

Transapical aortic valve implantation – a rescue procedure for patients with aortic stenosis and “porcelain aorta”

Katarzyna Czerwinska¹, Ewa Orłowska-Baranowska¹, Adam Witkowski¹, Marcin Demkow¹,
Elżbieta Abramczuk¹, Piotr Michałek¹, Lidia Greszata¹, Patrycjusz Stokłosa¹, Krzysztof Kuśmierski¹,
Jarosław Kowal², Janina Stepinska¹

¹Institute of Cardiology, Warsaw, Poland

²Military Institute of Health Service, Warsaw, Poland

Submitted: 7 August 2010

Accepted: 13 December 2010

Arch Med Sci 2011; 7, 3: 528-532

DOI: 10.5114/aoms.2011.23425

Copyright © 2011 Termedia & Banach

Correspondence author:

Ewa Orłowska-Baranowska

MD, PhD

Institute of Cardiology

Warsaw, Poland

E-mail: eorlowska@ikard.pl

Abstract

Surgical aortic valve replacement (AVR) still remains the treatment of choice in symptomatic significant aortic stenosis (AS). Due to technical problems, extensive calcification of the ascending aorta (“porcelain aorta”) is an additional risk factor for surgery and transapical aortic valve implantation (TAAVI) is likely to be the only rescue procedure for this group of patients. We describe the case of an 81-year-old woman with severe AS and “porcelain aorta”, in whom the only available life-saving intervention was TAAVI.

Key words: aortic stenosis, porcelain aorta, transapical aortic valve implantation.

Introduction

Surgical aortic valve replacement (AVR) still remains the treatment of choice in symptomatic patients with significant aortic stenosis (AS). “Porcelain aorta” in conjunction with critical AS is a very important factor disqualifying the patient from surgery [1, 2]. The recognition of “porcelain aorta” occurs in less than a third of cases before valve replacement and it is often made in the operating room.

The case report on the application of transcatheter aortic valve implantation in a patient with unclampable ascending aorta and severe aortic stenosis is presented below.

Case report

An 81-year-old woman, with AS and “porcelain aorta”, was referred to the Institute of Cardiology in Warsaw in order to decide whether she could undergo any interventional treatment.

Critical AS was diagnosed in 2005 when the patient had been hospitalized due to exacerbation of heart failure (HF) with orthopnoea (NYHA class III/IV). In transthoracic echocardiographic (TTE) severe AS was confirmed, with peak aortic gradient (PAG) – 90 mmHg, mean (MAG) – 57 mmHg, aortic valve area (AVA) – 0.6 cm² and moderate mitral valve insufficiency (MI) with good left ventricular ejection function (LVEF). No significant lesions were found in coronary arteries. Holter-EKG revealed a single episode of atrial fibrillation (AF). The patient was also diagnosed

with chronic lower limb venous insufficiency (several episodes of thrombophlebitis in the past – and put on vitamin K antagonist therapy) and other comorbidities such as hypothyroidism (after strumectomy), diabetes mellitus type 2 and osteoporosis. Surgery was carried out in the Cardio-Surgical Clinic of the Military Institute of Medicine in Warsaw on 7 December, 2005. The sternotomy revealed extensively atherosclerotic and calcified ascending aorta (“porcelain aorta”), which was the reason why planned AVR was finally not carried out.

Since that time the patient has been hospitalized many times because of decompensated HF. In July 2009 she was referred to our department to assess whether she could undergo transcatheter aortic valve implantation (TAVI). She was in NYHA class III/IV, suffering from significant physical tolerance impairment (distance < 50 m of slow walking) and also recurrent episodes of rest dyspnoea and dizziness during physical effort. The patient’s activity was limited to walking around her flat.

Physical examination showed the features of pulmonary congestion, AS and MI murmur. Electrocardiogram showed regular sinus rhythm (70/min), pathological sinistrogram and slow progression of R waves in V_1 - V_3 leads. In the chest X-ray apart from pulmonary congestion and hypertension, extensive atherosclerotic plaques and calcifications of the aortic valve and thoracic aorta were found. Additionally, pulmonary emphysema and features of osteoporosis were diagnosed.

A TTE confirmed severe AS (tricuspid valve) with PAG 120 mmHg, MAG 86 mmHg, and AVA 0.6 cm^2 and mild to moderate insufficiency of mitral and tricuspid valve with pulmonary hypertension (systolic pulmonary artery pressure – SPAP – 62 mmHg) (Figure 1). The patient was again disqualified from classical surgical AVR due to “porcelain aorta”. Moreover, the risk of morbidity with surgery in the 81-year-old patient with many comorbidities was estimated as 35.11%.

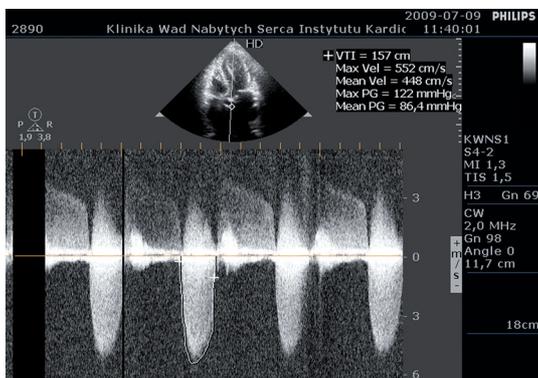


Figure 1. TTE of patient with severe aortic stenosis. CW Doppler-peak and mean gradient

The patient was offered TAVI as an alternative treatment modality and the only possibility of therapeutic intervention.

Because of “porcelain aorta” (Figure 2) and the possibility of damage of the fragile aortic wall with retrograde (transfemoral) TAVI the only possible way of replacement of the aortic valve was a transapical approach (TAAVI). On 8 September, 2009 at the Cardiac Catheterization Laboratory the transapical implantation of a 23 mm Edwards-Sapien prosthesis (Edwards Lifesciences) was carried out in general anaesthesia and under both angiographic and transesophageal echocardiogram (TEE) guidance. The procedure was performed without complications by a team of interventional cardiologists and surgeons (Figures 3 A, B) [3]. The correctly positioned stented bioprosthesis generated a systolic gradient of 15 mmHg with a small perivalvular leak immediately after the implantation.

The patient stayed in the postoperative room for two days. No pericardial effusion was found. Systolic pulmonary artery pressure (SPAP) on the second day after surgery dropped to 48 mmHg from 62 mmHg; LVEF on the 10th day after the surgery was 75%.

The postprocedural period was complicated by pulmonary congestion and left-sided pleurisy, effectively treated with diuretics, and recurrent episodes of AF with a rapid ventricular rate that receded after giving amiodarone. The patient was taking triple anticoagulant therapy – clopidogrel, aspirin and low-molecular-weight heparin – for 13 days after the procedure.

The patient, in stable condition, with good function of circulatory and respiratory systems, was discharged from the hospital on the 19th day after TAAVI, with recommendations to continue anticoagulant therapy with antagonists of vitamin K and double antiplatelet therapy for 6 months.

After 3 and 6 months post-procedure a significant improvement of the physical tolerance was observed. The distance after the procedure increased

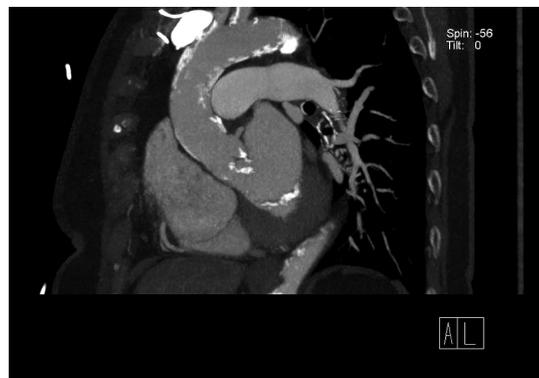


Figure 2. Angio-CT scan. Extensive calcification of the ascending aorta

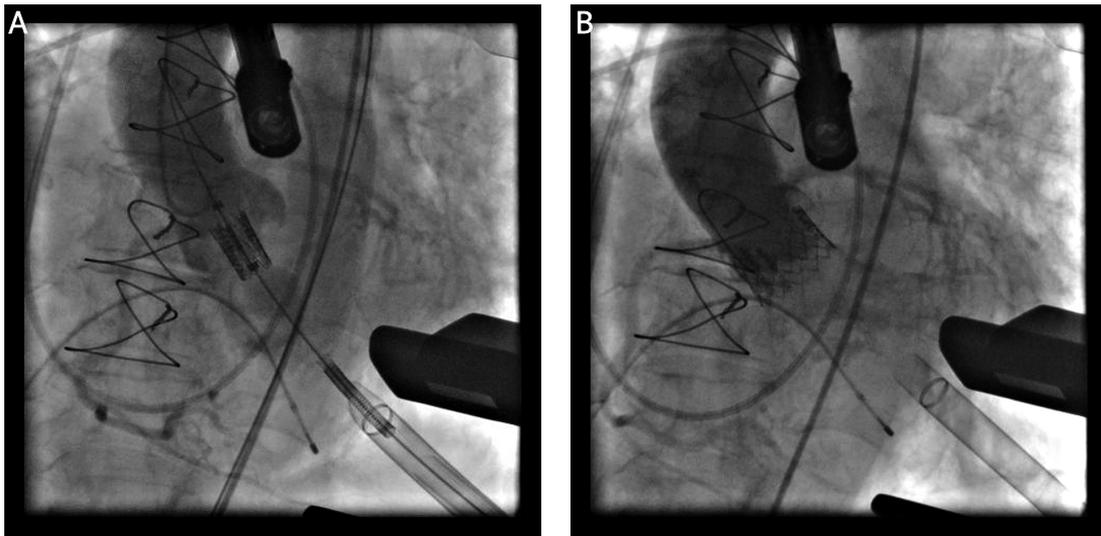


Figure 3 A, B. Fluoroscopy. Implantation of Edwards-Sapien prosthesis

Table I. Transoesophageal echocardiographic (TEE) after transapical aortic valve implantation

TEE	3 months	6 months	1 year
Peak aortic gradient [mmHg]	28	26	21,5
Mean aortic gradient [mmHg]	14	14	11,7
LVEF [%]	70	70	70
RVSP [mmHg]	52		58

to 1 km walking on flat ground (from 50 m). The patient was able to walk up to the second floor and reported no effort or rest dyspnoea. Life comfort and the estimate of mood were improved. Moreover, the patient had to undergo an immediate appendectomy because of acute appendicitis on 25 November, 2009 with no complications.

A physical examination did not show features of heart failure. A slight systolic murmur was heard

over the aortic valve; there was also a systolic murmur over the mitral valve.

A control TTE showed normal function of the aortic Edwards-Sapien bioprosthesis (PAG – 28 mmHg, MAG – 14 mmHg), with persistent mild perivalvular leak and very good LVEF. The dimensions of the heart cavities were comparable to those before the procedure. The degree of mitral and tricuspid valve insufficiency were reduced (Table I, Figures 4, 5).

The improvement concerning the estimation of the clinical symptoms of heart failure remained a year after the procedure (NYHA II) just as the echocardiographic parameters. A control TTE showed correct functioning of the bioprosthesis (Table I).

Discussion

Without surgical correction 5-year survival in symptomatic severe AS is less than 20% [1, 2, 4].

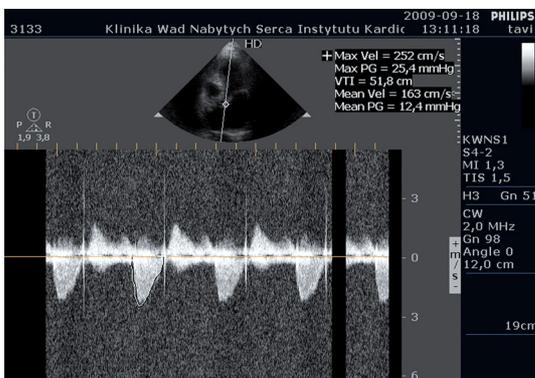


Figure 4. TTE after TAVI procedure. CW Doppler- peak and mean gradient of Edwards-Sapien prosthesis

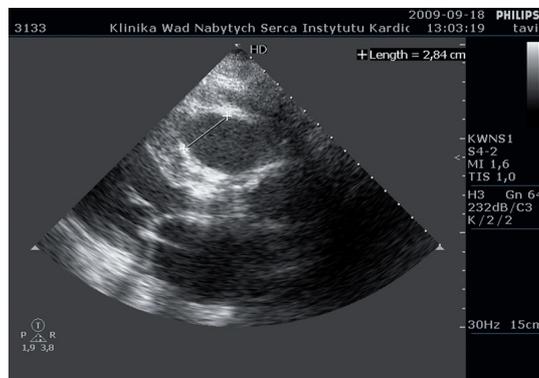


Figure 5. TTE 2D PLAX Edwards-Sapien prosthesis

Aortic valve replacement still remains the treatment of choice. The perioperative mortality is low (3%). However, among elderly people with many comorbidities and in case of additional surgical procedures such as coronary artery bypass graft (CABG) it increases to 15% or more [4]. It is estimated that over one third of patients with severe AS are disqualified from AVR mainly because of advanced age, low LVEF and concomitant diseases [1, 2].

In the case presented in this paper, the additional factor strongly influencing the decision to avoid surgical AVR was advanced atherosclerosis and extensive calcium incrustation of the thoracic aorta (“porcelain aorta”), regardless of other comorbidities and advanced age.

“Porcelain aorta” is a risk factor that significantly worsens the prognosis of surgery due to technical problems which prolong the duration of surgery and increase the risk of embolization to the central nervous system (CNS) (which turns out to be the major factor disqualifying the patient from surgical treatment).

A serious dysfunction of the CNS, caused by cholesterol and calcium microembolism, is observed in over 10% of patients with advanced atherosclerosis of the ascending aorta who underwent CABG [5]. There are a few case reports describing successful AVR with endarterectomy of the aortic root or the use of a conduit with a valve prosthesis connecting the cardiac apex with the descending aorta, worked out about 32 years ago by Cooley [6-8]. Also several reports about the “no-touch” technique of CABG surgery have been published [8, 9].

The diagnosis of “porcelain aorta” seems not to provoke many clinical and financial problems. Chest X-ray, transthoracic echocardiography or CT scan is usually sufficient. Nonetheless, it is very often overlooked (in two thirds of cases) probably because of the lack of clinical symptoms and many times “porcelain aorta” seems to be found by chance, as in the reported case, during the surgery, in the operating room, despite the importance of its diagnosis. This situation exposes the patient to unfounded and extensive cardio-surgical intervention and increases unnecessary costs of diagnostic and interventional procedures.

Commonly used scales of surgical risk estimation such as Logistic Euroscore and STS score do not take into account the issue of “porcelain aorta” as well as other important risk factors, which disqualify patients, regardless of other comorbidities, from cardio-surgical intervention.

Moreover, the advanced atheromatic changes within the aorta also limit the possibilities of TAVI, excluding an antegrade approach through the femoral and subclavian artery. The only procedure that can save the life of patients with severe AS and “porcelain aorta” is the TAAVI [3, 10-14].

The first procedure of TAVI was performed in 2002. It remains the alternative method to surgery for high-risk patients in the still growing patient population. Usually the procedure is performed in older patients with many concomitant diseases, in whom the surgical risk of death is more than 20% according to Logistic EuroSCORE or 10% according to STS. As in our case, TAVI could be the only possible procedure to save the patient’s life [10-14].

Both available types of stented bioprosthesis for transcatheter implantation, Edwards Sapien (*Edwards Lifesciences*) and Core Valve (*Medtronic*), can be implanted by the retrograde way through the femoral or subclavian artery; the Edwards-Sapien prosthesis also with a transapical approach – the preferred way in peripheral vascular diseases and/or “porcelain aorta”. The periprocedural death rate for TAVI is 2% and the 30-day mortality range from 5% to 15% – roughly half of that predicted for surgery, depending on the type of the procedure and on the experience of the operators. A higher death rate is characteristic for TAAVI because of the mere procedure and higher-risk patients with many comorbidities, which usually is reflected by a higher EuroSCORE [7-10]. The most frequent early complications (first 30 days) are need of blood transfusion, injury of aorta and conduction disturbances that provoke permanent pacemaker implantation, renal failure and pneumonia. The percentage of adverse vascular, cardiac and cerebral incidents, e.g. death, stroke and myocardial infarction, is about 15%. Transient renal failure, paroxysmal AF, and longer period of hospitalization occur frequently with the transapical approach whereas the risk of neurological complications concerning this route of implantation is lower (6%) in comparison with the retrograde, transarterial approach [10-14].

The results of the long-term follow-up show that the survival rate after 1 month is 90%, after 1 year 80% and after 2 years 70%. It should be emphasized that during 3-year observation no aortic valve prosthesis dysfunctions occurred. Infections of the implanted valve and the need of reimplantation are very rare and the main adverse event is bleeding caused by chronic double antiplatelet therapy recommended for 6 months after the intervention. The most frequent causes of death in long-term follow-up are concomitant diseases [10-14].

Taking into considerations that the major causes of death in TAVI (among the patients who underwent TAVI) are not related to the procedure itself, and that the risk of death in classic AVR is prohibitively high in old patients, with many comorbidities, TAVI and in particular TAAVI in patients with “porcelain aorta” and/or peripheral atherosclerosis is an attractive alternative to a surgical approach. Despite the fact that in this hybrid procedure a higher risk of death

and complications in comparison to the transarterial route is expected, it is still the only possible therapeutic intervention in this patient cohort [10-14].

Nowadays it is well known that porcelain aorta is one of the main indications for such a procedure, but we wanted to stress in the presented case report the difficulties in preoperative evaluation (to avoid diagnosis made during surgery) and the possibility to carry out development in medical science and practice.

References

1. Vahanian A, Baumgartner H, Bax J, Butchart E. Guidelines on the management of valvular heart disease: the Task Force on the Management of Valvular Heart Disease of the European Society of Cardiology. *Eur Heart J* 2007; 28: 230-68.
2. Bonow RO, Carabello BA, Chatterjee K, et al. ACC/AHA guidelines for the management of patients with valvular heart disease: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on practice guidelines (writing committee to revise the 1998 guidelines for the management of patients with valvular heart disease): developed in collaboration with the society of cardiovascular anesthesiologist: endorsed by the Society for Cardiovascular Angiography and Interventions and the Society of Thoracic Surgeons. *Circulation* 2006; 114: 450-527.
3. Lichtenstein SV, Cheung A, Ye J. Transapical transcatheter aortic valve implantation in Humans. Initial Clinical Experience. *Circulation* 2006; 114: 591-6.
4. Rosario V, Freeman MS, Otto CM. Spectrum of calcific aortic valve disease: pathogenesis, disease, progression and treatment strategies. *Circulation* 2005; 111: 3316-26.
5. Stewart BF, Siscovick D, Lind BK. Clinical factors associated with calcific aortic valve disease. *J Am Coll Cardiol* 1997; 29: 630-4.
6. Kuan-Ming Chiu, Tzu-Yu Lin, Jer-Shen Chen, Shao-Jung Li, Chin-Yang Chan, Shu-Hsun Chu. Left ventricle apical conduit to bilateral subclavian artery in a patient with porcelain aorta and aortic stenosis. *Circulation* 2006; 113: 388-9.
7. Nishimura Y, Okamura Y, Hiramatsu T, et al. Apicoaortic valved conduit is a good alternative for aortic stenosis with porcelain aorta after off-pump coronary artery bypass grafting. *Interact Cardiovasc Thorac Surg* 2007; 6: 374-5.
8. Gammie JS, Krowsoski LS, Brown JM. Stenosis population aortic valve bypass surgery: midterm clinical outcomes in a high-risk aortic. *Circulation* 2008; 118: 1460-6.
9. Akpınar B, Güden M, Sanisoğlu I, Konuralp C, Yılmaz O, Sönmez B. A no-touch technique for calcified ascending aorta during coronary artery surgery. *Tex Heart Inst J* 1998; 25: 120-3.
10. Vahanian A, Alfieri O, Al-Attar N. Transcatheter valve implantation for patients with aortic stenosis: a position statement from the European Association of Cardio-Thoracic Surgery (EACTS) and the European Society of Cardiology (ESC), in collaboration with the European Association of Percutaneous Cardiovascular Interventions (EAPCI). *Eur Heart J* 2008; 29: 1463-70.
11. Rosengart TK, Feldman T, Borger MA, et al. Percutaneous and minimally invasive valve procedures: a scientific statement from the American Heart Association Council on Cardiovascular Surgery and Anesthesia, Council on Clinical Cardiology, Functional Genomics and Translational Biology Interdisciplinary Working Group, and Quality of Care and Outcomes Research Interdisciplinary Working Group. *Circulation* 2008; 117: 1750-67.
12. Webb JG, Altwegg L, Boone RH. Transcatheter aortic valve implantation. Impact on clinical and valve-related outcomes. *Circulation* 2009; 119: 3009-16.
13. Webb JG, Pasupati S, Humphries K. Percutaneous transarterial aortic valve replacement in selected high-risk patients with aortic stenosis. *Circulation* 2007; 116: 755-63.
14. Svensson LG, Dewey T, Kapadia S, Roselli EE. United States Feasibility Study of transcatheter insertion of a stented aortic valve by the left ventricular Apex. *Ann Thorac Surg* 2008; 86: 46-55.