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Endovascular treatment of severe aortic stenosis in high and intermediate surgical risks patients

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Abstract

Aims. To evaluate the safety and efficacy of transcatheter aortic valve replacement with CoreValve bioprothesis in patients with severe aortic stenosis in high and intermediate surgical risk.

Methods and results. Data was prospectively collected from 81 patients with severe aortic stenosis, who underwent CoreValve implantation in one centre. After risk stratification 38 patients (46.9%) were at high risk (STS score >8%). In 43 cases (53.1%) patients were at intermediate STS score (STS score >3 and <8%), but due to different coexisting characteristics patients were not candidates for surgery. Technical success was achieved in all cases. All-cause hospital mortality was 6.2% (5 cases) generally, without statistical difference between two groups (10.5% in high risk group, 4 patients; 2.3% in intermediate group, 1 patient). In two patients post-operation period was complicated by stroke (1 minor stroke, 1 major stroke; 2.5±1.7% of cases); in one case acute myocardial infarction developed 6 hours post CoreValve implantation (1.2%); in one case acute renal failure developed, leading to death of the patient. No significant differences in cerebrovascular accidents and myocardial infarction between the different risk groups were observed throughout hospital period. During three years 56 patients (72±5,0%) were available for follow up. Two patients died during follow-up: one patient died due to cancer progression (23 months after the implantation), one due to progression of chronic kidney insufficiency (18 months after implantation). No cerebrovascular or cardiac accidents were observed during follow up period.

Conclusion. In selected patients with intermediate surgical risk TAVR procedure with the use of CoreValve system have good clinical outcomes in hospitalisation period and long-term follow-up.

Key words Severe aortic stenosis, self-expanding valve, STS score risk evaluation.

Abbreviations

BMI = body mass index;
CT = computer tomography;
PCI = percutaneous coronary intervention;
STS = Society of Thoracic Surgeons;
TAVR = transcatheter aortic valve replacement;
TEE = transesophageal echocardiography

Introduction

Aortic stenosis is the most common valvular heart disease, which affects 2-4% of individuals older 65 years in USA and performs 43% of all valvular heart diseases in Europe[1]. Aortic stenosis increase in incidence with age, so one in eight people over the age of 75 have moderate to severe aortic valve disease[2]. Regarding the population aging, this condition becomes a serious public health problem. Medical management of severe aortic stenosis is a suboptimal strategy, may provide temporary symptom relief but is not effective long term[3]. Surgical aortic valve replacement is a gold standard recommended treatment, but patients with severe symptoms have been found to have a significantly higher operative mortality than those with no or only mild symptoms[4]. The use of a bioprosthetic valves can be an opportunity in treatment of elderly patients with severe stenosis (<0.6 cm^2) or severe left ventricular dysfunction[5-6]. Approximately 30% of the patients with severe symptoms and coexisting conditions are not candidates for surgery[7-9]. Endovascular treatment of severe aortic stenosis - transcatheter aortic valve replacement (TAVR) proved to be

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effective and safe treatment in a group of inoperable and high-risk for surgery operation patients[10-12] since 2002, when the procedure was first performed[13-14]. Patients, undergoing TAVR procedure usually in advanced age, with serious comorbidity conditions (Logistic EuroSCORE> 20%), and with contra indications to open surgery[15-18]. 30-days mortality rate is reported on 5-20% level; myocardial infarction observed in 2-11% of cases, stroke in 3-9%, other vascular complications in 10-15% and AV-block in 4-30% of the patients. Mild to moderate paravalvular aortic valve regurgitation is present almost in half of the patients. The survival rate for 1 year with the use of transfemoral approach is 80-90%[19-20].

Bioprosthesys CoreValve (Medtronic, USA) is a representative of third generation of artificial aortic valves for endovascular implantation. It is manufactured by suturing 3 valve leaflets and a skirt, made from a single layer of porcine pericardium, onto a self-expanding, multi-level, radiopaque frame made of Nitinol. It can be implanted from femoral, left subclavian, axillar approach. TAVR procedure with CoreValve system is performed in cathlab or hybrid room, by physicians who have received Medtronic CoreValve™ training, under TEE guidance and under general anesthesia.

The aim of the study is clinical-functional analysis of immediate and long-term results of TAVR with the use of CoreValve transcatheter aortic valve in patients with severe aortic stenosis at high and intermediate surgical risk as defined by a Society of Thoracic Surgeons (STS) risk score[21].

Methods

Data was prospectively collected in the period 2011-2014 from 81 TAVR cases on the base of cardio-vascular center of Regional Clinical Hospital. Patients had severe aortic stenosis and cardiac symptoms for whom conventional surgery to replace the aortic valve was associated with high risk, or low risk in combination with contraindications for surgery. Two patients (2.5%) had additional severe aortic regurgitation. In four cases combined valve disease was present: severe aortic stenosis and mild mitral stenosis. Two patients had relative contra indication for TAVR procedure – bicuspid aortic valve. All patients underwent precise evaluation for TAVR procedure with the use of CT angiography, echocardiography (transesophageal echo was used, if visualization on transthoracic echo was not appropriate), aortography in selected cases. Risk for surgical procedure was evaluated using STS risk score. Decision to a transcatheter or surgical strategy was made by heart team, that includes interventional cardiologist, cardiac surgeon, anesthesiologist and additional specialists in the case of pertinent comorbidities (nephrologist, endocrinologist). Written informed consent was obtained in all cases prior to the procedures.

In our center all TAVR cases are performed under general anesthesia, under TEE guidance during all the procedure.

All procedures were performed with transfemoral access. Four patients underwent access site closure with the Perclose device (Abbott Vascular Devices, Santa Clara, CA, USA) using pre-closure technique. In 77 cases standard arterial surgical cut-down was used, due to calcification (48 patients) and obesity (28 patients with BMI>30). According to the standard recommendations at the time of the procedure, patients were treated with 100 mg of acetylsalicylic acid, a 600 mg loading dose of clopidogrel, and unfractionated heparin 70-100 U/kg.

After TAVR procedure patients were followed up at 1, 6, 12 months and once a year after 12th months by means of a clinical visit or a standardized telephone interview. In the case of necessity additional hospital visit was administrated. Control TTE was performed every 6 months after the CoreValve implantation to assess valve function, peri-device flow and general echo parameters.

Results

All 81 patients were available for follow-up. Technical success was achieved in all cases. After risk stratification 38 patients (46.9%) were at high risk (STS score >8%). In 43 cases (53.1%) patients were at intermediate STS score (STS score ≥3 and ≤8%), but due to different coexisting characteristics patients were not candidates for surgery (Table 1).

Table 1. Patients, refused for surgery with low and intermediate STS score.

Coexisting condition	Value
Patients, refused for surgery, n (%)	43 (53.1)
Porcelain aorta, n (%)	27 (62.8)
Chest-wall irradiation, n (%)	11 (25.6)
Chest-wall deformation, n (%)	2 (4.7)
Frailty, n (%)	2 (4.7)
Mental health features, n (%)	1 (2.3)

Patients in high risk group were significantly older, with lower body mass index, but in both groups prevalence of arterial hypertension was very high (>95%) (Table 2). Significant symptoms of heart failure (NYHA III-IV) were prevalent in high risk group (76.3% vs. 34.9%, p=0.03). Chronic obstructive pulmonary disease and renal failure were also more prevalent in high risk patients. In past medical history there was no difference in frequency of myocardial infarction, coronary arteries interventions between two groups, but high risk patients had more previous strokes (31.6% vs. 4.7%, p=0.006). Left ventricular ejection fraction was higher among intermediate risk patients (58±2.16 vs. 49.8±13.3, p<0.001). No difference in echocardiographic variables were find between two groups, mean aortic valve gradient was 45.2±14.7 mmHg in high risk patients and 44.7±13.9 mmHg in intermediate risk group (p=0.04); aortic valve area was 0.6±0.3 cm^2 in high risk patients and 0.6±0.2 cm^2 in intermediate patients (p=0.7).

Significant coronary arteries disease was diagnosed in 57.9% in high risk group and in 41.9% in intermediate group (p=0.26, 40 patients in both groups). The decision about the time of the revascularisation (simultaneous or

Table 2. Clinical characteristics, echo findings.

Characteristic	High risk group (38 patients)	Intermediate risk group (43 patients)	p
Age, years	82.6±6.6	74.8±8.4	p<0.001
Male, n (%)	18 (47.4)	23 (53.5)	p=0,19
BMI (kg/m^2)	23.9±5.4	29.2±5.8	p<0.001
STS score	10.2±2.1	4.1±1.8	p<0,001
Diabetes Mellitus	13 (34.2)	8 (18.6)	p=0,16
Arterial hypertension	37 (97.4)	41 (95.3)	p=0,53
Hypercholesterolemia	25 (65.8)	24 (60.1)	P=0,39
Heart Failure (NYHA III – IV), n (%)	29 (76.3)	15 (34.9)	p=0,03
Coronary arteries disease	22 (57.9)	18 (41.9)	p=0,26
Prev. Myocardial infarction	4 (10.5)	5 (11.6)	
Coronary arteries interventions – total number (%) CABG PCI	 1 (2.6) 21 (55.3)	 0 18 (41.9)	 p=0,47 p=0,3
Peripheral Vascular disease, n (%)	13 (34.2)	10 (23.3)	p=0,28
COPD (any)	15 (39.5)	5 (11.6)	p=0,02
Chronical kidney disease	17 (44.7)	3 (6.9)	p=0,001
Cancer	5 (13.2)	12 (27.9)	p=0,04
Atrial fibrillation	10 (26.3)	11 (25.5)	p=0,57
Permanent pacemaker	4 (10.5)	3 (7.0)	p=0,44
Previous stroke	12 (31.6)	2 (4.7)	p=0,006
Echocardiography characteristics: Mean aortic-valve gradient, mm Hg Aortic-valve area, (cm^2) Pulmonary hypertension, n(%) Mitral regurgitation (moderate to severe)	 45.2±14.7 0.6±0.3 14 (36.8) 8 (21.1)	 44.7±13.9 0.6±0.2 13 (30.2) 9 (20.9)	 p=0,4 p=0,7 p=0,41 p=0,6
EF, % ±SD	49.8±13.3	58±2.16	p<0,001

staged procedure) was made individually in every patient, considering the significance of lesion and clinical condition. In 82.5% (33 patients) – PCI was performed at the time of diagnostic (ad-hock procedure) or before 1 month-2 weeks before planned TAVR, and in 17.5% of cases (7 patients) simultaneous PCI and TAVR was performed.

Post TAVR—need for permanent pacemaker was at the same for both groups – in 9 patients in high risk group (23.7%), in 10 patients in intermediate group (23.3%, p=0.58).

All-cause hospital mortality was 6.2% (5 cases) generally, without statistical difference between two groups, probably due to the small amount of patients (10.5% in high risk group, 4 patients; 2.3% in intermediate group, 1 patient). In two patients post-operation period was complicated by stroke (1 minor stroke, 1 major stroke; 2.5±1.7% of cases); in one case acute myocardial infarction developed 6 hours post CoreValve implantation (1.2%); in one case acute renal failure developed, leading to death of the patient. No significant differences in cerebrovascular accidents and myocardial infarction between the different risk groups were observed throughout hospital period. During three years 56 patients (72±5,0%) were available for follow up. Two patients died during follow-up: one patient died due to cancer progression (23 months after the implantation), one due to progression of chronic kidney insufficiency (18 months after implantation). No cerebrovascular or cardiac accidents were observed during follow up period.

Discussion

The performed analysis is based on a single-centre experience with patients undergoing TAVR in high and intermediate surgical risks, with the use of CoreValve self-expanding system. All patients, included in analysis, were precisely discussed by heart team of our multidisciplinary hospital. The risk for surgical aortic valve replacement was counted with the use of STS score, as the most exact predictor of outcome, as it was recognised, that the logistic EuroSCORE overestimates the risk for adverse clinical outcomes[22]. In big randomized trials, such as SURTAVI, STS score was chosen for risk evaluation of the patients[23]. Several conditions, such as porcelain aorta, chest wall irradiation or deformation, frailty making intermediate and low surgical patients contra-indicated for surgery. These factors are always discussed by a heart team, for choosing the appropriate treatment strategy. According to contemporary practice in Europe[24], intermediate risk patients were included to our analysis. In several single-centre and multi-centre studies patients in low surgical risks were also included[24-25].

All cause death in our centre was 6.2% for all patients, which is similar to analysis, performed by Wenaweser et. al.[26], where all cause death was 6.4%. But in these study, patients were divided in three

Table 3. Clinical outcomes at 30 days

Hospitalization period	All patients (81 patients)	High risk group (38 patients)	Intermediate risk group (43 patients)	p
All cause death, n (%)	5 (6.2)	4 (10.5)	1 (2.3)	0.16
Minor stroke, n (%)	1 (1.2)	1 (2.6)	0 (0)	0.47
Major stroke, n (%)	1 (1.2)	0 (0)	1 (2.3)	0.53
Myocardial infarction, n (%)	1 (1.2)	0 (0)	1 (2.3)	0.53
Acute renal failure, n (%)	1 (1.2)	1 (2.6)	0 (0)	0.47
Access cite complications, n (0)	0 (0)	0 (0)	0 (0)	

groups: low, intermediate and high risk patients. All cause mortality rate was lower in low risk patients and intermediate risk patients compared with high risk group. In our experience, statistically significant difference between intermediate and high risk patients was not achieved (p=0.16), probably because of small amount of patients. All-cause death during hospitalisation was observed on a rate 2.3%, what can be considered as a good result of implantation. Long-term results in intermediate group were not worse, compare with high risk group. We consider, that selected patients with intermediate surgical risk will have good clinical outcomes in hospitalisation period and long-term follow-up. Randomized trials, PARTNER II and SURTAVI should be completed, to prove, that TAVR procedure can be preferred for patients with intermediate surgical risk.

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