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An Alternative Approach for Very High-risk Non-operative Patients with Severe Aortic Stenosis and Multivessel Coronary Disease - Staged Coronary Angioplasty and Transcatheter Aortic Valve Implantation – Case Report and Review of Literature

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Authors' contributions

All the authors made substantial intellectual contributions to this study. Authors AOW and MG were involved in the conception, design and data collection as well as interpretation of results, preparation of the manuscript, revision of the article at various stages and preparation of the final draft. Authors ML, OT, AA and SG contributed in conception, design, manuscript preparation and approval of the final document. All authors read and approved the final manuscript.

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Case Study

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ABSTRACT

The Aim: The management of obstructive coronary artery disease before the transcatheter aortic valve implantation (TAVI) is not yet well established.
Presentation of Case: We describe a 68-year-old patient with severe aortic stenosis, multivessel coronary artery disease, severe left ventricle dysfunction and several co-morbidities, who was disqualified from aortic valve replacement concomitant to coronary artery by-pass grafting because of excessive operative risk (logistic EuroScore 27.62%, STS 13.3% risk of mortality). After careful assessment he was treated with staged percutaneous coronary intervention (PCI) of the left main

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and the left anterior descending artery and right coronary artery with drug-eluting stents implantation, followed by TAVI. In the postoperative period heart rhythm disturbances occurred and he required pacemaker implantation. At the 2 year follow-up he was doing well without angina and heart failure symptoms. An improvement in left ventricle contractility on echocardiography (EF-45%) with proper prosthesis function were noted. However, 25 months after the procedure he died from stroke.

Discussion and Conclusion: Coronary artery disease is frequent in patients referred for TAVI and is associated with worse prognosis. The approach to the management of these patients is still unclear. We present and discuss several procedural strategies. The staged procedure with time interval appears to be a better alternative for patients with severe aortic stenosis with significant coronary artery disease and severe left ventricular dysfunction and co-morbidities. In doubtful cases, if symptoms of aortic stenosis and coronary artery disease are difficult to differentiate, PCI as a first step and clinical observation enable proper selection of an appropriate method for further treatment.

Keywords: Aortic stenosis; percutaneous coronary intervention; transcatheter aortic valve implantation.

1. INTRODUCTION

Cardiovascular disease represents a leading cause of death worldwide [1]. The management of coronary artery disease (CAD) before transcatheter aortic valve implantation (TAVI) is not yet well established. The presence of CAD negatively impacts procedural and long-term outcomes after TAVI [2,3].

2. PRESENTATION OF CASE

The patient was a 68-year-old male who was referred to our hospital for qualification to invasive treatment because of severe aortic valve stenosis. He suffered from dyspnoea at rest and minimal exertion (NYHA class IV) and unstable angina (CCS class III/IV). He was obese, had concomitant diabetes mellitus type 2 treated with insulin and chronic kidney disease. He had two strokes in the past and experienced post-stroke movement disorder however he also had proper logical contact.

2.1 Findings Revealed

- Transthoracic (TTE) and transesophageal (TEE) echocardiography: severe calcific aortic stenosis (a max transvalvular gradient of 48.5mmHg, mean gradient of 30mmHg) with effective orifice area of 0.6 cm2 and mild aortic valve regurgitation, moderate mitral and tricuspid regurgitation, right ventricle systolic pressure of 70mmHg, generalized hypokinesis with akinesis of apical and septal walls, low ejection fraction (23%) and concentric left ventricular hypertrophy.
- Coronary angiogram: left main (LM) – critical distal stenosis; left anterior descending artery (LAD) – ostial and medial critical stenosis, collateral circulation from right coronary artery (RCA); circumflex artery (CX) – proximal critical stenosis, intermediate branch (IM) – proximal occlusion; RCA – dominant with significant distal stenosis (Figs. 1A, B, C).
- Computed tomography of iliac and femoral arteries: patent, without significant stenosis.
- Ultrasonography of carotid arteries: atherosclerotic changes in divisions of both common carotid arteries with 40% stenosis. Patent external carotid arteries. Right vertebral artery with decreased flow, left artery - not visualized.
- N-terminal pro-brain natriuretic peptide (NTpBNP) level was 4769.5 pg/ml, glomerular filtration rate was 40ml/min/1.73m2.

Our patient was presented at the heart team meeting and declined for surgical aortic valve replacement (SAVR) because of the excessive operative risk (EuroScore 11 points (27.62%), STS 13.3% risk of mortality; 53.5% risk of morbidity or mortality). However, he was found to be eligible for the staged coronary percutaneous coronary intervention (PCI) and TAVI. Possible treatment strategies were discussed with the patient and his family and a decision to choose the multi-staged invasive option was undertaken.

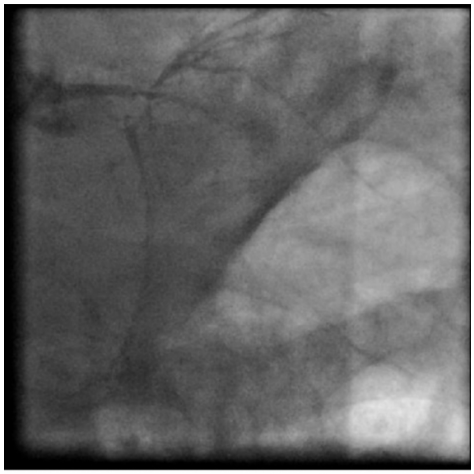

Fig. 1A

Fig. 1B

Fig. 1C

Fig. 1. Coronary angiogram

2.2 Stage I

The coronary angioplasty was performed at the first stage. The LM and the proximal LAD were pre-dilated and drug-eluting stent (DES) BioMatrix® 3.0x28 mm was implanted (initial stenosis 95%, residual 5%), the medial LAD was treated with pre-dilatation and implantation of the DES BioMatrix® 3.0x24 mm (initial stenosis 75%, residual 5%). Stents were post-dilated with 3.5x20mm high-pressure balloons. After opening the struts in the direction of LCX subsequently the kissing balloon technique was used for the proximal CX (initial stenosis 90%, residual 20%) (Figs. 2A, B).

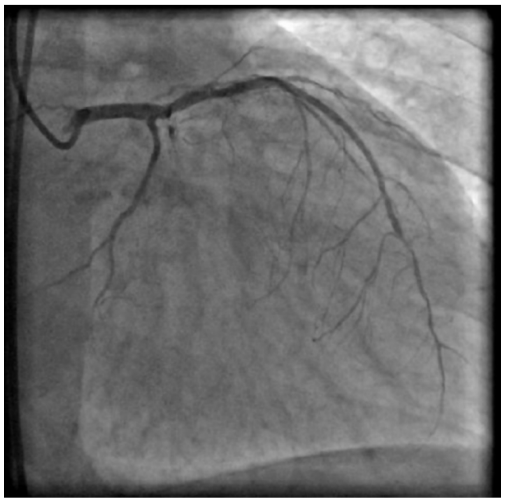

Fig. 2A

Fig. 2B

Fig. 2. I stage coronary angioplasty

2.3 Stage II

After one month, PCI of distal RCA with implantation of DES PROMUS® 3.0x28 mm was carried out (initial stenosis 80%, residual 0%) (Fig. 3).

Fig. 3. II stage coronary angioplasty

2.4 Stage III

The patient was readmitted to our department 3 months later for TAVI. His functional symptomatic status improved and reduction in anginal and heart failure symptoms were noted (NYHA III and CCS II).

The CoreValve® (Medtronic Inc., USA) implantation (Fig. 4) was carried out in the catheterisation laboratory under general anaesthesia and with the use of TEE. A temporary pacemaker was inserted for rapid pacing and for risk of potential atrio-ventricular block. Vascular access was obtained with puncture of both femoral arteries and the 6F delivery sheaths were introduced. After the placement of vascular suture-mediated system Prostar XL® (Abbott Vascular, USA), the 18F sheath was introduced. The aortic valve was precisely reassessed and valvuloplasty of the aortic valve was performed with a 20 mm Z-MED II-X® balloon (NuMED Inc., USA) during rapid ventricular pacing (160/min). A 29 mm Medtronic CoreValve® was advanced and positioned within the native aortic valve. TEE and haemodynamic invasive assessment confirmed proper positioning of the prosthesis with patent coronary ostia and complete reduction in transvalvular gradient with only trivial aortic regurgitation (end diastolic pressure was 18 mm Hg, diastolic pressure in aorta was 55 mmHg). Control angiography at the end of procedure revealed dissection of right common femoral artery, which was probably caused by the 18F sheath. A self-expanding stent Xact® 9-7x40 mm (Abbott Vascular, USA) was successfully implanted and flow was restored.

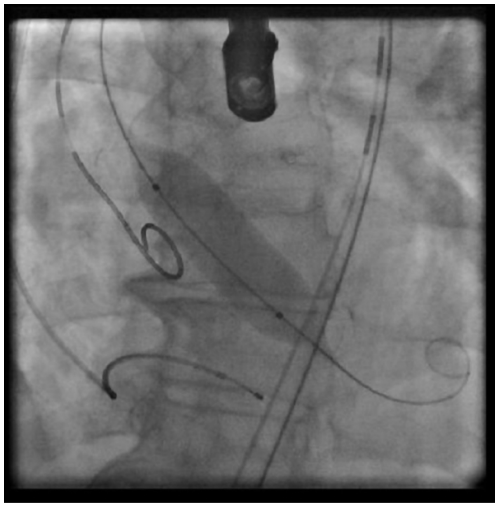

Fig. 4A

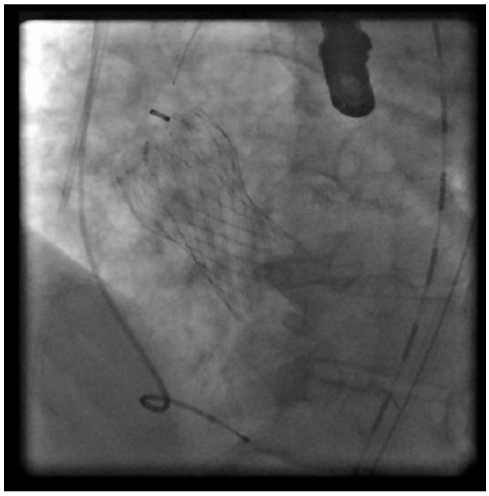

Fig. 4B

Fig. 4. TAVI

2.5 Postoperative Management

In the postoperative period first-degree atrio-ventricular block and a new left bundle branch block developed. Since frequent supraventricular

and ventricular premature beats and episodes of atrial fibrillation were also recorded, amiodarone was initiated, which was followed by periods of symptomatic sinus bradycardia (35/min). Therefore after 4 days a dual chamber pacemaker Medtronic ADAPTA ADDR01® (DDDR) was implanted.

The patient was discharged home on the 9th day after TAVI. At the 2 year follow-up he was doing well without angina and heart failure symptoms. During follow up an improvement in left ventricle contractility on echocardiography (EF-45%) was observed with proper prosthesis function and maximal transvalvular gradient 11mmHg without a significant regurgitation.

However, 25 months after the final procedure, he died after suffering the third stroke.

3. DISCUSSION

In patients referred for TAVI, CAD is frequent and associated with worse baseline characteristics [2]. The management of patients with CAD and aortic stenosis who are qualified for TAVI is still unclear. According to Abramowitz et al. [3] study, PCI before TAVI in high-risk elderly patients with significant CAD and severe AS is feasible, safe and does not increase the periprocedural risk for complications or the all-cause mortality. In turn, Griese at al. [4],who analysed the impact of concomitant PCI on outcomes of 65 patients receiving TAVI compared to 346 patients treated with TAVI alone, assessed that concomitant PCI was associated with increased early and late mortality. Similarly, Stefanini et al. [5] showed that the severity of CAD is associated with impaired clinical outcomes at 1 year after TAVI. We assume that several factors may contribute to these results. TAVI prosthesis is designed to enable proper coronary blood flow and to permit access of angiographic catheters to coronary arteries. However, if prosthesis is located close to coronary ostium, access for angiographic catheters may be difficult. In turn, performing PCI in a patient with TAVI prosthesis (especially self-expanding) requires a high level of expertise [6]. Wenaweser et al. [7] proved that PCI may be safely performed in addition to TAVI either as a staged or a concomitant intervention in carefully selected patients. Griese et al. [4] also did not find differences between synchronous vs staged approach for PCI in terms of early mortality. Therefore it is preferred to perform coronary revascularisation before TAVI. The coexistence of both diseases significantly increases the risk of PCI with TAVI, as well as the coronary artery by-pass grafting with SAVR [8]. Rapid ventricular pacing, which is used during TAVI, is particularly dangerous for patients with significant coronary stenosis. Gautier et al. [2] suggest that CAD in TAVI patients seldom requires revascularisation and does not preclude satisfactory outcomes after TAVI.

Drug eluting stents were implanted in stenotic arteries in our patient in two first stages to enhance the follow up results. Clinical use of DES has significantly reduced the incidence of restenosis following angioplasty and new innovative approaches have been designed to improve the results [9].

The CAD was not the only cardiovascular problem coexisting to aortic stenosis in our patient. He presented severe left ventricle dysfunction related to advanced aortic stenosis and significant CAD. According to Elhmidi et al [10] patients with aortic stenosis and severe left ventricular dysfunction exhibit a significantly increased 6-month mortality after TAVI. However, survivors show a significant potential for left ventricle function recovery. These observation was also present in our patient, who developed significant improvement in left ventricular function after TAVI and the effect was durable in the 2 year follow up.

Timing of PCI has also become a point of discussion in literature. Two management strategies are usually described: TAVI and PCI may be carried out together during one procedure or may be staged (revascularisation in some period before TAVI as a hybrid procedure) [4,6,7,11,12]. The benefits of single-stage procedure are: reducing the number and costs of hospitalisations, one, instead of several, procedure. According to Dvir et al. [6] lowering the gradients along the aortic valve soon after PCI may improve coronary flow and the long-term outcome. Disadvantages include the risk of coronary stent thrombosis during the intervals in coronary flow while rapid pacing, the risk of urgent cardiopulmonary bypass due to complications, the risk of pressing the coronary stent with the prosthesis stent and disorder in coronary flow [6].

Multi-staged procedure exposes the patient to the necessity of several operations, however it brings tangible benefits – as in the case which we describe. In our patient single-stage

procedure would have prolonged the radiation time, would have increased the procedural risk and the risk of contrast nephropathy, especially with co-existing diabetes and baseline impaired renal function. Moreover, multivessel coronary revascularisation itself significantly increases the procedural risk, and in the presence of co-morbidities this risk rises dramatically. The number and severity of cardiovascular and non-cardiovascular risk factors, including diabetes, hypertension, dyslipidemia, renal failure, history of stroke, should be considered to estimate the global risk in the patient [13].

4. CONCLUSION

Therefore we believe that the staged procedure with time interval is a better alternative for patients with severe aortic stenosis, significant coronary artery disease and poor left ventricle function. In doubtful cases, if symptoms of aortic stenosis and CAD are difficult to differentiate, PCI as a first step and clinical observation may enable proper selection of an appropriate method for further treatment. Selection of management strategy should be considered individually.

CONSENT

The authors declare that informed consent was obtained from the patient (when alive) for publication of this case report and accompanying images.

ETHICAL APPROVAL

Not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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