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Original Research Article

Association between atrial fibrillation and the risk of new-onset left bundle branch block following transcatheter mitral valve replacement: A retrospective analysis of the national inpatient sample

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Abstract

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Aim: Transcatheter mitral valve replacement (TMVR) offers an alternative for high-risk patients with mitral valve disease. Atrial fibrillation (AF) frequently coexists with mitral valve disease, while new-onset left bundle branch block (NLBBB) following transcatheter valve interventions may adversely affect cardiac function and necessitate permanent pacemaker implantation. However, the association between pre-existing AF and NLBBB following TMVR remains inadequately characterized.

Methods: This retrospective study analyzed TMVR hospitalizations with or without AF using National Inpatient Sample data from 2016 to 2022. The primary outcome was the risk of NLBBB following TMVR. The association between AF and NLBBB risk was evaluated using multivariable logistic regression, adjusting for sociodemographic characteristics and comorbidities. Sensitivity analyses were performed using inverse probability of treatment weighting (IPTW) and interaction test to validate the robustness of our findings.

Results: Among 1,754 patients undergoing TMVR, 65.6% (n = 1,150) had documented AF. AF patients were significantly older (74.63 ± 9.91 *vs.* 68.24 ± 13.88 years; P < 0.001) and exhibited higher prevalence of peripheral vascular disease (P = 0.004) and hypothyroidism (P = 0.024). The incidence of NLBBB was 4.61% in the AF cohort. Multivariable analysis demonstrated that AF was independently associated with increased NLBBB risk (aOR 2.09; 95% CI 1.13-3.84; P = 0.018), the finding that remained consistent after IPTW analysis (ATT 1.90; 95% CI 1.07-3.69; P = 0.030). Further stratification revealed that persistent AF significantly correlated with NLBBB development (ATT 2.74; 95% CI 1.23-6.09; P = 0.014), whereas paroxysmal AF did not show statistical significance (ATT 1.84; 95% CI 0.88-3.82; P = 0.100).

Conclusions: Patients with AF, particularly persistent AF, demonstrated significantly higher risk of NLBBB following TMVR.

Keywords: Transcatheter mitral valve replacement, new-onset left bundle branch block, atrial fibrillation, the national inpatient sample

INTRODUCTION

The global prevalence of mitral valve disease has exhibited a significant increasing trend, particularly in aging populations[1]. The current therapeutic modalities for mitral valve disease each present distinct clinical limitation[2]. Transcatheter mitral valve replacement (TMVR), a minimally invasive percutaneous technique for mitral valve replacement, has shown superior safety profiles compared to conventional surgery in high-risk surgical patients (STS score > 8%) over the past decade[3]. Previous studies have identified atrial fibrillation (AF), cardiac functional status, and left atrial dimension as significant predictors of postoperative outcomes following mitral valve surgery[4,5].

AF represents a prevalent comorbidity in patients with mitral valve disease, with a preoperative incidence of approximately 40%[6]. Mechanistically, AF may influence cardiac conduction through multiple mechanisms, including the promotion of fibrotic changes, exacerbation of congestive heart failure, and induction of electrical and structural atrial remodeling[7,8]. Consequently, this shared pathophysiology may potentially induce bundle branch remodeling, thereby precipitating the development of left bundle branch block (LBBB). As an established independent mortality predictor in cardiovascular populations, LBBB represents a clinically significant conduction abnormality, particularly following transcatheter valve interventions. There is sufficient evidence to suggest that it primarily occurs through multiple pathophysiological mechanisms, including the induction of ventricular asynchrony, abnormal septal motion, microstructural remodeling of myocardial fibrosis, or mitral regurgitation. These factors contribute to left ventricular dysfunction, ultimately precipitating adverse cardiovascular events such as clinical heart failure, and permanent pacemaker implantation[9-11]. When coexisting with AF, LBBB and AF exhibit synergistic detrimental effects, further significantly reducing left ventricular ejection fraction

(LVEF) and worsening prognosis[12]. According to the literature, the incidence of LBBB after TAVR reaches 10%-22%[13-15], which significantly increases the risk of all-cause mortality and cardiovascular mortality, severely affecting patient prognosis[16-18]. However, the incidence and risk factors for LBBB following TMVR remain poorly characterized, and the electrophysiological impact of pre-existing AF on conduction system vulnerability requires further elucidation.

Given the paucity of evidence regarding the impact of AF on the occurrence of new-onset left bundle branch block (NLBBB) following TMVR, we conducted this nationwide analysis utilizing the National Inpatient Sample (NIS) database to systematically investigate differences in demographic and clinical characteristics, incidence of NLBBB, and associated clinical outcomes between patients with AF and non-AF undergoing TMVR.

METHODS

Data source

This retrospective study utilized data from the NIS database spanning January 1, 2016, to December 31, 2022. As the largest publicly available all-payer inpatient database under the Healthcare Cost and Utilization Project (HCUP), the NIS encompasses approximately 97% of inpatient discharges from 46 U.S. states, with an annual sample size exceeding 7 million records representing a 20% stratified sample of U.S. community hospital discharges[19]. The NIS systematically captures clinical data such as patient demographics, diagnostic codes, comorbidities, surgical procedures, in-hospital complications, and healthcare costs, all coded using the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) and Procedure Coding System (ICD-10-PCS). Since the NIS database is publicly accessible and contains no personally identifiable information, it is exempt from requiring informed consent by Institutional Review Boards (IRBs).

Study population

Data from the NIS spanning the years 2016 to 2022 were utilized in this study. We included all hospitalizations involving TMVR for patients (aged ≥ 18 years), who were identified using specific International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) procedure codes:02UG3JH, 02UG3JZ, 02QG3ZZ, and 02QG3ZE. Hospitalizations for AF were identified using ICD-10-CM codes I48.0, I48.1, I48.2, and I48.9. NLBBB during hospitalization was ascertained using ICD-10-CM codes I44.4, I44.5, and I44.7. Patients with missing baseline data or pre-existing LBBB before TMVR were excluded from the analysis [Figure 1]. For each included hospitalization, baseline demographic characteristics (e.g. age, sex), hospital features (e.g. bed size, teaching status), and clinically relevant comorbidities were extracted and analyzed. Comorbidities were assessed using the Elixhauser Comorbidity Index and corresponding ICD-10-CM codes [Supplementary Table 1].

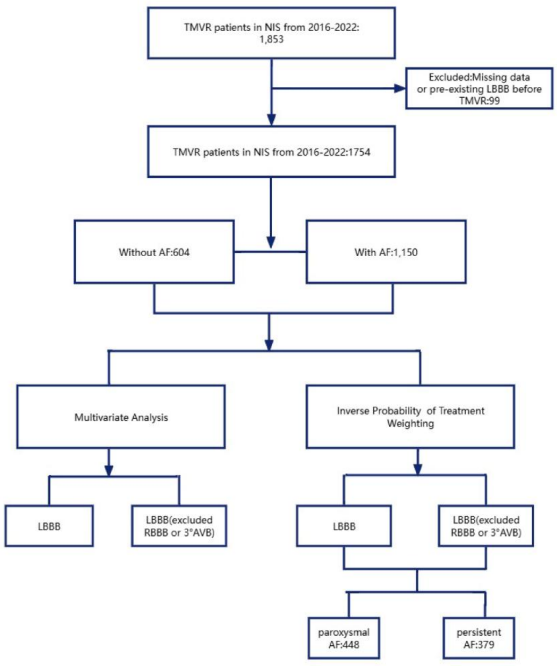


Figure 1. Study flowchart. NIS: national inpatient sample; TMVI: transcatheter mitral valve replacement; AF: atrial fibrillation; LBBB: left bundle branch block; RBBB: right bundle branch block; 3°AVB: third-degree atrioventricular block.

Study outcome

The primary endpoint was the risk of NLBBB following TMVR patients with AF compared to non-AF patients.

Data analysis

National estimates of hospitalizations and patient numbers were calculated by applying NIS sampling weights to ensure representativeness[20]. Descriptive statistics summarized categorical variables as frequencies (%) and continuous variables as mean ± standard deviation (SD). Group comparisons employed weighted linear regression for continuous variables and weighted chi-square tests for categorical variables.

Multivariable regression analyses were conducted to evaluate the independent effect of AF on outcomes after adjusting for confounders. The regression model included covariates that demonstrated significant between-group differences in baseline characteristics or univariate analyses: age; sex; race; payment type; median household income based on the patient's ZIP code; smoking status; dyslipidemia; prior stroke; prior myocardial infarction; prior percutaneous coronary intervention; prior coronary artery bypass grafting; pulmonary circulation disorders; peripheral vascular disorders; neurological disorders; chronic pulmonary disease; hypothyroidism; renal failure; liver disease; rheumatoid arthritis/collagen vascular diseases; coagulopathy; weight loss; obesity; diabetes; and hypertension. Results were expressed as unadjusted and adjusted odds ratios (aORs) with corresponding 95% confidence intervals (CIs).

To enhance the robustness of our findings, we conducted a sensitivity analysis using IPTW by excluding patients with right bundle branch block (RBBB) or third-degree atrioventricular block (3°AVB). Subsequently, we stratified the AF population into paroxysmal and persistent AF subgroups to evaluate the differential impact on postoperative NLBBB. Stabilized inverse probability weights were calculated using predicted probabilities derived from the propensity score model[21]. Subgroup analyses were conducted to investigate the association between AF and NLBBB across various patient subgroups stratified by age; sex; chronic lung disease; renal disease; smoking

status; hyperlipidemia; obesity; weight loss; and diabetes. For each subgroup analysis formal interaction tests were performed using likelihood ratio tests to compare models with and without interaction terms between AF stratification variables assessing whether associations varied significantly across subgroups ($P < 0.05$ considered significant).

All analyses accounted for complex survey design incorporating survey weights stratification clustering variables[22-24]. Statistical analyses utilized R software (http://www.R-project.org, The R Foundation) and Empower Stats (http://www.empowerstats.com, X&Y Solution, Inc., Boston, MA).

RESULTS

Baseline demographics of TMVR patients with AF or non-AF

The NIS database identified 1,754 patients who underwent TMVR between 2016 and 2022, comprising 1,150 (65.6%) with AF and 604 (34.4%) without AF. Notably, the proportion of AF patients undergoing TMVR demonstrated a significant temporal increase from 57.14% in 2016 to 66.0% in 2022 (P-trend < 0.001) [Supplementary Figure. 1]. Comparative analysis revealed that AF patients were significantly older than non-AF patients (74.63 ± 9.91 *vs.* 68.24 ± 13.88s; $P < 0.001$) and exhibited higher prevalence rates of peripheral vascular disease($P = 0.004$) and hypothyroidism ($P = 0.024$) [Table 1].

Table 1. Baseline Demographics in patients with TMVR between 2016 to 2022: stratified by AF.

Variable	No AF (n = 604)	AF (n = 1150)	P-value
Demographics			
Age (mean ± SD)	68.24 ± 13.88	74.63 ± 9.91	< 0.001**
Female	321 (53.15%)	644 (56.00%)	0.254

Race			< 0.001**
White	433 (71.69%)	925 (80.43%)	
Black	82 (13.58%)	94 (8.17%)	
Hispanic	46 (7.62%)	52 (4.52%)	
Other	43 (7.12%)	79 (6.87%)	
Primary Payer, *n* (%)			< 0.001**
Medicare/Medicaid	437 (72.35%)	952 (82.78%)	
Private	50 (8.28%)	47 (4.09%)	
Other	96 (15.89%)	124 (10.78%)	
Self-pay	21 (3.48%)	27 (2.35%)	
Median Household Income Quartile, *n* (%)			0.017*
First (lowest)	144 (23.84%)	241 (20.96%)	
Second	172 (28.48%)	270 (23.48%)	
Third	150 (24.83%)	341 (29.65%)	
Fourth (highest)	138 (22.85%)	298 (25.91%)	
Smoking	220 (36.42%)	366 (31.83%)	0.052
Dyslipidemia	361 (59.77%)	726 (63.13%)	0.168
Hospital Teaching Status, *n* (%)			0.474
Non-teaching	4 (0.66%)	13 (1.13%)	
Teaching	33 (5.46%)	53 (4.61%)	
Urban teaching	567 (93.87%)	1084 (94.26%)	
Hospital Bed Size, *n* (%)			0.893
Small	45 (7.45%)	80 (6.96%)	
Medium	93 (15.40%)	184 (16.00%)	
Large	466 (77.15%)	886 (77.04%)	
Medical History, *n* (%)			
Prior stroke	60 (9.93%)	140 (12.17%)	0.161

Prior MI	73 (12.09%)	109 (9.48%)	0.089
Prior PCI	61 (10.10%)	94 (8.17%)	0.177
Prior CABG	153 (25.33%)	244 (21.22%)	0.050
Comorbidities, *n* (%)			
Pulmonary circulation Disorders	250 (41.39%)	518 (45.04%)	0.143
Peripheral vascular disorders	94 (15.56%)	245 (21.30%)	0.004*
Chronic pulmonary disease	170 (28.15%)	323 (28.09%)	0.979
Hypothyroidism	116 (19.21%)	275 (23.91%)	0.024*
Renal failure	303 (50.17%)	586 (50.96%)	0.753
Liver disease	56 (9.27%)	82 (7.13%)	0.114
Rheumatoid arthritis/ collagen vascular diseases	20 (3.31%)	46 (4.00%)	0.471
Coagulopathy	143 (23.68%)	292 (25.39%)	0.429
Obesity	77 (12.75%)	174 (15.13%)	0.176
Weight loss	40 (6.62%)	103 (8.96%)	0.090
Hypertension	499 (82.62%)	955 (83.04%)	0.821
Diabetes	192 (31.79%)	316 (27.48%)	0.059

Note: MI, myocardial infarction; PCI, percutaneous coronary intervention; CABG, coronary artery bypass grafting. Descriptive statistics were expressed as frequencies and percentages for categorical variables and as mean ± standard deviation (SD) for continuous variables. Group comparisons utilized weighted linear regression for continuous variables and weighted chi-square tests for categorical variables. *Indicates statistically significant differences at $P < 0.05$; ** Indicates statistically significant differences at $P < 0.001$.

The outcome of the risk of NLBBB in AF patients who underwent TMVR

The analysis revealed a significantly higher incidence of postoperative NLBBB in AF patients (4.61%) compared to non-AF patients (2.48%) within the overall TMVR cohort ($P = 0.028$). The temporal patterns of postoperative LBBB incidence among TMVR

patients over the seven-year study period are depicted in Figure 2. Multivariable regression analysis, after adjustment for potential confounders, established AF as an independent predictor of NLBBB following TMVR (unadjusted OR 1.90, 95% CI 1.06-3.39, P = 0.031; model I aOR 2.24, 95% CI 1.18-4.24, P = 0.031; model II aOR 2.09, 95% CI 1.13-3.84, P = 0.018). Notably, after excluding patients with RBBB or t3°AVB, the AF group demonstrated a 2.21-fold increased risk of postoperative LBBB compared to non-AF patients (unadjusted OR 2.21, 95% CI 1.19-4.08, P = 0.012; model I aOR 2.24, 95% CI 1.18-4.24, P = 0.014; model II aOR 2.33, 95% CI 1.22-4.43, P = 0.010) [Table 2].

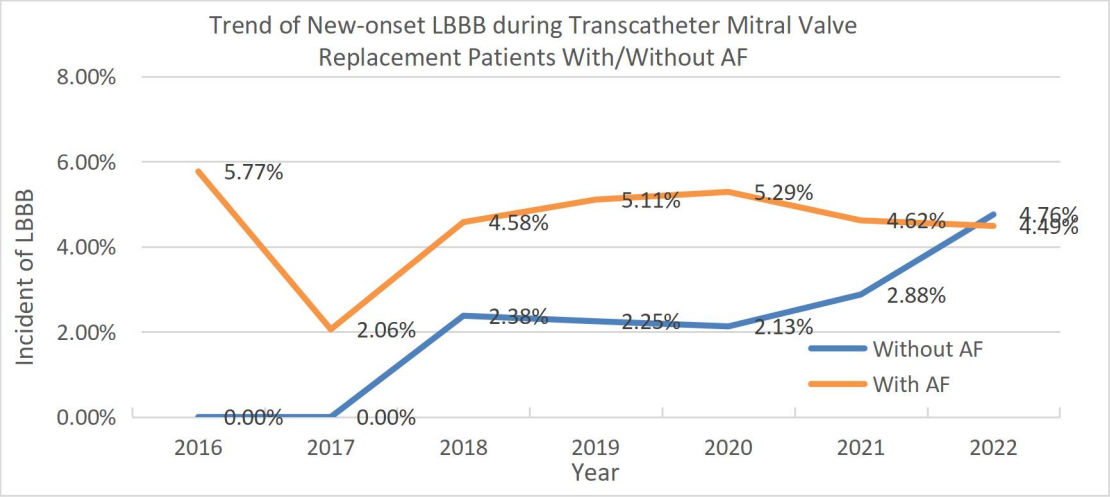


Figure 2. Trend of New-onset LBBB during TMVR patients with/without AF from 2016 to 2022.

Table 2. Results of different atrial fibrillation subtypes on LBBB: Inverse Probability of Treatment Weighting.

Clinical outcome	IPTW	Paroxysmal AF N = 448	Persistent AF N = 379
LBBB	ATT	1.84 (0.88, 3.82) p = 0.100	2.74 (1.23, 6.09) p = 0.014*
	ATC	1.76 (0.85, 3.65)	2.67 (1.15, 6.20)

		$p = 0.131$	$p = 0.022$*
	ATE	1.79 (0.88, 3.64)	2.70 (1.23, 5.89)
		$p = 0.108$	$p = 0.013$*

Results in table: OR (95%CI) *P*-value. Note: Adjusted for: age; female; race; primary payer; median household income quartile; smoking; dyslipidemia; prior stroke; prior MI; prior PCI; prior CABG; pulmonary circulation disorders; peripheral vascular disorder; neurological disorders; chronic pulmonary disease; hypothyroidism; renal failure; liver disease; rheumatoid arthritis/collagen vascular diseases; coagulopathy; weight loss; obesity; diabetes; hypertension.

The robustness of clinical outcome through sensitivity analyses

Using IPTW analysis, patients with AF revealed a significantly elevated risk of postoperative NLBBB compared to non-AF patients (ATT 1.99; 95%CI:1.07-3.69; $P = 0.030$; ATC 1.86; 95%CI:1.01-3.44; $P = 0.046$; ATE 1.91; 95%CI:1.01-3.43; $P = 0.030$). This association remained robust after excluding patients with pre-existing RBBB or 3°AVB (ATT 2.41;95%CI:1.20-4.81; $P = 0.013$; ATC 2.25; 95%CI:1.19-4.27; $P = 0.013$; ATE 2.35; 95%CI:1.23-4.50; $P = 0.010$) [Table 3].

Table 3. Subgroup analysis of AF patients on new-onset LBBB.

Stratification Variable	Subgroups	Odds Ratio (95% CI)	*P*-value	*P* for Interaction
Gender				0.284
	Female	2.96 (1.17, 7.52)	0.022*	
	Male	2.19 (0.85, 5.62)	0.104	
Age				0.559
	< 60 Years	3.22 (0.56, 18.60)	0.191	
	≥ 60 Years	2.20 (0.49, 9.94)	0.306	
Chronic Lung Disease				0.517

	No	2.46 (1.10, 5.47)	0.028*	
	Yes	3.27 (1.36, 7.84)	0.008**	
Kidney Disease				0.846
	No	1.98 (0.90, 4.32)	0.088	
	Yes	1.36 (0.60, 3.11)	0.460	
Smoking Status				0.508
	No	2.40 (1.12, 5.14)	0.024*	
	Yes	1.60 (0.67, 3.85)	0.292	
Hyperlipidemia				0.786
	No	1.83 (0.63, 5.33)	0.265	
	Yes	2.20 (0.81, 5.99)	0.121	
Obesity				0.280
	No	1.81 (0.95, 3.45)	0.072	
	Yes	2.33 (1.01, 5.38)	0.048*	
Weight loss				0.760
	No	2.12 (1.13, 3.97)	0.019*	
	Yes	1.71 (0.46, 6.33)	0.419	
Diabetes				0.144
	No	1.49 (0.72, 3.07)	0.283	
	Yes	2.56 (1.17, 5.57)	0.018*	

Note: *$p < 0.05$; **$p < 0.01$.

AF patients were stratified into paroxysmal AF (n = 448) and persistent AF (n = 379) subgroups, after excluding those with unspecified AF (ICD-10-CM code I48.91). The impact of different AF subtypes on postoperative NLBBB was reanalyzed using IPTW. The results revealed a significantly higher risk of NLBBB in the persistent AF group compared to the non-AF group (ATT 2.74; 95%CI: 1.23-6.09; P = 0.014; ATC 2.67; 95%CI: 1.15-6.20; P = 0.022; ATE 2.70; 95%CI: 1.23-5.89; P = 0.013). Although the risk of NLBBB was higher in the paroxysmal AF group compared to the non-AF group, no statistically significant difference was observed (ATT 1.84; 95%CI: 0.88-3.82; P =

0.100; ATC 1.76; 95%CI: 0.85-3.65; P = 0.131; ATE 1.79; 95% CI: 0.88-3.64; P = 0.108) [Table 4].

The outcomes of potential effect modification between AF and other clinical variables on NLBBB risk

Interaction analyses using likelihood ratio tests revealed no statistically significant effect modification by age, sex, chronic lung disease, chronic kidney disease, smoking status, hyperlipidemia, obesity, weight loss, and diabetes mellitus (all P-interactions $>$ 0.05) on the AF-LBBB association [Table 5]. These findings indicate the consistent association between AF and NLBBB following TMVR across diverse patient subgroups, suggesting an effect independent of age, sex, or comorbid conditions.

DISCUSSION

The association between AF and NLBBB following TMVR remains unexplored in the literature. We analyzed patients who underwent TMVR between 2016 and 2022, categorizing them into AF and non-AF groups to evaluate the risk of intraoperative NLBBB. The key findings are summarized below: 1) In patients undergoing TMVR, the incidence of postoperative NLBBB was 4.61% in AF patients versus 2.48% in those without AF; 2) The risk of NLBBB in the AF group was 2.09-fold higher compared to the non-AF group, suggesting that AF serves as an independent predictor of NLBBB following the procedure; 3) Compared with paroxysmal AF, persistent AF has a more significant impact on the occurrence of NLBBB after TMVR, suggesting that distinct AF phenotypes may differentially influence the incidence of NLBBB post-intervention

AF represents a prevalent complication of mitral valve disease. Mitral valve disorders, particularly mitral regurgitation and stenosis, induce volume and pressure overload in the left atrium, promoting left atrial dilation and fibrosis. These structural alterations create both electrophysiological and anatomical substrates conducive to AF development. The findings of this study indicate that the proportion of patients with AF was significantly higher than non-AF patients among those undergoing TMVR(65.6% versus 34.4%), This innovative observation not only fills a critical gap in the current

literature but also provides clinicians with valuable data references and practical guidance for managing TMVR patients. LBBB, due to its anatomical predisposition, is a frequent conduction disorder following TAVR. This conduction disturbance can further exacerbate pre-existing cardiac conditions through multiple ventricular-level electrophysiological remodeling processes and mechanical dyssynchrony, while also inducing progressive ventricular remodeling in structurally normal hearts. These pathological changes ultimately lead to cardiac dysfunction, culminating in decompensation and cardiomyopathy development[25,26]. To our knowledge, the probability of postoperative LBBB occurrence in patients undergoing TMVR and the specific clinical impact of AF on postoperative LBBB have not been reported in the literature with definitive conclusions. Utilizing the NIS database, we conducted a comprehensive retrospective analysis of all patients undergoing TMVR between 2016 and 2022. The cohort was systematically stratified into AF and non-AF groups to investigate the association with postoperative NLBBB. Our findings revealed that AF is significantly associated with an increased risk of NLBBB following TMVR compared to non-AF patients. Notably, persistent AF exhibited a more pronounced effect on postoperative NLBBB development than paroxysmal AF, indicating differential impacts of AF phenotypes on conduction disturbances. These findings provide new clinical data regarding the occurrence of conduction disorders after TMVR and their associated risk factors and potential clinical outcomes.

Previous studies report that LBBB typically presents at a mean age of 70 ± 10 years, with prevalence increasing with age[27-30]. In our cohort, TMVR with AF patients were older (mean age: 74.63 ± 9.91 years), which may partially explain the higher risk of postoperative LBBB in this population. AF induces structural and electrophysiological remodeling in atrial and sinoatrial nodal tissues. Experimental and clinical evidence further demonstrates that sustained AF promotes sinus node remodeling[31-33]. The characteristic rapid atrial rate in AF increases susceptibility to ventricular arrhythmias, while the atrioventricular node serves a critical protective role by regulating ventricular impulse conduction. However, persistent high-frequency atrial depolarization may

induce electrophysiological remodeling of the AV node itself[34]. Similar pathophysiological mechanisms could potentially contribute to bundle branch remodeling in AF[35]. The evolution of transcatheter valve replacement techniques has highlighted the contribution of anatomical characteristics (e.g. annular calcification, implantation depth) to postoperative conduction abnormalities[36,37]. Comprehensive anatomical assessment before TMVR is essential, including evaluation of atrial dimensions[38-40], left ventricular outflow tract obstruction (LVOTO), and valve displacement risk. The eft ventricular outflow tract (LVOT), located at the basal interventricular septum, lies in close anatomical proximity to the left bundle branch (LBB). Post-implantation, the anterior mitral leaflet is displaced, forming a "neo-LVOT". A reduced neo-LVOT area may precipitate acute LVOTO, manifesting as immediate hemodynamic instability post-deployment, with intraprocedural echocardiography revealing valve malposition or anterior leaflet-induced obstruction[41]. The irregular cardiac rhythm and structural atrial remodeling in AF may increase procedural complexity, potentially exacerbating LVOTO and valve displacement risks, which may subsequently result in conduction system injury and bundle branch block.

In contrast to paroxysmal AF, persistent AF induces progressive structural remodeling (including fibrotic deposition and ion channel dysregulation) that results in irreversible pathological alterations[42]. Electrophysiological mapping studies demonstrate that patients with persistent AF present with tripled atrial dilatation magnitude and a 40% reduction in conduction velocity compared to paroxysmal AF cases[43]. This may partially explain why persistent AF demonstrates a more pronounced association with new-onset LBBB following TMVR. Our retrospective study reveals a correlation without establishing causation. Further research is necessary to better understand the underlying mechanisms and nature of the relationship among the three variables.

Our study offers several methodological strengths, employing a comprehensive sensitivity analysis through IPTW, and stratified analysis to repeatedly validate the stability of our research findings, thereby enhancing the result's reliability. By

leveraging the NIS database, we analyzed a nationally representative cohort of 1,754 TMVR patients from 2016 to 2022, which ensures the generalizability of our data. The key innovations of our research include: (1) This is the first study to investigate the differential impact of AF on the risk of LBBB following TMVR, providing additional clinical evidence regarding the influence of AF on postoperative LBBB occurrence and offering important insights into the factors contributing to conduction abnormalities after TMVR. (2) confirming differential effects of AF subtypes on postoperative LBBB development, with persistent AF showing a more significant influence on LBBB occurrence compared to paroxysmal AF. However, the potential pathophysiological mechanisms underlying the increased LBBB risk in AF patients undergoing TMVR remain incompletely understood. Future research directions should focus on prospectively assessing the impact of AF on postoperative outcomes in TMVR patients experiencing LBBB and exploring the potential causal relationship between AF and postoperative LBBB development.

Limitations

Several limitations should be acknowledged. First, certain clinically relevant variables were unavailable, including echocardiographic data (to assess structural differences), LBBB duration, electrocardiographic confirmation, specific TMVR device models, TMVR access route, intraprocedural hemodynamics, valve type, and coexisting complications. The absence of these data may limit a comprehensive evaluation of patient outcomes. Second, as the study relied on ICD-10 coding within the NIS database, potential misclassification or incomplete documentation could affect accuracy. Although NIS data quality has been extensively validated, this inherent limitation may introduce bias. Finally, the study spanned a period of evolving TMVR techniques (2016-2022), during which procedural refinements, valve technologies, and patient selection criteria underwent significant advancements. Consequently, early practices may differ from current standards, potentially limiting the direct applicability of our findings to contemporary clinical settings.

Conclusions

Our study indicates that patients with AF, particularly those with persistent AF, exhibited a significantly higher risk of developing NLBBB following TMVR. The formation of NLBBB can lead to further deterioration of cardiac function affecting the patient's prognosis. These findings suggest that personalized management strategies should be implemented for AF patients undergoing TMVR to mitigate the risk of postoperative conduction abnormalities. Additionally, this study highlights the imperative for further exploration into the underlying mechanisms contributing to these observed disparities, thereby providing significant guidance for future research endeavors.

List of abbreviations

AF: Atrial Fibrillation

LBBB: Left bundle branch block

LBBB: Left bundle branch

LVOTO: left ventricular outflow tract obstruction

LVOTO: left ventricular outflow tract

NLBBB: New-onset Left bundle branch block

NIS: National Inpatient Sample

ICD-10-CM/PCS: The International Classification of Diseases, Tenth Revision Clinical

IPTW: Inverse Probability of Treatment Weighting

OR: odds ratio

aOR: adjusted odds ratio

RBBB: Right bundle branch block

TMVR: Transcatheter Mitral Valve Replacement

3°AVB: Third-degree Atrioventricular block

DECLARATIONS

Authors' contributions:

Formal analysis and Writing - original draft: Q.C;

Funding acquisition, Resources and Supervision: XP.M, SB.J, and GZ.C;

Formal analysis and Software: SZ.F, B.S, and CY.Y;

Project administration and Investigation: Y.C, Y.G, L.H, T.L, and R.Y.

Availability of data and materials

The data for this research was derived from the National Inpatient Sample (NIS) of the Healthcare Cost and Utilization Project, which can be accessed at https://www.hcup-us.ahrq.gov/nisoverview.jsp for usage agreements and associated fees. With authorization from the U.S. Department of Health and Human Services, the dataset is also available upon reasonable request from the corresponding author.

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Conflict of interest

The authors declare that they have no conflicts of interest.

Ethical approval and consent to participate

The data for this study were derived from the National Inpatient Sample (NIS) database, a publicly accessible healthcare resource that contains no personally identifiable information. Under the Health Insurance Portability and Accountability Act (HIPAA) regulations, our institutional review board determined that patient consent was not required for this analysis.

Consent for publication

Not applicable.

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