positioning or a too large valve [7]. A systematic review of clinical outcomes of coronary occlusion following TAVI found that women comprised 81% of cases, 80% of events involved the left main coronary artery, 60% were caused by a displaced native valve leaflet, and 88% occurred within 1 hour of implantation [12].

Two mechanisms of coronary obstruction are described: the first and more common one is due to the displacement of the calcification from the native valve, which obstructs the coronary ostium; the second cause is more hypothetical—obstruction due to a portion of the TAVI frame placed over the coronary ostium [9].

The management of the coronary obstruction depends on the implanted prosthetic valve: CoreValve can be ensnared and repositioned, whereas Sapien 3 will need

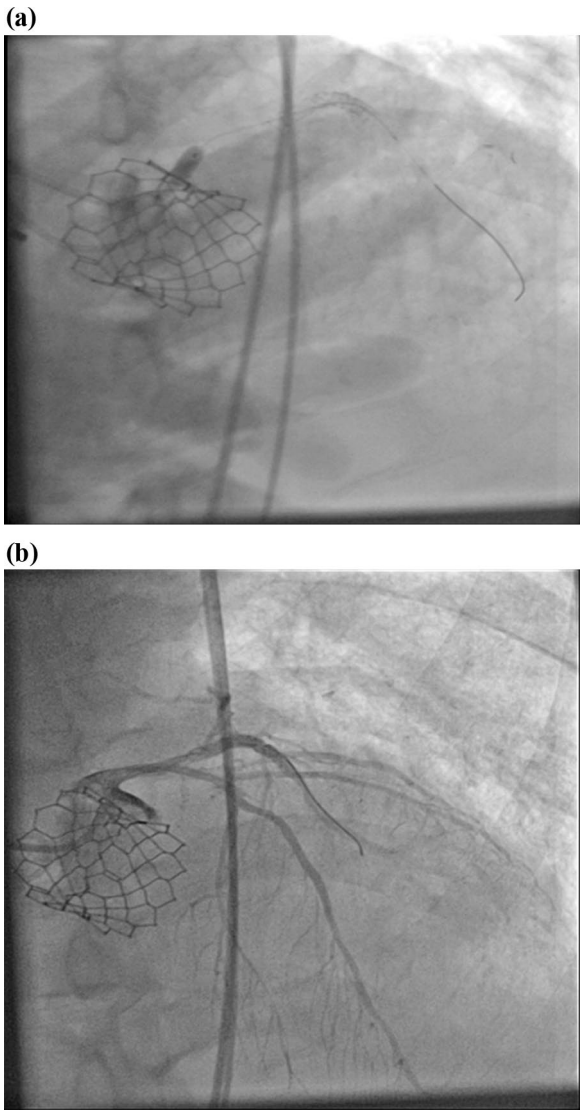

Fig. 4 **a**. Implantation of a DES 4,0/12 in the LM. **b**. TIMI grade 3 flow restored in LMCA, LAD, and Cx

immediate cannulation of the occluded ostium using a high-pressure balloon [13].

Coronary occlusion during or immediately after TAVI is a life-threatening complication that, despite the low incidence, is poorly predictable and requires immediate diagnosis and treatment. It is crucial to note that the management of this complication varies on the basis of the type of valve implanted. Therefore, careful patient selection is essential for the success of the technique.

Abbreviations

ACE	Angiotensin-converting enzyme
CT	Computed tomography
Cx	Circumflex
DES	Drug eluting stent
ECG	Electrocardiography
EuroSCORE	European System for Cardiac Operative Risk Evaluation
IABP	Intra-aortic balloon pump
JL	Judkins left
LAD	Left anterior descending
LM	Left main
LMCA	Left main coronary artery
LVH	Left ventricular hypertrophy
LVEF	Left ventricular ejection fraction
NYHA	New York Heart Association
RCA	Right coronary artery
STS	Society of Thoracic Surgeons
TAVI	Transcatheter aortic valve implantation
TIMI	Thrombolysis in myocardial infarction

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Author contributions
Georgi Goranov analyzed and interpreted the patient data regarding the TAVI procedure and the subsequent acute coronary occlusion. Georgi Goranov was part of the team that performed the TAVI procedure and the emergency coronary intervention. Velina Doktorova was a contributor in writing the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests
The authors declare that they have no competing interests.

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