ORIGINAL ARTICLE

Acute kidney injury as the most important predictor of poor prognosis after interventional treatment for aortic stenosis

Anita Korczak[1], Robert Morawiec[1], Michał Stegienta[1], Aleksandra Ryk[2], Andrzej Walczak[3], Jan Krekora[1], Michał Krejca[3], Jarosław Drożdż[1]

[1]2nd Department of Cardiology, Medical University of Lodz, Department of Cardiology and Cardiac Surgery of the Hospital of the Clinical and Didactic Center in Lodz, Łódź, Poland
[2]Department of Biostatistics and Translational Medicine, Medical University of Lodz, Łódź, Poland
[3]Department of Cardiac Surgery of the Hospital of the Clinical and Didactic Center in Lodz, Medical University of Lodz, Łódź, Poland

Correspondence to:
Anita Korczak, MD,
2nd Department of Cardiology,
Medical University of Lodz,
Department of Cardiology and Cardiac Surgery of the Hospital of the Clinical and Didactic Center in Lodz,
Pomorska 251, 92–213 Łódź,
Poland,
phone: +48 42 201 43 08,
e-mail:
anita.korczak@umed.lodz.pl

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ABSTRACT

Background: Aortic stenosis (AS) is the most common acquired valvular disease. There are two methods of interventional treatment: surgical aortic valve replacement (SAVR) and transcatheter aortic valve implantation (TAVI). The choice between SAVR and TAVI depends on the assessment of individual perioperative risk and long-term treatment outcomes. It is essential to identify factors that may influence the outcomes of the treatment to minimize their negative effects.

Aims: The study aimed to identify the most important risk factor which affects treatment outcomes in patients with AS undergoing SAVR/TAVI.

Methods: This study reviewed retrospectively patients with AS who underwent SAVR or TAVI. The primary outcomes included incidences of major adverse cardiovascular events (MACE) defined as cardiovascular death, stroke, and hospitalization for cardiovascular issues assessed over a one-year follow-up period. An occurrence of postprocedural AKI (acute kidney injury) was identified as an independent predictor of MACE.

Results: The study included 78 patients, with the same number of subjects in each group (SAVR/TAVI [n = 39]). Twenty-nine patients developed AKI. It was similar in both groups (SAVR [n = 15]; TAVR [n = 14]). In the SAVR group, 13 (33%) patients developed at least one MACE compared to 5 (13%) patients in the TAVI group. AKI and the type of procedure (SAVR) were shown to be significantly and independently associated with the development of MACE ($P = 0.01$ and $P = 0.03$, respectively) as shown in the Cox multivariable regression model.

Conclusions: Our study demonstrated that AKI is the strongest predictor of major adverse cardiovascular events after using both methods of aortic valve replacement (SAVR/TAVI).

Key words: acute kidney injury, major adverse cardiovascular events, severe aortic stenosis, surgical aortic valve replacement, transcatheter aortic valve implantation

INTRODUCTION

Aortic stenosis (AS) is the most common acquired heart defect among adults. The average prevalence of severe aortic valve stenosis is estimated to be 0.2% in patients between 55 and 64 years of age. It increases with age, reaching approximately 3% at 75–80 years of age and even 10% after 80 years of age [1]. Severe, symptomatic aortic stenosis is associated with death of at least half of patients within 2 years after the onset of first symptoms. Such patients should undergo aortic valve replacement. The most common surgical methods are surgical aortic valve replacement (SAVR) and transcatheter aortic valve implantation (TAVI) [2].

The surgical risk increases with age, and patients are at risk of developing serious concomitant diseases; therefore, TAVI becomes an alternative treatment for this group of patients [3–6].

Indeed, several randomized clinical trials compared those procedures and confirmed that TAVI was non-inferior and even superior to SAVR with regard to clinical outcomes [3, 7–9].

WHAT'S NEW?

In this article, we argue that acute kidney injury (AKI) is the strongest predictor of major adverse cardiovascular events (MACE) in patients with aortic stenosis (AS) who underwent surgical aortic valve replacement (SAVR) or transcatheter aortic valve intervention (TAVI) during one-year follow up. To the best of our knowledge, this study is the first that investigated impact of postprocedural AKI on the occurrence of MACE (including cardiovascular death, stroke, and hospitalization for cardiovascular problems) in both groups (SAVR and TAVI), during long-term follow-up.

Still, the final decision regarding the choice of the optimal treatment method should be made by the Heart Team after individual assessment of benefits and risks of the procedure and the patient's preferences [3, 5].

Chronic kidney disease (CKD) often coexists in patients with severe aortic stenosis, possibly due to similar etiology. Renal dysfunction provokes aortic valve calcification. Recent studies have shown that acute kidney injury (AKI) is a common complication after cardiac surgery and its frequency is significantly higher in patients with CKD [10]. Depending on the research, it occurs in 3% to 43% of SAVR and 3% to 57% of TAVI procedures. Several studies showed that postprocedural AKI is associated with poor prognosis [11, 12]. However, TAVI is a generally less invasive procedure, which might mitigate the negative impact of postoperative AKI.

The study aimed to identify the most important risk factor which affects treatment outcomes in patients with AS undergoing SAVR/TAVI.

METHODS

Study population

This retrospective cross-sectional study with active follow-up enrolled a total of 120 consecutive patients with severe aortic stenosis who underwent TAVI or SAVR between December 2018 and December 2019 in the Department of Cardiac Surgery. The decision on choice of treatment method in each case was made at a meeting of the Heart Team consisting of an attending cardiologist, cardiac surgeon, invasive cardiologist, and echocardiographer. Afterward, patients who qualified for conservative treatment or those who died before the planned procedure (TAVI/SAVR) were excluded from further analysis. The full exclusion criteria were incomplete medical documentation and lack of consent for the proposed interventional treatment. Besides, patients qualified for aortic balloon valvuloplasty or those who died before the planned aortic valve replacement (SAVR/TAVI), as well as patients with severe CKD (stage G5 according to Kidney Disease: Improving Global Outcomes [KDIGO] on the treatment of dialysis), were also excluded from the study.

Patients were divided into 2 groups based on the treatment method (TAVI/SAVR). The surgical protocol was a source of intraoperative information, and the postoperative course was assessed on the basis of daily observations made by physicians and available in the hospital database. We analyzed all available clinical data including laboratory test results and transthoracic echocardiography (performed twice: before the procedure and before the discharge in each case). The study protocol was approved by the Local Ethics Committee and the study followed the principles outlined in the Declaration of Helsinki.

Procedural details

The surgical aortic valve replacement (SAVR) was performed in the operating room under general anesthesia with extracorporeal circulation, from the classic median approach and median sternotomy. The procedure consisted of the removal of the native aortic valve and implantation of the prosthesis.

The TAVI procedures were performed in a hybrid operating room. The patients were under conscious sedation or general anesthesia. The choice of vascular approach (femoral/transapical/transaortic) depended on the anatomy and severity of atherosclerosis of the peripheral arteries and aorta, as assessed by computed tomography. During the procedure, the patients were continuously monitored with arterial blood pressure measurement and received a temporary cardiac pacing electrode. Depending on the valve morphology and the number of calcifications, aortic valve valvuloplasty was performed during rapid ventricular pacing. The valve was positioned under video-assisted control and echocardiographic guidance and then implanted.

Analyzed clinical parameters

During preparation for the procedure, the patients underwent transthoracic and transesophageal echocardiography and also coronary diagnostics (coronary computed tomography angiography [CCTA]/coronarography — the choice of method depended on the patient's age, symptoms, risk factors, and positive family history of ischemic disease) and, in the case of TAVI, also multislice computed tomography of the aorta. The study groups were subject to a detailed clinical assessment (severity of symptoms according to the New York Heart Association [NYHA] class, body mass index [BMI], concomitant diseases, i.e., diabetes, hypertension, atrial fibrillation, renal diseases), echocardiographic (left ventricular ejection fraction, aortic valve area, maximal and minimal transvalvular gradient, maximal aortic valve velocity), and biochemical (creatinine, glomerular filtration rate [GFR], N-terminal pro-B-type natriuretic peptide, hemoglobin). All patients had a surgical risk estimated based on common cardiac surgical risk scales: the European Cardiac Risk Assessment System (EuroSCORE II) or the Society of Thoracic Surgeons (STS) [3, 13].

Table 1. Types and sizes of valves used during the procedure

Type of valve	SAVR (n = 39)	Type of valve	TAVI (n = 39)
Medtronic Hancock II[a] size, mm (n)	21 (9) 23 (6) 25 (7)	Portico TM Valve[b] size, mm (n)	23 (1) 25 (2)
St. Jude Epic/Epic TM Supra[b] size, mm (n)	19 (1) 21 (2) 23 (4) 25 (4) 27 (1)	Evolut R[a] size, mm (n)	23 (1) 26 (5) 27 (4) 29 (4) 34 (1)
Medtronic Freestyle[a] size, mm (n)	21 (1)	Evolut PRO[a] size, mm (n)	25 (1) 26 (5) 29 (5) 34 (1)
Edwards Perimount[c] size, mm (n)	21 (1) 23 (1) 25 (1) 27 (1)	Edwards Sapien Lifesciences[c] size, mm (n)	23 (1) 26 (6) 29 (1)
		Core Valve[a] size, mm (n)	23 (1)

Producer: [a]Medtronic, Münchenbuchsee, Switzerland. [b]Abott, Chicago, IL, US. [c]Edward Lifesciences Corporation, Irvine, CA, US

Names of the valves: Core Valve, Edwards Perimount, Edwards Sapien Lifesciences, Evolut PRO, Evolut R, Medtronic Freestyle, Medtronic Hancock II, Portico TM Valve, St. Jude Epic/ Epic TM Supra

Abbreviations: SAVR, surgical aortic valve replacement; TAVI, transcatheter aortic valve implantation

The serum creatinine level was measured in each patient 24 hours before the procedure and every day after the procedure until discharge from the hospital.

The baseline renal function was estimated based on the patient's medical history and results of laboratory tests before the procedure. Chronic kidney disease was defined when the glomerular filtration rate (eGFR) was lower than 60 ml/min/1.73 m^2; stages were assessed according to the KDIGO [10, 14].

Acute kidney injury was diagnosed when serum creatinine level increased by ≥0.3 mg/ml (≥26.4 µmol/l) within 48 h or increased ≥1.5 times within 7 days compared with baseline (using the KDIGO), as recommended by the Valve Academic Research Consortium-3 (VARC-3) [14].

Follow-up and study endpoints

An occurrence of adverse events was evaluated within one year of the follow-up period. Major adverse cardiovascular events (MACE) were defined as cardiovascular death, stroke, and hospitalization for cardiovascular issues. According to VARC-3, hospitalization was defined as any admission to an inpatient unit or hospital ward for ≥24 h, including an emergency department stay due to cardiac or cardiovascular reasons [14].

All patients included in the study were observed during one-year follow-up. All MACE data were collected from the inter-hospital electronic database of patients. We collected follow-up data from all patients included in the study. In the case of more than one MACE in one patient, only the first event that occurred was considered in further MACE analysis.

Statistical analysis

Categorical variables are presented as numbers with a corresponding percentage. Categorical variables were compared using the χ^2 test or for a low number of counts (<5 in any cell of a frequency table) — the 2-way Fisher's exact test. Continuous variables are presented in the form of mean with standard deviation or median with interquartile range. The normality of distribution was verified by the Shapiro-Wilk test. Differences between the groups were assessed using the t-test or Mann-Whitney U test (depending on the normality of distribution). A survival analysis using the Kaplan-Meier curve and log-rank test was performed to compare the MACE-free survival time of patients with and without AKI. Univariable Cox regression was carried out to find factors associated with the occurrence of MACE. Subsequently, statistically significant variables were included in the multivariable Cox regression model built using the forward stepwise method. P-value below the level of 0.05 was considered statistically significant. All calculations were carried out in STATISTICA 13.3 software (TIBCO, Palo Alto, CA, US).

RESULTS

Overall, from 120 hospitalized patients with severe AS, 42 subjects met exclusion criteria, mainly due to qualification for conservative treatment (n = 30; 6 of them did not give consent to the proposed surgical treatment), qualification for balloon aortic valvuloplasty (n = 5), or death before performing the procedure — SAVR/TAVI (n = 7), and 78 patients were included in further analysis. Most of the 78 studied patients were females (male n = 34 [43.6%], female n = 44 [56.4%], mean age [SD]: 73.3 [10.52]). Thirty-nine patients underwent SAVR, and 39 patients underwent TAVI. The types of valves used for SAVR are presented in Table 1. None of the patients received a mechanical prosthesis. TAVI procedures were performed from the femoral (n = 25), transapical (n = 8), and transaortic (n = 6) approach.

Table 2. Study group characteristic

	All patients (n = 78)	SAVR (n = 39)	TAVI (n = 39)	*P*-value
Age, years, mean (SD)	73.3 (10.5)	66.7 (9.1)	79.9 (7.3)	<0.01
Male, n (%)	34 (43.6)	18 (46.2)	16 (41)	0.74
BMI, kg/m², mean (SD)	27.6 (5.1)	27.1 (4.3)	28 (5.7)	0.36
EuroSCORE, %, median (IQR)	2.7 (1.7–4.7)	2.2 (1.3–3.5)	3.6 (2.1–6.9)	0.01
STS, %, median (IQR)	2.5 (1.6–4.1)	1.9 (1.2–3.5)	3.6 (2.1–5.5)	<0.01
Diabetes, n (%)	21 (26.9)	11 (28.2)	10 (25.6)	1.00
Hypertension, n (%)	69 (88.5)	35 (89.7)	34 (87.2)	1.00
Pulmonary embolism in the past, n (%)	1 (1.3)	1 (2.6)	0 (0)	1.00
Myocardial infarction in the past, n (%)	18 (23.1)	7 (18)	11 (28.2)	0.42
Current smoking, n (%)	15 (19.2)	11 (28.2)	4 (10.3)	0.08
Atrial fibrillation, n (%)	30 (38.5)	13 (33.3)	17 (43.6)	0.49
PCI in the past, n (%)	7 (9)	2 (6.1)	5 (14.3)	0.43
Cardiostimulator implanted before intervention, n (%)	9 (11.5)	3 (7.7)	6 (15.4)	0.48
GFR (45–59), ml/min/1.73 m², n (%)	19 (24)	10 (26)	9 (24)	0.78
GFR (30–44), ml/min/1.73 m², n (%)	12 (15)	6 (15)	6 (15)	
GFR (15–29), ml/min/1.73 m², n (%)	3 (5)	1 (2)	2 (5)	
Hemoglobin, g/dl, mean (SD)	12.7 (1.8)	13 (1.8)	12.5 (1.9)	0.31
NT-proBNP, pg/ml, (n = 70), median (IQR)	2098 (775–5413)	1849 (843–4572)	2948 (772.5–7765.5)	0.34

Abbreviations: BMI, body mass index; GFR, glomerular filtration rate; IQR, interquartile range; NT-proBNP, N-terminal pro-B-type natriuretic peptide; PCI, percutaneous coronary intervention; SD, standard deviation; STS, Society of Thoracic Surgeons; other — see Table 1

Table 3. Comparison of echocardiographic parameters and stage of the NYHA class before and after intervention

	Total (n = 78)	SAVR (n = 39)	TAVI (n = 39)	*P*-value	Total (n = 78)	SAVR (n = 39)	TAVI (n = 39)	*P*-value
	Before procedures				After procedures			
Maximal valve gradient, mm Hg, mean (SD)	67 (22.4)	70 (21.6)	64 (23.1)	<0.01	24 (9.5)	29 (8.1)	18 (7)	<0.01
Mean valve gradient, mm Hg, mean (SD)	42 (14.9)	45 (14.1)	39 (15.2)	<0.01	13 (5.4)	16 (4.9)	10 (3.7)	<0.01
Maximal valve velocity, m/s, mean (SD)	4.1 (0.7)	4.1 (0.7)	4 (0.7)	<0.01	2.4 (0.5)	2.7 (0.4)	2.1 (0.4)	<0.01
Ejection fraction, %, mean (SD)	55.9 (10)	56.4 (9.6)	55.4 (10.7)	0.68	52 (10)	52.3 (9.2)	51.8 (10.8)	<0.01
NYHA stage I, n (%)	0 (0)	0 (0)	0 (0)	0.86	2 (3)	2 (5)	0 (0)	0.47
NYHA stage II, n (%)	12 (15)	6 (15)	6 (15)		66 (90)	30 (85)	36 (97)	
NYHA stage III, n (%)	63 (81)	33 (85)	30 (77)		3 (4)	2 (5)	1 (3)	
NYHA stage IV, n (%)	3 (4)	0 (0)	3 (8)		2 (3)	2 (5)	0 (0)	

Abbreviations: NYHA, New York Heart Association; other — see Tables 1 and 2

Basic demographic, clinical, echocardiographic, laboratory characteristics, and estimated surgical risk (based on EuroSCORE II/ STS) of the patients studied are presented in Tables 2 and 3. Apart from age, both groups did not differ significantly in terms of demographic parameters. The mean age of TAVI patients (mean [SD] = 79.9 [7.3]) was higher than the mean age of patients with SAVR (mean [SD] = 66.7 [9.1]) (*P* <0.01). In addition, EuroSCORE II (median [IQR] = 3.6 [2.1–6.9]) and STS scores (median [IQR] = 3.6 [2.1–5.5]) of patients undergoing TAVI were higher than EuroSCORE II (median [IQR] = 2.2 [1.3–3.5]) and STS scores (median [IQR] = 1.9 [1.2–3.5]) of patients treated with SAVR (*P* <0.05) (Table 2). Also, echocardiographic parameters measured before and after surgery were different between the groups (*P* <0.01) (Table 3). The SAVR group demonstrated a higher mean of maximal valve velocity and mean of maximal or mean valve gradient than the TAVI group (*P* <0.01). There were no significant differences in ejection fraction before surgery between the 2 groups.

Before surgery, CKD was assessed in 34 (44%) patients. The number of CKD was the same in each group (n = 17; 44%) (Table 2).

Acute kidney injury occurred in a total of 29 patients (37%), and 41% (n = 12) of them had been previously diagnosed with CKD. There was no statistically significant difference in the number of AKI cases between the SAVR group (40%; n = 15) and the TAVI group (36%; n = 14) (*P* = 0.86) (Table 4). We recorded 24 incidences of MACE in 18 patients during one-year follow-up: 15 incidences in the SAVR group and 9 incidences in the TAVI group (Tables 4 and 5). Eight patients died within a year after the procedure. The number of deaths after SAVR (n = 4) and

Table 4. Summary of the main endpoints

Characteristic	Total (n = 78)	SAVR (n = 39)	TAVI (n = 39)	*P*-value
AKI, n (%)	29 (37)	15 (40)	14 (36)	0.86
Number of patients with at least one MACE, n (%)	18 (23)	13 (33)	5 (13)	0.06
Number of all MACE events, n	24	15	9	NA

Abbreviations: AKI, acute kidney injury; MACE, major adverse cardiovascular events; NA, not applicable; other — see Table 1

Table 5. Summary of all MACE occurrences in patients after SAVR and TAVI with and without AKI

	AKI (yes) (n = 29)			AKI (no) (n = 47)		
MACE	Total n (%)	SAVR n (%)	TAVI n (%)	Total n (%)	SAVR n (%)	TAVI n (%)
Any	13 (100)	10 (77)	3 (23)	11 (100)	5 (45)	6 (55)
Death	5 (100)	4 (80)	1 (20)	3 (100)	0 (0)	3 (100)
Residual stroke	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	1 (100)
Hospitalization for cardiac disorders	8 (100)	6 (75)	2 (25)	6 (100)	5 (83)	1 (100)
Hospitalization for vascular issues	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	1 (100)

Both the choice of procedure and occurrence of AKI were significantly associated with MACE risk (P-value for SAVR 0.03, for AKI 0.01 — for details see Table 6). Singular MACE items were not analyzed statistically due to the low number of events

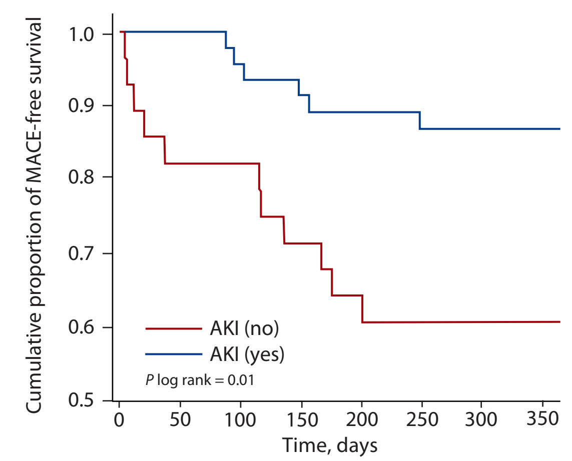
Abbreviations: see Tables 1 and 4

TAVI (n = 4) was the same. All patients who died following SAVR were diagnosed with postoperative AKI, while in the TAVI group only 25% of those who died had AKI. We noted 18% (n = 14) of rehospitalizations for cardiac disorders within a year. Seventy-eight percent (n = 11) of them were in the SAVR group (more than half [n = 6] of patients were diagnosed with AKI), and 22% (n = 3) were in the TAVI group (66% of patients were diagnosed with AKI) (Table 5).

In the SAVR group, two patients who died were also rehospitalized for cardiac disorders before death. In the TAVI group, the patients who died, also had other MACEs: one patient had a stroke after TAVI, and the remaining three were rehospitalized for cardiac disorders before death. One patient after TAVI, required hospitalization in the Vascular Surgery Department due to a complication associated with the femoral approach.

The Kaplan-Meier curve (Figure 1) presents the proportion of MACE-free survival against time, for patients with and without AKI. It implies that occurrence of AKI is significantly associated with the MACE-free survival time of patients who underwent AVR and TAVI (*P* log-rank = 0.01).

The univariable Cox model shows that the SAVR procedure and AKI are parameters significantly associated with a higher risk of MACE. These variables were taken into the multivariable Cox regression model, which shows that AKI is associated with a 3.75 higher risk of MACE, even after adjustment for type of treatment (SAVR) (HR, 3.75; 95% confidence interval [CI], 1.39–10.20; *P* = 0.01). The model shows that AKI was a risk factor for MACE independently of the type of procedure (Table 6).



Time, days	0	50	100	150	200	250	300	350
Group AKI, no	47	47	47	44	42	41	41	41
Group AKI, yes	29	24	24	21	17	17	17	17

Figure 1. The Kaplan-Meier curve presenting the proportion of MACE-free survival against time for patients with and without AKI *P* log-rank = 0.01

Abbreviations: see Table 4

DISCUSSION

In our study, we recorded 24 incidences of MACE in 18 patients during one-year follow-up: 15 incidences in the SAVR group and 9 incidences in the TAVI group. MACE was higher in the SAVR group (n = 15) than in the TAVI group (n = 9). SAVR is a more invasive procedure and is burdened with a high risk of complications. Therefore, even younger patients have a worse prognosis. Hence, less invasive methods need improvement as they are associated with a better prognosis, even in older and more burdened patients.

We identified AKI as the strongest predictor of poor prognosis in patients with aortic stenosis undergoing isolated aortic valve replacement, in the SAVR group and in the TAVI group. After that, we analyzed the impact of AKI on the occurrence of MACE during long-term clinical follow-up in both groups (SAVR/TAVI). Firstly, we observed no significant

Table 6. The univariable and multivariable Cox regression model for detecting factors associated with occurrence of MACE

	Univariable analysis		Multivariable analysis	
	HR (95% CI)	*P*-value	HR (95% CI)	*P*-value
Sex (male)	1.3 (0.5–3.4)	0.61		
Age (for every 10 years)	0.9 (0.6–1.4)	0.63		
Procedure (SAVR)	2.9 (1.003–8.1)	0.049	3.2 (1.1–9.0)	0.03
EF (for every 5%)	1.0 (0.8–1.3)	0.89		
AKI (yes)	3.6 (1.4–9.9)	0.01	3.8 (1.4–10.2)	0.01
Creatinine level before surgery (for every 10 µmol/l)	1.1 (0.8–1.5)	0.56		
Diabetes	1.0 (0.6–1.8)	0.94		
Hypertension	1.0 (0.5–2.1)	0.96		
Myocardial infarction in the past	1.0 (0.6–1.9)	0.95		
Smoking currently	1.5 (0.6–4.2)	0.40		
Atrial fibrillation	1.0 (0.6–1.8)	0.93		
BMI, kg/m^2	1.0 (0.9–1.1)	0.62		
Hemoglobin, g/dl	1.0 (0.8–1.3)	0.93		
EuroSCORE (%)	1.1 (0.9–1.2)	0.32		
STS	1.0 (0.8–1.2)	0.69		
NT-proBNP, pg/ml	1.0 (0.99–1.0)	0.70		
GFR, ml/min	1.01 (0.99–1.03)	0.43		

Abbreviations: CI, confidence interval; EF, ejection fraction; HR, hazard ratio; other — see Tables 1, 2 and 4

difference in the occurrence of AKI in either group. In the PARTNER-1 trial and a study conducted by Thongprayoon et al. [15], there was also no difference in the incidence of AKI between TAVI and SAVR [2, 15]. A meta-analysis conducted by Shah et al. [16], showed lower rates of AKI after TAVI in comparison with SAVR but similar rates of AKI requiring renal replacement therapy. The discrepancy between the studies may be explained by a lack of standard definition of acute kidney injury and differences in the patient risk profile. Transcatheter aortic valve intervention is a generally less invasive procedure, which might suggest that it will be associated with a lower risk of postoperative AKI. However, this procedure is conducted in patients with concomitant diseases and involves pre- and postoperative administration of contrast agents and application of prolonged rapid ventricular pacing during valvuloplasty/valve positioning. Besides, the TAVI procedure might also be associated with bleeding which occurs due to vascular complications. All these factors might contribute to a higher risk of AKI than could be expected. SAVR is also associated with an increased risk of AKI because of many hemodynamic and inflammatory factors (such as cardiopulmonary bypass, transfusion, hypothermia, non-pulsed blood flow, and hemodilution) [16]. Our study shows that CKD was an important predictor of postoperative development of AKI. Studies conducted so far have also pointed out the same dependency [15, 17–20]. TAVI techniques (e.g. advances in 3D echocardiography, and the use of moderate sedation) are constantly being improved. Hence, this method, rather than SAVR, is likely to be a more modifiable factor in the reduction of postoperative renal function impairment [16, 21].

In addition, we observed that postprocedural AKI is a significant predictor of MACE.

During one-year follow-up, patients with AKI experienced more adverse events than those without AKI.

Death rates were the same in both groups. All patients who died after the SAVR procedure were diagnosed with postprocedural AKI, in contrast to the TAVI group in which only one patient who died had developed AKI. In the present study, we observed that SAVR patients were hospitalized significantly more frequently for cardiac disorders. More than half were diagnosed with AKI. A previous study shows that AKI plays the main role in predicting mortality in both groups [11, 20]. However, its role in predicting rehospitalization for cardiac disorders is less probable [22, 23]. A meta-analysis made by Bianco et al. [24] and a study conducted by Abbas et al. [25] show a significantly higher rate of rehospitalizations for cardiac disorders in patients who underwent TAVI. Kodali et al. [26] reported a similar rate of rehospitalizations for TAVI and SAVR (24.7% vs. 21.7%; $P = 0.41$). Danielsen et al. [27], in their meta-analysis, show a slightly higher rate of rehospitalizations after SAVR (17%) than after TAVI (16%). Neither of these studies assessed the impact of postprocedural AKI on the occurrence of MACE. It is crucial to perform further research focused on identifying AKI-related prognostic risk factors, as well as novel methods of prevention and treatment of AKI in patients after SAVR/TAVI.

Limitations

Our study has a few limitations which are mainly associated with its retrospective character. It is a single-center study, and its data are limited as they were obtained from one cardiology department. However, our center of cardiology and cardiac surgery is the only one performing TAVI procedures in the area of 2.5 million inhabitants (data from 30 June 2020). In addition, the study included quite a small number of patients. However, some patients who qualified for invasive treatment (TAVI/SAVR) refused to sign consent, and some died before surgery. We did not include the urine output criterion for AKI diagnosis because of incomplete medical documentation.

CONCLUSION

Our study demonstrated that AKI is the strongest predictor of major cardiovascular adverse events after both methods of aortic valve replacement (SAVR/TAVI).

Article information

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