The Outcomes of Pulmonary Hypertension Patients With Severe Aortic Stenosis Who Underwent Surgical Aortic Valve Replacement or Transcatheter Aortic Valve Implantation

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The outcomes for patients who undergo transcatheter aortic valve implantation (TAVI) and surgical aortic valve replacement (SAVR) with pulmonary hypertension (PH) is not well understood. We sought to evaluate the outcomes of patients with PH who underwent TAVI compared with SAVR. We identified patients who were diagnosed with PH and underwent TAVI SAVR for aortic valve stenosis in the National Inpatient Sample database who were admitted from 2011 to 2014. Propensity score matching was used to generate 2 matched cohorts for TAVI and SAVR and outcomes were compared using logistic regressions. A total of 36,786 patients were diagnosed with PH and had an intervention for aortic valve stenosis. Twenty six percent underwent TAVI (n = 9,560) and 74% underwent SAVR (n = 27,225). Patients in the TAVI group were older (81.0 vs 68.5, p <0.001) had more women (53.2% vs 45.4%) and less African-American patients (4.6% vs 8.3%; p <0.001 for both). Although both groups had comparable co-morbidities, the TAVI group had higher prevalence of congestive heart failure, chronic pulmonary disease, renal failure, peripheral vascular disease, coronary artery disease, and previous stroke compared with the SAVR group (p ≤0.002). After propensity-score-matching, patients with PH had no statistically significant difference in in-hospital mortality between for TAVI or SAVR procedures (5.6% vs 4.6%, odds ratio [OR] 1.23, confidence interval [CI] 0.92 to 1.66, p = 0.165). However, TAVI patients were less likely to have cardiac complications (15.4% vs 19.9%, OR 0.73, CI 0.61 to 0.87, p = 0.001) and respiratory complications (12.4% vs 25.1%, OR 0.42, CI 0.35 to 0.51, p <0.001). In conclusion, whereas patient with PH who underwent TAVI and SAVR had similar in-hospital mortality, TAVI was associated with lower cardiac, respiratory and bleeding complications compared with SAVR.
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The prevalence of pulmonary hypertension (PH) associated with aortic stenosis (AS) is around 29%.[1] It has been hypothesized that severe aortic stenosis causes continuous high left atrial pressure that is reflected on pulmonary vascular bed, which eventually leads to secondary increase in pulmonary arteriolar tone and reactive PH.[2] The prevalence of PH has been reported to be from 11% to 56%.[3] As aortic stenosis and PH is commonly encountered, PH has increasingly been identified as a risk factor for morbidity and mortality in patients who underwent surgical aortic valve replacement (SAVR) or transcatheter aortic valve implantation (TAVI).[4−6] Studies that compared conservative therapy versus aortic valve replacement in patients with PH and severe aortic stenosis revealed poor results in both groups, however, aortic valve replacement group had better outcomes.[5] Furthermore, significantly elevated pulmonary artery pressures at baseline may serve as a poor prognostic factor when performing preprocedural assessment of the patients.[4,5] Although SAVR used to be the standard therapy for severe AS,[7] TAVI has evolved as a new treatment option for inoperative patients initially, then an alternative for high-risk and now intermediate-risk patients.[8] Nevertheless, the comparative outcomes between TAVI or SAVR in PH patients has not been fully explored. Therefore, we sought to evaluate the outcomes of patient with PH who underwent TAVI compared with SAVR.

Methods

We performed a retrospective analysis of patients who underwent TAVI and SAVR with PH in the NIS database

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from 2011 to 2014. The NIS is a publicly available identified database of hospital discharges in the United States, containing data from approximately 8 million hospital stays that were selected using a complex probability sampling design and the weighting scheme recommended by the Agency for Healthcare Research and Quality which is intended to represent all discharges from nonfederal hospitals. An overview of the NIS database can be found on the Agency for Healthcare Research and Quality website.[9] Each record includes one primary diagnosis and up to 25 secondary diagnoses. After weighting the data, we identified 36,786 weighted adult patients who were diagnosed with PH using the International Classification of Disease, Ninth Edition, Clinical Modification (ICD-9-CM) codes (416.0, 416.8, and 416.9). Then, we identified patients who underwent TAVI or SAVR as a primary procedure using the codes (35.05 and 35.06; 35.21 and 35.22), respectively. Patients with concomitant coronary artery bypass graft procedures were excluded. Using the Clinical Classification Software codes provided by the Healthcare Cost and Utilization Project and the Elixhauser Comorbidity Index,[10] co-morbidities were appointed through ICD-9 codes. Supplemental Table 1 identifies co-morbidities from the Elixhauser co-morbidity index, and ICD-9 codes used for other co-morbidities and in-hospital outcomes. Institutional board review approval was not required as the NIS is a publicly available database.

The primary outcome of the study was in-hospital mortality. The secondary outcomes included in-hospital complications which included hemorrhage requiring blood transfusion, vascular complications (injury to blood vessels, accidental puncture, injury to retroperitoneum, other vascular complications, vascular complications requiring surgery), cardiac complications (iatrogenic cardiac complications, hemopericardium, cardiac tamponade, and pericardiocentesis), permanent pacemaker (PPM) implantation, respiratory complications (postprocedural pneumothorax, postprocedural pulmonary edema, pulmonary collapse, prolonged mechanical ventilation >96 hours, tracheostomy), postprocedural stroke, and acute kidney injury (AKI). All procedure-related complications were identified using appropriate ICD-9-CM codes (Supplementary Table 1).

The data were expressed as weighted mean values ± standard deviation, and frequencies were denoted in percentages. Independent *t* tests were used for the comparison of continuous variables measurements in normal distributed data and Mann-Whitney *U* test was used for non-normal distribution data, whereas chi-square test for categorical variables. Weighted values of patient level observations were generated to produce a nationally representative estimate of the entire US population of hospitalized patients. Propensity score matching using a 1:5 ratio nearest number matching method was used to generate a TAVI and a SAVR group with similar characteristics. This propensity score model included patient's demographics, all of the Elixhauser co-morbidities (except for pulmonary circulation disorders and valvular disease), other relevant co-morbidities (atrial fibrillation, coronary artery disease, dyslipidemia, carotid disease, previous stroke, and smoking), procedure urgency (elective vs nonelective), hospital characteristics, patients' insurance and socioeconomic status. Logistic regressions were used to determine of odds for adverse outcomes comparing the TAVI and SAVR groups. Linear regression models were used to assess the length of stay (LOS). Log transformation of LOS was done to adjust for positively skewed data. SPSS version 25 software (IBM Corp, Armonk, New York) was used for all statistical analyses.

Results

During the study period, a total of 36,786 PH (mean age 71.8 ± 13.2, 47.4% women, and 6.9% African-Americans) had severe AS. 9,560 patients underwent TAVI (26%) and 27,225 (74%) underwent SAVR. Patients in the TAVI group were older (81.0 vs 68.5, $p < 0.001$) were more likely to be women (53.2% vs 45.4%) and less likely to be African-American (4.6% vs 8.3%; $p < 0.001$ for both). The TAVI group had a higher burden of co-morbidities compared with the SAVR group in term of hypertension, uncomplicated diabetes mellitus, congestive heart failure, chronic pulmonary disease, renal failure, coronary artery disease, previous stroke, transient ischemic attacks, and hyperlipidemia ($p \leq 0.002$ for all). TAVI patients had more elective admissions, less likely to have private insurance, and less likely to have median household income in the lowest quartile compared with SAVR patients ($p < 0.001$ for all). Baseline characteristics stratified by TAVI or SAVR are described in (Table 1).

Using multivariate logistic regression, TAVI patients had higher in-hospital mortality (odds ratio [OR] 1.16, confidence interval [CI] 1.01 to 1.34, $p = 0.040$) and vascular complications (OR 2.22, CI 1.84 to 2.67, $p < 0.001$) but lower cardiac complications (OR 0.71, CI 0.65 to 1.76, $p < 0.001$), respiratory complications (OR 0.38, CI 0.35 to 0.42, $p < 0.001$), and AKI (OR 0.61, CI 0.56 to 0.66, $p < 0.001$) compared with SAVR patients (Table 2; Figure 1).

After propensity-score-matching patients with PH who underwent TAVI or SAVR, 1,239 patients were identified in the TAVI group and compared with 2,920 patients in the SAVR group. Histogram of standardized differences of covariates between TAVI and SAVR groups before and after matching are shown in supplementary Figure 1. Baseline characteristics of the propensity score-matched group stratified by procedure type is shown in (Table 3).

There was no statistically significant difference in in-hospital mortality between the TAVI group and SAVR group (5.6% vs 4.6%, OR 1.23, CI 0.92 to 1.66, $p = 0.165$). TAVI patients were less likely to have bleeding requiring transfusion (10.8% vs 24.0%), cardiac complications (15.4% vs 19.9%), and respiratory complications (12.4% vs 25.1%). In contrast, TAVI patients had a higher incidence of vascular complications (4.0% vs 1.7%) compared with the SAVR group (Table 4; Figure 2).

Discussion

The main findings of this propensity score-matched analysis are (1) PH patients who underwent TAVI had comparable in-hospital mortality compared with those who underwent SAVR. (2) Patients who underwent TAVI had lower length of stay compared with those who underwent SAVR. (3) Patients in the TAVI group had in-hospital

Table 1
Baseline characteristics of pulmonary hypertension patients who underwent SAVR and TAVI procedure for severe AS

Variable	TAVI (n = 9,560)	SAVR (n = 27,225)	p Value
Age years. (mean ± SD)	81.03 ± 8.44	68.53 ± 13.06	<0.001
Age years. (median, IQR)	83.00 (77.00-87.00)	70.00 (61.00-78.00)	<0.001
Women	53.2%	45.4%	<0.001
			<0.001
White	86.8%	77.7%	
Black	4.6%	8.3%	
Hispanic	3.5%	7.4%	
Asian	1.1%	2.0%	
Native American	0.1%	0.4%	
Other	3.9%	4.2%	
Elective hospitalization	71.5%	62.7%	<0.001
Primary expected payer			<0.001
Medicare	90.8%	66.2%	
Medicaid	0.9%	6.5%	
Private insurance	6.4%	22.7%	
Self-pay	0.5%	2.2%	
No charge	0.0%	0.4%	
Other	1.3%	2.0%	
Median household income (percentiles)			<0.001
0 to 25	19.8%	23.8%	
26 to 50	25.2%	26.0%	
51 to 75	26.4%	25.9%	
76 to 100	28.6%	24.3%	
Bed size			<0.001
Small	5.1%	5.5%	
Medium	16.0%	19.0%	
Large	78.9%	75.4%	
Location/teaching status			<0.001
Rural	1.2%	1.7%	
Urban nonteaching	9.4%	22.2%	
Urban teaching	89.5%	76.1%	
Hospital region			<0.001
Northeast	27.0%	23.9%	
Midwest	24.5%	22.9%	
South	31.5%	31.4%	
West	17.0%	21.8%	
Comorbidities			
Hypertension	77.8%	71.0%	<0.001
Diabetes mellitus, uncomplicated	30.2%	27.1%	<0.001
Diabetes mellitus, complicated	6.1%	5.9%	0.38
Dyslipidemia	62.5%	54.2%	<0.001
Atrial fibrillation	52.9%	56.1%	<0.001
Coronary artery disease	69.1%	40.5%	<0.001
Prior percutaneous coronary intervention	17.0%	6.2%	<0.001
Prior coronary artery bypass grafting	6.3%	17.9%	<0.001
Prior Stroke/transient ischemic attack	11.4%	8.0%	<0.001
Carotid disease	8.1%	4.3%	<0.001
Smoker	3.0%	9.6%	<0.001
Acquired immune deficiency	0.0%	0.1%	<0.001
Alcohol abuse	1.1%	2.8%	<0.001
Deficiency anemia	28.6%	24.8%	<0.001
Rheumatoid arthritis/collagen vascular disease	5.6%	3.8%	0.21
Chronic blood loss anemia	1.4%	1.6%	0.10
Congestive heart failure	13.6%	3.1%	<0.001
Chronic pulmonary disease	37.8%	28.0%	<0.001
Depression	7.1%	8.1%	0.002
Coagulopathy	24.9%	36.7%	<0.001
Drug abuse	0.2%	1.9%	<0.001
Hypothyroidism	21.4%	14.2%	<0.001
Liver disease	3.0%	2.7%	0.069
Lymphoma	1.4%	0.6%	<0.001

(*continued*)

Table 1 (***Continued***)

Variable	TAVI (n = 9,560)	SAVR (n = 27,225)	p Value
Fluid and electrolytes disturbances	29.4%	40.8%	<0.001
Metastatic cancer	0.2%	0.1%	0.23
Solid tumor without metastasis	2.2%	1.1%	<0.001
Other neurological disorders	5.1%	5.3%	0.45
Obesity	17.6%	26.8%	<0.001
Paralysis	1.5%	1.3%	0.11
Psychosis	1.2%	2.4%	<0.001
Renal failure	39.6%	22.3%	<0.001
Peripheral vascular disease	18.7%	31.0%	<0.001
Peptic ulcer disease excluding bleeding	0.0%	0.0%	0.075
Weight loss	6.2%	7.1%	0.005

Values are expressed as mean ± SD for continuous variables or percentages for categorical variables.

IQR = interquartile range; SAVR = surgical aortic valve replacement; TAVI = transcatheter aortic valve implantation.

complications except for vascular complications and PPM implantation compared with patients who underwent SAVR.

Despite the advances in the management of PH, published data have demonstrated PH as an independent risk factor for 1-year mortality in patients who underwent TAVI.[11] Similarly, PH was also found to be an independent risk factor for operative mortality and long-term survival in patients who underwent SAVR (relative risk 1.7, p = 0.02).[3] The mechanism of how PH affect outcome is not well understood and this is mainly driven by the fact that PH has different etiologies. If PH is secondary to chronic lung disease, or chronic thromboembolic disease is different if it is related to left heart failure or aortic valve disease. Furthermore, the severity of PH is also important as it may result in right heart failure and may influences anesthetic risk and decisions about offering SAVR.

Previous data have suggested that PH patients had elevated New York Heart Association class and were more likely to be symptomatic, which could account for the increased mortality in both the TAVI and SAVR groups.[12] In our studied population, PH who underwent TAVI were older with a higher burden of co-morbidities. Yet, TAVI patients had a comparable in-hospital mortality rate with SAVR patients. Leon et al demonstrated that even in intermediate-risk aortic stenosis patients, no statistically significant difference in all-cause mortality between TAVI and SAVR patients was seen,[13] however, the number of PH patients was stated in PARTNER 2 or SURTAVI trials which does not provide insight into the impact of PH on TAVI and SAVR outcomes in severe AS patients.[13,14]

PH is considered a risk factor for extubation failure after cardiac surgery which in turn, represents a risk for prolonged intubation, infections, and longer hospital stay.[15] Furthermore, prolonged ventilation increases the risk of long-time ventilation and ventilator-associated pneumonia.[16] In addition, patients with PH have been shown to have 1.3 times longer ventilation compared with those without PH.[12] Furthermore, it has been demonstrated that patients who underwent SAVR had a significant decrease in right ventricular function compared with those who underwent TAVI, which could account for the increased respiratory complications in patients who underwent SAVR compared with those who underwent TAVI.[17] We observed that patients who underwent TAVI had significantly lower respiratory complications compared with those who underwent SAVR, concurring with available information.[18] This might be explained by the fact that differences in

Table 2
Multivariate logistic regression of the outcomes of pulmonary hypertension patients who underwent TAVI or SAVR

Outcome	TAVI	SAVR	UOR (95 CI) TAVR (when compared with SAVR)	aOR (95 CI) TAVI (when compared with SAVR)	Unadjusted p Value	Adjusted p Value
Overall (n)	9,560	27,226				
In-hospital mortality,	4.2%	3.8%	1.37 (1.24-1.55)	1.16 (1.01-1.34)	<0.001	0.040
Length of stay, days (IQR)	7 (4-11)	9 (6-15)				<0.001
Bleeding requiring transfusion	11.7	22.8	0.45 (0.42-0.48)	0.42 (0.38-0.46)	<0.001	<0.001
Vascular complications	3.5%	1.8%	2.01 (1.75-2.32)	2.22 (1.84-2.67)	<0.001	<0.001
Cardiac complications	15.1%	20.2%	0.70 (0.66-0.75)	0.71 (0.65-0.76)	<0.001	<0.001
PPM	9.0%	7.6%	1.19 (1.09-1.29)	1.08 (0.97-1.20)	<0.001	0.12
Respiratory Complications	12.7%	24.2%	0.45 (0.42-0.48)	0.38 (0.35-0.42)	<0.001	<0.001
Postprocedural stroke	1.3%	1.1%	1.21 (0.98-1.49)	0.73 (0.54-0.98)	0.65	0.039
AKI	20.8%	25.2%	0.78 (0.74-0.83)	0.61 (0.56-0.66)	<0.001	<0.001

AKI = acute kidney injury; aOR = adjusted odds ratio; IQR = interquartile range; PPM = permanent pacemaker; SAVR = surgical aortic valve replacement; TAVI = transcatheter aortic valve implantation; UOR = unadjusted odds ratio.

Unadjusted odds ratios are displayed given low event rate.

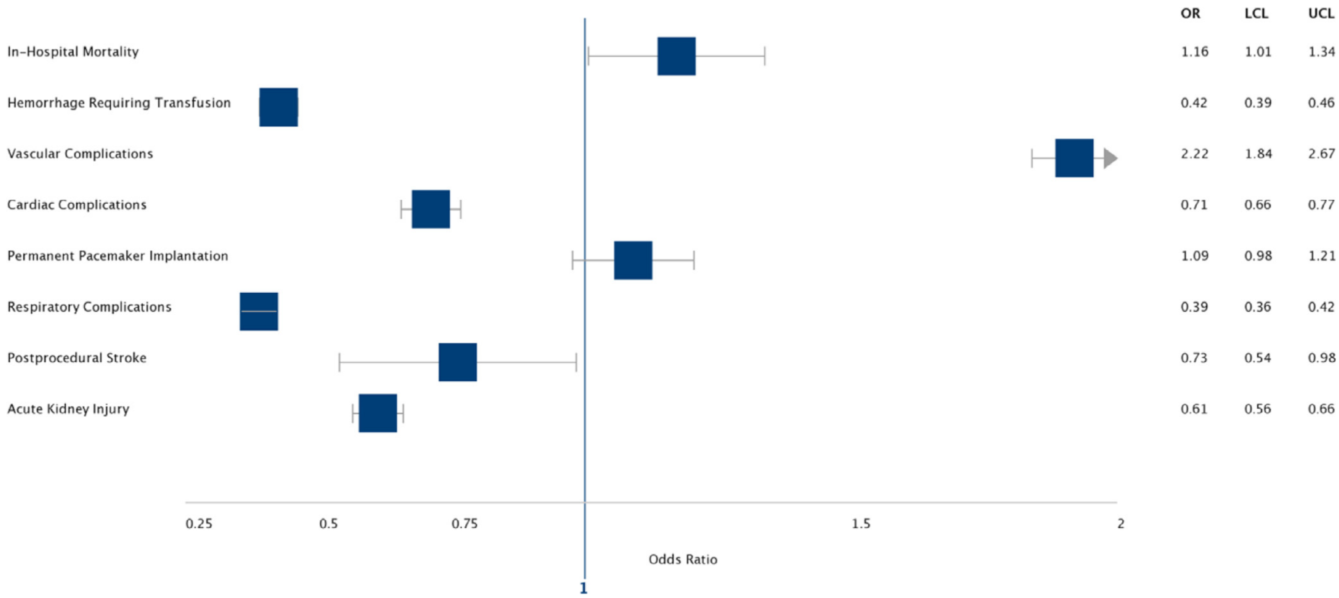

Figure 1. Multivariate logistic regression of the outcomes of pulmonary hypertension patients undergoing transcatheter or surgical aortic valve replacement. LCL = lower confidence limit; OR = odds ratio; UCL = upper confidence limit.

Table 3
Baseline characteristics for the propensity score-matched pulmonary hypertension patients who underwent SAVR or TAVI

Variable	TAVR Group	SAVR Group	p Value
Age years (mean ± SD)	79.44 ± 9.08	78.50 ± 8.26	0.94
Age years (median, IQR)	82.00 (75.00-86.00)	77.00 (70.00-85.00)	<0.001
Women	52.9%	51.5%	0.49
			0.77
White	86.6%	86.1%	
Black	5.3%	5.4%	
Hispanic	3.1%	4.1%	
Asian	1.0%	0.9%	
Native American	0.2%	0.2%	
Other	3.9%	3.3%	
Elective hospitalization	69.3%	67.6%	0.34
Primary expected payer			0.78
Medicare	90.0%	90.2%	
Medicaid	1.3%	1.1%	
Private Insurance	7.1%	7.1%	
Self-pay	0.5%	0.6%	
No charge	0.0%	0.0%	
Other	1.0%	1.0%	
Median household income (percentiles)			0.58
0 to 25	19.9%	20.5%	
26 to 50	26.1%	24.1%	
51 to 75	24.7%	26.6%	
76 to 100	29.4%	28.8%	
Bed Size			0.55
Small	4.4%	3.9%	
Medium	17.3%	16.1%	
Large	78.3%	80.0%	
Location/teaching Status			<0.001
Rural	1.0%	1.7%	
Urban nonteaching	12.9%	11.2%	
Urban teaching	86.1%	87.1%	
Hospital region			0.001
Northeast	28.2%	30.6%	
Midwest	20.1%	19.2%	
South	34.7%	28.6%	
West	17.0%	21.6%	

(continued)

Table 3 (***Continued***)

Variable	TAVR Group	SAVR Group	p Value
Comorbidities			
Hypertension	76.4%	77.1%	0.70
Diabetes mellitus uncomplicated	29.8%	32.0%	0.24
Diabetes mellitus complicated	6.5%	7.6%	0.30
Dyslipidemia	60.3%	60.6%	0.86
Atrial fibrillation	57.2%	57.5%	0.90
Coronary artery disease	62.7%	62.7%	1.00
Prior Percutaneous coronary intervention	13.2%	12.4%	0.58
Prior coronary artery bypass grafting	14.0%	14.0%	1.00
Prior Stroke/transient ischemic attack	10.6%	10.7%	0.94
Carotid disease	6.9%	7.0%	0.87
Smoking	3.5%	4.0%	0.52
Alcohol abuse	1.4%	1.0%	0.35
Deficiency anemia	27.4%	27.5%	0.92
Rheumatoid arthritis	6.1%	5.6%	0.60
Chronic blood loss anemia	1.5%	1.6%	0.87
Congestive heart failure	7.3%	5.6%	0.085
Chronic pulmonary disease	35.9%	35.1%	0.67
Depression	7.3%	7.5%	0.87
Coagulopathy	28.4%	27.3%	0.53
Drug abuse	0.2%	0.5%	0.31
Hypothyroidism	19.3%	19.9%	0.72
Liver disease	2.9%	3.1%	0.81
Lymphoma	1.0%	0.9%	0.83
Fluid and electrolytes disturbances	32.5%	32.7%	0.93
Metastatic cancer	0.2%	0.1%	0.56
Solid tumor without metastasis	1.9%	2.1%	0.77
Other neurological disorders	4.3%	4.7%	0.62
Obesity	19.1%	21.5%	0.13
Paralysis	1.2%	1.4%	0.72
Psychosis	1.4%	1.8%	0.42
Renal failure	34.6%	34.2%	0.83
Peripheral vascular disease	27.4%	25.7%	0.36
Weight loss	6.3%	6.5%	0.86

Values are expressed as mean ± SD for continuous variables or percentages for categorical variables.
IQR = interquartile range; SAVR = surgical aortic valve replacement; TAVI = transcatheter aortic valve implantation.

physiological change during the 2 procedures such as anesthesia, blood loss, infection risk of SAVR which influences risk of adverse outcomes.

Although Durko et al have shown a lower early stroke rate in TAVI patients compared with SAVR patients,[19] both SURTAVI trial and PARTNER 2 trial have demonstrated no difference in post-procedural stroke or PPM placement between TAVI and SAVR.[13,14] Similarly, the findings of the current study in patients with PH suggest that TAVI patients have no statistically significant difference in post-procedural stroke or PPM placement compared with SAVR patients. Furthermore, our findings suggest a lower AKI rate

Table 4
Propensity score-matched outcomes of pulmonary hypertension patients undergoing TAVI or SAVR

Outcome	TAVI	SAVR	OR (95% CI) TAVI (when compared with SAVR)	p Value
Overall (n)	1,239	2,920		
In-hospital mortality	5.6%	4.6%	1.23 (0.92-1.66)	0.165
Bleeding requiring blood transfusion	10.8%	24.0%	0.38 (0.31-0.47)	<0.001
Vascular complications	4.0%	1.7%	2.36 (1.58-3.52)	<0.001
Cardiac complications	15.4%	19.9%	0.73 (0.61-0.87)	0.001
Permanent pacemaker implantation	9.4%	8.0%	1.18 (0.93-1.49)	0.152
Postprocedural stroke	1.3%	1.3%	1.02 (0.56-1.84)	0.949
Respiratory complications	12.4%	25.1%	0.42 (0.35-0.51)	<0.001
AKI	21.4%	26.9%	0.74 (0.63-0.86)	<0.001

AKI = acute kidney injury; CI = confidence interval; SAVR = surgical aortic valve replacement; TAVI = transcatheter aortic valve implantation.

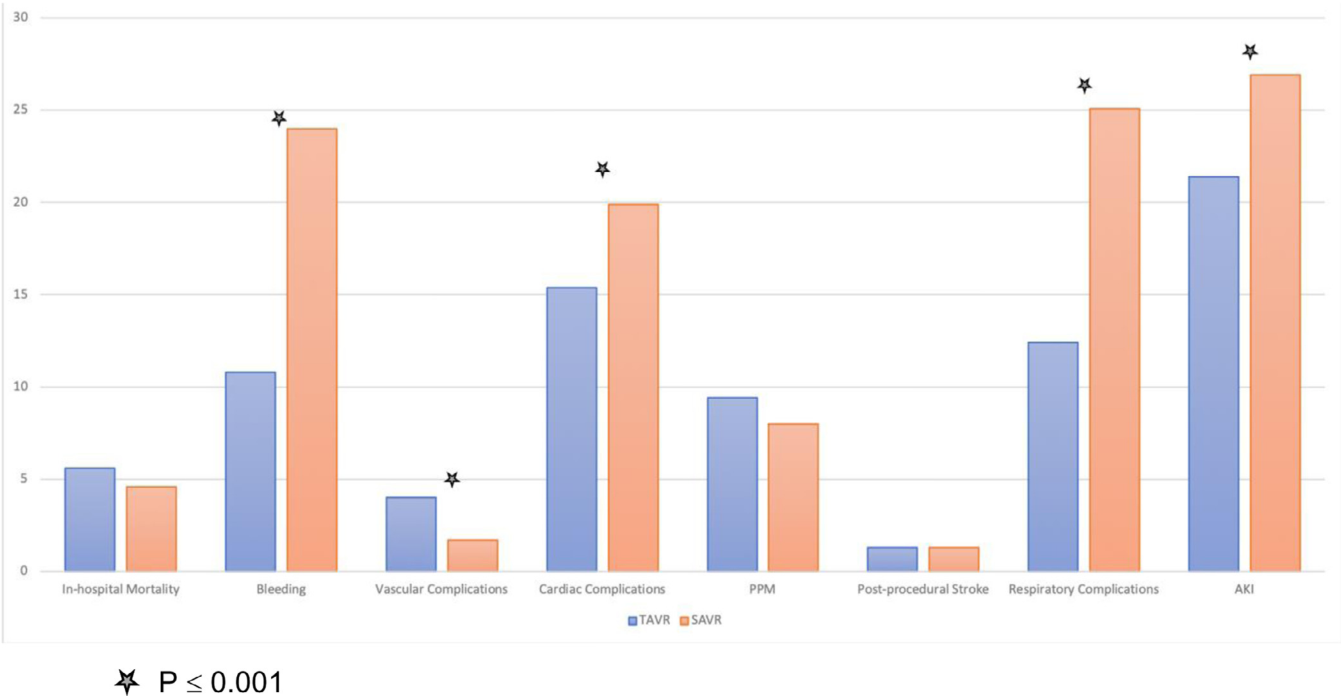

Figure 2. Propensity score-matched outcomes rates for pulmonary hypertension patients who underwent TAVI or SAVR. AKI = acute kidney injury; PPM = permanent pacemaker placement.

in PH patients in patients who underwent TAVI despite a higher rate of renal failure in TAVI patients at baseline. The SURTAVI trial has shown similar findings with lower incidence of AKI in those who underwent TAVI.[14] Expectedly, we found TAVI patients to have higher incidence of vascular complication compared with SAVR patients, which was consistent with existing data.[13,14]

Our study has demonstrated an unadjusted mortality rate of 4.2% in PH patients who underwent TAVI compared with 3.8% in those who underwent SAVR. Nalluri et al have shown that in coronary artery bypass grafting patients, in-hospital mortality rate in the TAVI group was 1.8% compared with 3.5% in the SAVR group.[20] Another study has demonstrated that in-hospital mortality rate in nonteaching hospitals for patients who underwent TAVI was 3.2% compared with 2.0% in patients who underwent SAVR.[21] Interestingly, in patients with chronic pulmonary lung disease, TAVI patients had less in-hospital mortality 3.3% compared with the SAVR group 4.2%.[22] Similarly, in patients with mitral stenosis, TAVI patients were also found to have lower in-hospital mortality compared with SAVR patients (7.9% vs 8.1%).[23]

Our study has several limitations. This study is a retrospective observational study, which poses a possible selection bias and unmeasured confounding factors. Furthermore, the National Inpatient Sample is an administrative database which could be subject to inaccurate coding and underreporting of co-morbid diagnoses. In addition, data regarding the severity and the etiology of PH were missing, which may contribute to the differences in outcomes reported, particularly if the severity of PH was significantly different in the 2 cohorts studied. Furthermore, we were unable to assess for a dose response relation based on the severity of PH. Furthermore, the type of anesthesia used for the TAVI procedure was not available. This is important as with early experience, TAVI was undertaken under general anesthesia, whereas in recent years, TAVI now undertaken with moderate sedation which might contribute to more favorable outcomes associated with TAVI. Despite these limitations, we used a large publicly available database to address the limited data around outcomes in PH patients after aortic valve replacement with TAVI compared with SAVR.

In conclusion, in this observational study, patients with PH and severe symptomatic AS who underwent TAVI had comparable in-hospital mortality and lower cardiac complications, respiratory complications and bleeding complications compared with patients who underwent SAVR.

Disclosures

The authors have no conflicts of interest to disclose.

Supplementary materials

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.amjcard.2019.05.018.

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