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ORIGINAL RESEARCH

Safety of Transcatheter Aortic Valve Replacement in Patients with Aortic Aneurysm: A Propensity-Matched Analysis

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ABSTRACT

Introduction: There is a paucity of data regarding the outcomes of transcatheter aortic valve replacement (TAVR) among patients with thoracic or abdominal aortic aneurysms (AA). Using the Nationwide Inpatient Sample (NIS) database, we explored the safety of TAVR among patients with a diagnosis of AA.

Methods: We queried the National Inpatient Sample database (2012–2017) for hospitalized

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patients undergoing TAVR, using ICD-9 and ICD-10 codes for endovascular TAVR. Reports show that > 95% of endovascular TAVR in the US is via transfemoral access, so our population are mostly patients undergoing transfemoral TAVR. Using propensity score matching, we compared the trends and outcomes of TAVR procedures among patients with versus without AA.

Results: From a total sample of 29,517 individuals who had TAVR procedures between January 2012 and December 2017, 910 had a diagnosis of AA. In 774 matched-pair analysis, all-cause in-hospital mortality was similar in patients with and without AA OR 0.63 [(95% CI 0.28–1.43), $p = 0.20$]. The median length of stay was higher in patients with AA: 4 days (IQR 2.0–7.0) versus 3 days (IQR 2.0–6.0) $p = 0.01$. Risk of AKI [OR 1.01 (0.73–1.39), $p = 0.87$], heart block requiring pacemaker placement [OR 1.17 (0.81–1.69), $p = 0.40$], aortic dissection [OR 2.38 (0.41–13.75), $p = 0.25$], acute limb ischemia [OR 0.46 (0.18–1.16), $p = 0.09$], vascular complications [OR 0.80 (0.34–1.89), $p = 0.53$], post-op bleeding [OR 1.12 (0.81–1.57), $p = 0.42$], blood transfusion [OR 1.20 (0.84–1.70), $p = 0.26$], and stroke [OR 0.58 (0.24–1.39), $p = 0.25$] were similar in those with and without AA.

Conclusions: Data from a large nationwide database demonstrated that patients with AA undergoing TAVR are associated with similar in-hospital outcomes compared with patients without AA.

Keywords: Transcatheter aortic valve replacement; Aortic stenosis; Aortic aneurysm

Key Summary Points

Patients with a diagnosis aortic aneurysm (thoracic or abdominal) undergoing transcatheter aortic valve replacement (TAVR) have same risk of periprocedural complications as those without a diagnosis of aortic aneurysms (AA).

Patients with a diagnosis of aortic aneurysm had a longer length of hospital stay.

Further studies are needed to determine how specific features of aortic aneurysm such as size, shape, thrombus burden, or calcifications affect the safety of TAVR.

INTRODUCTION

Aortic stenosis (AS) is an insidious disease with rapid progression once patients become symptomatic; it has a high mortality rate if left untreated [1]. Aortic valve replacement (AVR) is the only effective treatment for symptomatic AS. Despite an overall low mortality rate, there is a significant risk of complications with surgical AVR, especially in older and frail patients [2]. Transcatheter aortic valve replacement (TAVR) has gained wide acceptance as a safe alternative to surgery in those with symptomatic, severe AS [3]. A variety of vascular access sites are feasible for valve delivery during TAVR [4]. The use of trans-apical access for TAVR in the US national registry has declined progressively from 76% in 2012 to less than 1% in 2019 [5]. In the same registry, endovascular access for TAVR is dominated by (transfemoral TAVR) TF-TAVR used in > 95% of all TAVR procedures [5]. Alternative endovascular access including axillary, brachiocephalic, subclavian, and carotid arteries, as well as the aorta and inferior vena cava are options for vascular access during TAVR in special circumstances. These account for approximately 4% of all TAVR access in the US [5]. Prior to TAVR, detailed imaging is performed to define the vascular transit route and exclude unfavorable anatomy such as vascular stenosis, calcifications, tortuosity, and aneurysms [6]. Aneurysms, of particularly the ascending aorta, are a common finding in patients with AS [7]. Patients with aortic aneurysm (AA) have an abundance of cardiovascular risk factors that potentially elevate the risk associated with valve surgery [8]. In such patients, TAVR has demonstrated superior outcomes when compared to both conservative and surgical management [9, 10]. Emphasis on importance of vascular anatomy on the choice of procedural vascular access [6] enhances the

possibility that patients with severe AS and AA may be considered for a trans-apical route or denied TAVR entirely. Early TAVR trials excluded patients with significant AA [9, 10]. However, this should not be a deterrent, as two small single-center studies have suggested that the short-term outcomes of transfemoral TAVR (TAVR) are comparable between patients with and without AA [11, 12]. In this study, we aimed to use a large United States national database to examine the safety of performing TAVR (mainly transfemoral TAVR) in patients with a diagnosis of AA compared to patients without AA. We hypothesized that there would be no difference in peri-procedural safety outcomes and hospital length of stay in patients with and without AA.

METHODS

This was a retrospective cohort study wherein we obtained data for the years 2012–2017 from the Healthcare Cost and Utilization Project (HCUP)-Nationwide Inpatient Sample (NIS). The NIS is a stratified sample of all-payer inpatient hospital stays designed to produce U.S. regional and national estimates of inpatient utilization, access, charges, quality, and outcomes. Annually, the NIS data contain approximately 7 million hospital stays which, when adjusted for discharge weight, estimates more than 35 million hospitalizations nationally. Details of the NIS data have been previously described [13]. We used publicly available de-identified data, hence this study met criteria for the University of Texas Medical Branch Institutional Review Board exemption. The study was performed in accordance with the Declaration of Helsinki 1964 and its later amendments. The review board waived the need for informed consent based on established institutional IRB policies.

We searched the NIS database from the beginning of 2012 to the end of 2017 for hospitalizations during which endovascular TAVR was performed using appropriate International Classification of Diseases, ninth edition (ICD-9) and International Classification of Diseases, tenth edition (ICD-10) procedure codes (see supplementary material for a complete listing of ICD-9 and ICD-10 codes used) [14]. Reports show that $> 95\%$ of endovascular TAVR in the US is via transfemoral access, so our population is mostly patients undergoing transfemoral TAVR [5]. Next, we used ICD-9 and ICD-10 diagnosis codes to identify hospitalizations with a primary or secondary diagnosis of unrepaired thoracic, abdominal, thoracoabdominal, or unspecified AA. We restricted our analysis to individuals 40 years and older as the prevalence of aortic stenosis is $\leq 0.2\%$ before the age of 65 [15]. The study outcomes of interest were; rates of procedure-related complications, which included in-hospital stroke, acute kidney injury (AKI), heart block requiring a permanent pacemaker (PPM), aortic dissection, acute limb ischemia, vascular complications, post-operative bleeding, blood transfusion, and all-cause mortality. We also examined rates of discharges to nursing facilities and length of hospital stay in days. Outcomes variable were identified directly from database variable list (hospital mortality, length of stay in days) or adjudicated by the presence or absence of relevant ICD-9 and ICD-10 procedure or diagnosis codes (remaining outcome variables) as shown in the supplementary material.

Baseline characteristics of participants with and without AA were compared using a Chi-square test for categorical variables and a Student's *t* test for continuous variables on the weight-adjusted sample. Using a logistic regression model of demographic (age, gender, race), comorbidity variables (history of smoking, hypertension, diabetes, obesity, congestive heart failure, peripheral artery disease, coronary artery disease, chronic kidney disease, admission status, length of stay) and hospital factors (location, region, and bed size), we estimated the propensity score and assessed for covariate balance using *t* test and standardized differences. We matched those with AA to those without AA in a greedy nearest neighbor 1:1 model with caliper set at 0.2. We assessed for normality of the variables using the Shapiro–Wilk test. We performed a paired *t* test and Wilcoxon rank-sum test for normally distributed and non-normally distributed continuous outcome variables, respectively. Chi-square and logistic regression were done for

binary outcomes variables on matched subjects only. The final effect size is reported as the odds ratio (OR) for a binary variable, mean ± SD, or median with interquartile range (IQR) for continuous variable. We performed a subgroup analysis of outcomes of interest based on AA location. For all analyses, we set the significant value for p at < 0.05. All statistical analyses were performed with StataCorp. 2013. (Stata Statistical Software: Release 13. College Station, TX: StataCorp LP).

RESULTS

There were 29,517 TAVR procedures carried out in the period between January 2012 and December 2017. Of these, 910 (3%) had a diagnosis of AA. The mean age was 80.5 years ± 8.2. The predominant race was Whites (82.6%), and 46% were females. The prevalent comorbidities included hypertension (84.5%), coronary artery disease (71.1%), and congestive heart failure (51.2%). The majority of procedures were elective (79.2%) and were performed in large (75.6%) and urban teaching hospitals (89.5%).

The majority of aneurysms were abdominal in location (66.7%), followed by those in the thoracic (32%) and thoracoabdominal (1.4%) regions (Table 1). The mean age was 80.5 ± 8.2 years in the AA group and 80.3 ± 8.7 years in the group without AA, and this was not statistically significant on the weight-adjusted sample before matching ($p = 0.47$). After accounting for hospital discharge weight, patients with AA were less likely to be female when compared to those without AA (26.9 vs. 46.9% $p < 0.001$). There was also some racial variation between the groups with 90.4% Whites in the group with AA and 87.1% Whites in the group without AA ($p < 0.001$). Patients with AA were more likely to have a history of smoking (40.5 vs. 31.6%, $p < 0.001$), and a diagnosis of coronary artery disease (77.7 vs. 70.9%, $p < 0.001$), when compared to the group without AA. Obesity was less common in the AA group when compared to those without AA (14.6 vs. 17.7%, $p = 0.02$). Hospital bed size was significantly different between the two groups with more patients with AA seen in small and medium-sized hospitals (based on number of hospital beds) compared to patients without AA ($p = 0.03$).

Matching resulted in 774 matched pairs. Satisfactory matching and balancing were also confirmed with standardized mean difference < 10 for all variables. The median length of stay was significantly higher in the group with AA compared to those without AA: 4 days IQR (2.0–7.0) versus 3 days IQR (2.0–6.0), $p = 0.01$. There was no significant difference in mortality between those with and without AA [OR 0.63, (95% CI 0.28–1.43), $p = 0.20$]. Acute kidney injury, the most frequent complication, occurred in 13.0% of patients with AA compared to 13.2% of those without AA [OR 1.01, (95% CI 0.73–1.39), $p = 0.87$]. Additionally, there were no differences in the risk of heart block requiring PPM [OR 1.17 (0.81–1.69), $p = 0.40$], aortic dissection [OR 2.38 (0.41–13.75), $p = 0.25$], acute limb ischemia [OR 0.46 (0.18–1.16), $p = 0.09$], vascular complications [OR 0.80 (0.34–1.89), $p = 0.53$], post-op bleeding [OR 1.12 (0.81–1.57), $p = 0.42$], blood transfusion [OR 1.20 (0.84–1.70), $p = 0.26$], stroke [OR 0.58 (0.24–1.39), $p = 0.25$], and disposition to nursing facility [OR 1.17 (0.95–1.46), $p = 0.09$] in those with and without AA (Table 2). In a sub-group analysis based on location of AA, there was no significant difference in all outcomes between those with AA in the thoracic location compared to those without AA. Compared to those without AA, those with abdominal AA had a higher median hospital length of stay 4 days IQR (2.0–2.7) versus 3 days IQR (2.0–6.0) and had a higher proportion of discharge to nursing facilities 49.0 vs. 42.1%, $p = 0.01$ (Table 3).

DISCUSSION

In this retrospective analysis of patients undergoing TAVR in a nationwide database, we found that length of stay was significantly increased in those with AA. However, there was no difference in complications between those with and without AA after propensity score matching. Specifically, we observed that the occurrence of

peri-procedural complications was comparable between those with and without AA with regards to the following outcomes: stroke, acute kidney injury, heart block requiring a permanent pacemaker, aortic dissection, aortic rupture, acute limb ischemia, vascular complications, post-operative bleeding and need for blood transfusion. In sub-group analysis based on the location of AA, those with abdominal AA had higher median hospital length of stay and were significantly less likely to discharge to home.

In our study population, length of stay was significantly longer in those with AA with a trend towards higher proportion of home discharge in the none AA group. Our sub-group analysis indicates that these findings were driven by abdominal aortic aneurysm. Importantly, there are procedural and patient factors such as frailty and type of procedural anesthesia, which have been closely tied to length of stay and ability to discharge home after TAVR and which could not be accounted for in this analysis [16–18]. Although patients with AA have an abundance of cardiovascular risk factors and are at increased risk for adverse cardiovascular events [7, 19], our analysis did not show any difference in in-hospital mortality due to AA after TAVR. Our analysis adjusted for many of the established predictors of mortality after TAVR including renal impairment, acuity of procedure, and vascular complications [20, 21]. Similar to our findings, Kobayashi et al. examined a single-center cohort of 232 patients with thoracic and abdominal aortic aneurysm where the majority had TF-TAVR and found similar rates of in-hospital and short-term mortality in patients with and without AA [11]. In another single-center study by Ryliski et al. including 457 patients with ascending AA up to 5 cm, the majority underwent TF-TAVR. No significant difference in mortality was seen compared to patients without AA [12]. The in-hospital mortality rate in our study is consistent with findings from analysis based on the US TVT registry [5].

Acute kidney injury is an important determinant of mortality outcome after TAVR. Our study reveals that AKI was the most frequent acute complication during TAVR in approximately 13% of both patients with AA and without AA [OR 1.01, (95% CI 0.73–1.39), $p = 0.87$]. In previous non-registry studies, the risk of AKI among patients undergoing TAVR varied widely depending on definition and strict accounting for incident and prevalent cases [22, 23]. In the US TVT registry, the risk of AKI among patients undergoing TAVR was consistently lower than the risk seen in our study population [5]. It is very likely that this reflects our inability to standardize the definition of AKI without access to laboratory values in our database.

In our analysis, we found that there was no difference in the likelihood of PPM placement in those with AA compared to those without AA. The need for post-TAVR PPM at 30 days after TAVR has varied widely in clinical trials from as low as 3.4–25% being highest with self-expandable (SE) valve prosthesis [24]. In the US TVT registry, requirement for post TAVR PPM in the immediate post TAVR period prior to hospital discharge rose from 9.1% at inception to a peak of 13% between 2014 and 2015 and has declined to 8.3% in 2019. The initial upward trend is attributable to uptake of SE prosthesis while the current downward trend is suggested to be due to declining surgical risk of TAVR recipients [5]. Our finding of a low rate of PPM likely reflects the fact that our study population includes lower proportion of TAVR between 2014 and 2015 when both rapid uptake of SE and high-risk patient population resulted in peak PPM requirements. In addition, an analysis of US 2011–2014 TVT registry with overall PPM requirement of 6.7% showed that TF-TAVR was associated with a lower requirement for PPM compared to transapical TAVR which were excluded from the current analysis [25]. While aortic root dilatation has been shown to be an important correlate of the need for post TAVR PPM [24], our sub-group analysis indicates that thoracic AA does not increase the need for PPM.

The mechanism of early stroke after TAVR is usually a downstream embolization of debris such as blood clots, dislodged intraluminal thrombi, and calcium [26]. Both calcium deposition and thrombus formation occur with increased frequency in patients with AA [27] and has been independently associated with

Table 1 Baseline characteristics of patients who underwent endovascular TAVR by AA status

	Total (%)	Unmatched cohort			Matched cohort		
	29,517	AA $N = 910$ (3.0%)	No AA $N = 28{,}607$ (97.0%)	p value	AA $N = 774$ (50%)	No AA $N = 774$ (50%)	p value
Mean age, years ± SD							
	80.5 (8.2)	80.5 (8.2)	80.3 (8.7)	0.47	80.1 (8.7)	80.4 (8.1)	0.43
Gender, *N* (%)							
Male	15,863 (53.7)	665 (73.1)	15,198 (53.1)	0.00	551 (71.2)	565 (73.0)	0.42
Female	13,651 (46.2)	245 (26.9)	13,406 (46.9)		223 (28.8)	209 (27.0)	
Race, *N* (%)							
White	24,382 (87.2)	780 (90.4)	23,602 (87.1)	0.00	697 (90.1)	717 (92.6)	0.13
Black	1169 (4.2)	22 (2.5)	1174 (4.2)		22 (2.8)	21 (2.7)	
Hispanic	1194 (4.3)	21 (2.4)	1173 (4.3)		20 (2.5)	17 (2.2)	
Others	1218 (4.3)	40 (4.6)	1178 (4.3)		35 (4.5)	19 (2.4)	
Missing	1554 (5.3)	47 (5.2)	1480 (5.2)				
Comorbidities							
Smoking	9422 (32.0)	369 (40.5)	9053 (31.6)	0.00	314 (40.6)	302 (39.0)	0.51
HTN*	29,517 (84.5)	771 (84.7)	24,158 (84.4)	0.82	650 (84.0)	668 (86.3)	0.18
DM*	10,874 (36.8)	230 (25.3)	10,644 (37.2)	0.00	203 (26.2)	216 (27.9)	0.46
Obesity	5185 (17.6)	133 (14.6)	5052 (17.7)	0.02	118 (15.2)	101 (13.0)	0.22
CHF*	15,113 (51.2)	476 (52.3)	14,637 (51.2)	0.52	412 (52.2)	432 (55.8)	0.31
CKD*	10,803 (36.6)	346 (38.0)	10,457 (36.6)	0.35	304 (39.3)	314 (40.6)	0.59
CAD*	20,991 (71.1)	707 (77.7)	20,284 (70.9)	0.00	592 (76.5)	598 (77.3)	0.70
Admission status							
Non-elective	6111 (20.8)	207 (22.9)	5904 (20.7)	0.10	176 (22.7)	170 (22.0)	0.69
Elective	23,269 (79.2)	698 (77.1)	22,571 (79.3)		598 (77.3)	604 (78.4)	
Missing	137 (0.5)		132 (0.5)				
Hospital region							
Northeast	7195 (24.3)	213 (23.4)	6982 (24.4)	0.40	191 (24.7)	176 (22.7)	0.80
Midwest	6769 (23.0)	232 (25.5)	6537 (22.9)		179 (23.1)	184 (23.8)	
South	9894 (33.1)	293 (32.2)	9601 (33.6)		250 (32.3)	263 (34.0)	
West	5659 (19.2)	172 (18.9)	5487 (19.2)		154 (19.9)	151 (19.5)	

Table 1 continued

	Total (%)	Unmatched cohort			Matched cohort		
	29,517	AA $N = 910$ (3.0%)	No AA $N = 28,607$ (97.0%)	*p* value	AA $N = 774$ (50%)	No AA $N = 774$ (50%)	*p* value
Hospital bed size							
Small	1694 (5.7)	56 (6.15)	1638 (5.73)	0.03	51 (6.6)	47 (6.1)	
Medium	5498 (18.6)	201 (22.1)	5297 (18.5)		181 (23.4)	179 (23.1)	
Large	22,325 (75.6)	653 (71.8)	21,672 (75.8)		542 (70.0)	548 (70.8)	0.90
Hospital teaching status							
Rural	253 (0.8)	12 (1.3)	241 (0.84)	0.18	10 (1.3)	6 (0.7)	
Urban non-teaching	2845 (9.6)	94 (10.3)	2751 (9.62)		81 (10.5)	81 (10.5)	
Urban teaching	28,607 (89.5)	804 (88.4)	25,515 (89.5)		683 (88.2)	687 (88.8)	0.23
Aneurysm location							
No aneurysm	28,607 (97.0)	0	28,607 (100)	0.00	0 (0.0)	774 (100)	
Thoracic	284 (0.9)	284 (32.0)			247 (32.6)		
Abdominal	592 (2.0)	592 (66.7)			499 (65.8)		
Thoracoabdominal	12 (0.04)	12 (1.35)			12 (1.58)		
Unknown	22 (0.07)	22(2.4)			16 (2.1)		0.00

**HTN* hypertension, *DM* diabetes mellitus, *CHF* congestive heart failure, *CKD* chronic kidney disease, *CAD* coronary artery disease

increased risk of cardiovascular events in non-TAVR populations [28]. Our study shows that the procedure-related stroke rate was not significantly different in both groups. These stroke rates are comparable to rates in the US TVT registry, which has remained stable over time [5]. Our analysis made adequate adjustments for factors which have been shown to be predictive of procedure related stroke in patients undergoing TAVR [29].

Vascular complications are an important cause of morbidity and mortality after TAVR [21]. In previous studies, the most consistent risk factor for vascular complications in transfemoral TAVR is a high sheath-to-femoral artery ratio [21]. Both aortic dissection and acute limb ischemia are often reported together as vascular complications in line with the Valve Academic Research Consortium-2 (VARC)-2 consensus document [30]. We analyzed rates of aortic dissection and acute limb ischemia, along with composite vascular complications in patients with and without AA. In the current analysis, aortic dissection, acute limb ischemia, and the composite vascular complications occurred at a similar frequency across our study groups. The rate of aortic dissection in our study is similar to rates in two previous studies based on early clinical trial and registry data [31, 32]. The risk of acute limb ischemia during TAVR is unknown. In patients undergoing percutaneous cardiac interventions through a femoral access, it was observed that limb ischemia could occur from flow-limiting iliofemoral dissection [33], failure of vascular closure device [34], and embolic phenomenon [35]. It is well documented that a higher prevalence of aortic thrombus in patients with AA could lead to a

Table 2 In-hospital outcomes of patients who underwent endovascular TAVR BY AA status

Outcomes, *N* (%)	AA *N* = 774	No AA *N* = 774	OR (CI)	*p* value
In-hospital death	NR	16 (2.0)	0.63 (0.28, 1.43)	0.20
Dissection	NR	NR	2.38 (0.41, 13.75)	0.25
Vascular complications	NR	13 (1.6)	0.80 (0.34, 1.89)	0.52
Acute limb ischemia	NR	15 (2.0)	0.46 (0.18, 1.16)	0.09
Bleeding	91 (11.8)	81 (10.5)	1.12 (0.81, 1.57)	0.42
Transfusion	79 (10.2)	66 (8.5)	1.20 (0.84, 1.70)	0.26
Stroke	NR	14 (1.8)	0.58 (0.24, 1.39)	0.25
LOS, median (IQR)	4 (2.0, 7.0)	3 (2.0, 6.0)		0.01*
Disposition to other facilities	359 (46.4)	326 (42.1)	1.17 (0.95, 1.46)	0.09
Acute kidney injury	100 (13.0)	102 (13.2)	1.01 (0.73, 1.39)	0.87
Permanent pacemaker	70 (9.0)	61 (7.8)	1.17 (0.81, 1.69)	0.40

NR Not reportable due to number of events being below NIS threshold for reporting event counts
LOS length of stay
*$p < 0.05$

higher risk of distal embolization in this patient population [36]. However, our study shows that this risk is not significantly increased during TAVR among patients with AA.

We found that periprocedural bleeding complications and blood transfusions occurred at similar rates in those with and without AA. Periprocedural bleeding complications during TAVR occur alongside vascular complications. Several factors contribute to increased risk of bleeding during TAVR including deficiencies in components of the coagulation cascade such as thrombocytopenia or acquired von Willebrand factor deficiency, comorbidities such as chronic kidney disease, and effects of medications such as anticoagulants and antiplatelets [37]. Bleeding complications directly attributable to the presence of AA can occur with aortic rupture or dissection. Therefore, it is not surprising that AA does not elevate the risk of periprocedural bleeding during TAVR given that the risk of aortic dissection is similar in both groups.

In this retrospective analysis, we used propensity score matched analysis to control for confounding. This approach likely increased the inferential power of our study and minimized bias. Additionally, the use of a national database with diversity in several patients and hospital factors makes our study the largest study to date to report the association between AA and outcomes of TAVR with good overall generalizability of our findings.

There are some limitations to our study. First, the NIS database is an administrative database which is liable to documentation and coding errors. However, the NIS database has been extensively validated internally and externally [38, 39]. Second, the study variables and outcomes were identified using ICD-9 and ICD-10 procedure and diagnosis codes. The current ICD diagnostic codes do not provide details for diagnosis of AA; regarding the size, anatomical features (i.e., exact location, shape or presence of thrombus); this precluded further granular analyses in our study. Similarly, the current ICD procedure codes for endovascular TAVR do not allow depicting the exact access (i.e., transfemoral, trans-axillary, etc.); however, reports show that > 95% of endovascular TAVR in the US is via transfemoral access, so our

Table 3 Sub-group analysis of in-hospital outcomes of in endovascular TAVR base on AA location

Outcomes, *N* (%)	Thoracic AAA			Abdominal AA		
	AA *N* = 247	No AA *N* = 774	*p* value	AA *N* = 499	No AA *N* = 774	*p* value
In-hospital death	NR	16 (2.0)	0.19	NR	16 (2.0)0.51	
Dissection	NR	NR	0.71	NR	NR	0.34
Vascular complications	NR	13 (1.6)	0.94	NR	13 (1.6)	0.31
Acute limb ischemia	NR	15 (2.0)	0.09	NR	15 (2.0)	0.19
Bleeding	21 (8.5)	81 (10.5)	0.37	65 (13.0)	81 (10.5)	0.14
Transfusion	19 (7.6)	66 (8.5)	0.66	59 (11.8)	66 (8.5)	0.06
Stroke	NR	14 (1.8)	0.27	NR	14 (1.8)	0.55
LOS, median (IQR)	3 (2.0, 7.0)	3 (2.0, 6.0)	0.43	4 (2.0, 7.0)	3 (2.0,6.0)	0.01*
Disposition to other facilities	101 (41.0)	326 (42.1)	0.73	244 (49.0)	358 (42.1)	0.01*
Acute kidney injury	30 (12.1)	102 (13.2)	0.65	64 (12.8)	102 (13.2)	0.85
Permanent pacemaker	28 (11.3)	61 (7.8)	0.08	40 (8.0)	61 (7.8)	0.93

NR Not reportable due to number of events being below NIS threshold for reporting event counts
LOS length of stay
*$p < 0.05$

population are mostly patients undergoing transfemoral TAVR [5]. Moreover, many useful data were irretrievable, including data regarding procedural details, imaging results, and medication. Finally, being an observational analysis, there is potential for selection bias or unmeasured confounders; however, we conducted robust adjusted analysis using propensity score matching to reduce allocation bias. Despite the aforementioned limitations, the strength of our analysis is related to its large sample size and national representation. Furthermore, our analysis is the largest to date to address the knowledge gap regarding the outcomes of patients with AA undergoing TAVR.

CONCLUSIONS

Endovascular TAVR, the majority of which are done through a trans-femoral access, is feasible and safe in patients with AA. Despite a slightly longer length of stay, the presence of AA did not increase mortality or other complications in patients undergoing TAVR through this approach. Our study suggests that the benefits of endovascular TAVR are well preserved with co-existing aortic aneurysm. Further studies are needed to determine how specific features of aortic aneurysm such as size, shape, thrombus burden, or calcifications affect the safety of endovascular TAVR in this population. The decision to pursue endovascular TAVR particular TF-TAVR should be individualized with TF-TAVR prioritized if AA features favors successful valve deployment via a transfemoral route.

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Compliance with Ethics Guidelines. The University of Texas Medical Branch Institutional Review Board (IRB) formally approved the study and waived the need for informed consent based on established institutional IRB policies. The study was performed in accordance with the Declaration of Helsinki 1964 and its later amendments.

Data Availability. Healthcare Cost and Utilization project is a publicly available data at https://www.hcup-us.ahrq.gov/tech_assist/centdist.jsp upon payment of relevant charges.

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