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RESEARCH ARTICLE

Predictors of Post Transcatheter Aortic Valve Implantation Electrical Abnormalities and Correlation of Pre Transcatheter Aortic Valve Implantation Computed Tomography with Post Operative Mechanical Trauma Related Complications

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Abstract: ***Background:*** Transcatheter Aortic Valve Implantation (TAVI) is a well-established therapy for severe aortic stenosis but is frequently complicated by cardiac conduction disturbances, often necessitating permanent pacemaker implantation (PPM). Pre-procedural Computed Tomography (CT) offers key insights into anatomical risk factors. ***Objectives:*** This study aimed to identify predictors of post-TAVI electrical abnormalities (new-onset LBBB and high-grade AV block) and correlate pre-TAVI CT features with post-operative mechanical trauma-related complications. ***Methods:*** This prospective cohort study enrolled 60 consecutive adults undergoing TAVI. All patients had pre- and post-procedural ECG and invasive electrophysiology (IEP). CT measurements included Aortic Valve Calcium Scoring (AVCS), membranous septum length, and annular geometry. Primary outcomes were new LBBB and complete AV block (CAVB) requiring PPM. ***Results:*** Post-procedure, QRS duration (94.8±9.9ms vs. 99.6±12.9ms, P=0.038) and PR interval (158.6±12.2ms vs. 178.1±15.2ms, P<0.001) were significantly prolonged. New LBBB incidence rose from 8.33% to 45% (P<0.001). Seventeen patients (28.33%) developed CAVB, with 10 (58.82%) requiring PPM. Patients with CAVB had significantly higher AVCS (4254.7±598.8 vs. 3298.9±846.6, P<0.001) and were more likely to receive mechanically expandable valves (64.71% vs. 16.28%) and have an irregular annulus (64.71% vs. 16.28%) (P<0.001 for both). One-year complication rates were low, and there were no significant correlations between calcification severity and mechanical complications. ***Conclusions:*** High AVCS, irregular aortic annulus, and the use of mechanically expandable valves are strong predictors of post-TAVI CAVB. Integrating detailed CT metrics with valve choice and implantation strategy is critical for mitigating electrical complications

Keywords: TAVI, Aortic Stenosis, Complete AV Block, Calcification, Membranous Septum

INTRODUCTION

Valvular heart disease remains a major global health burden, with aortic stenosis (AS) now among the most prevalent lesions. Its frequency escalates with age—affecting ~0.2% between 55–64 years and 2–7% beyond 65 years—and is projected to involve ~4.5 million individuals worldwide by 2030 [1]. Surgical aortic valve replacement has historically offered substantial symptomatic and survival benefits; however, nearly one-third of patients with severe AS are deemed ineligible for surgery owing to comorbidities and prohibitive surgical risk [2].

Since its first-in-human use by Alain Cribier in 2002, transcatheter aortic valve implantation (TAVI) has matured into a routine therapy for high-risk or inoperable patients and is increasingly used across the surgical-risk spectrum in line with ESC and AHA recommendations [3]. Despite its transformative impact, TAVI is associated with post-procedural cardiac conduction disturbances. Rates vary by prosthesis type, with self-expanding systems generally linked to higher incidences of high-grade atrioventricular (AV) block and new-onset left bundle branch block (LBBB), both of which often necessitate permanent pacemaker implantation (PPM). A meta-analysis estimates PPM implantation in ~14–17% of TAVI recipients [4].

Pre-procedural computed tomography (CT) is pivotal for comprehensive TAVI planning. Although CT can delineate aortic valve orifice area, its principal roles are annular and root sizing, identification of optimal fluoroscopic projections, and assessment of iliofemoral and alternative access routes [5]. Beyond these fundamentals, CT affords quantification and mapping of valvular/LVOT calcification, evaluation of the membranous septum length and aorto-annular angle, and appraisal of anatomic features that may influence conduction system vulnerability and mechanical trauma–related events (paravalvular leak, malposition, annular rupture) [6]. Integrating such CT metrics with electrophysiologic and clinical data could refine risk stratification for electrical complications, guide prosthesis choice and implantation depth, and ultimately mitigate adverse outcomes.

Accordingly, this study aimed to identify predictors of post-TAVI electrical abnormalities particularly high-grade AV block and new-onset LBBB and examine the correlation between pre-TAVI CT features and postoperative mechanical trauma–related complications in a prospective cohort undergoing contemporary TAVI.

2. Patients and Methods

Design and population

This prospective cohort study was conducted in the Cardiology Departments of Benha University Hospital, Naser City Insurance Hospital, and Ismailia Medical Complex. Consecutive 60 adults scheduled for TAVI between October 2023 and October 2024 were enrolled. The study was approved by the Research Ethics Committee of Benha Faculty of Medicine. Administrative permissions were obtained from institutional leadership. Written informed consent was secured from all participants prior to any study procedures, ensuring confidentiality and the right to withdraw at any time.

Patient Selection

Inclusion criteria were age >18 years, symptomatic severe aortic stenosis, and candidacy for TAVI. Exclusion criteria comprised markedly impaired cognition, other severe valvular disease, significant respiratory or renal dysfunction, unstable clinical status, active malignancy, or refusal to participate.

MATERIALS AND METHODS

Pre-procedural assessment

All patients underwent structured history (personal, comorbidities, prior cardiovascular and cerebrovascular events) and physical examination (vital signs, BMI, cardiovascular exam). Routine laboratory testing included CBC, coagulation profile (INR/PT), renal and liver function, and serum electrolytes.

Electrocardiography and invasive electrophysiology

Standard 12-lead ECG assessed rhythm, PR interval, QRS duration, and presence of RBBB, LBBB, LAHB, or LPHB. Invasive electrophysiology measured sinus node recovery time (SNRT, corrected SNRT), AV nodal effective refractory period (ERP) using programmed stimulation (S1=600 ms; decremental S1–S2), and intracardiac conduction intervals: atrium-to-His (AH; normal 55–130 ms) and His-to-ventricle (HV; normal 35–55 ms). Post-procedural ECG parameters were repeated to capture new or worsened conduction abnormalities.

CT acquisition and measurements

CT was performed on a 256-slice scanner. For AVCS (Agatston), ECG-gated acquisition at 75% RR, 270-ms rotation, 3-mm collimation, 80 mA, 120 kV was used; calcification was defined at >130 HU. CT aortography (retrospective ECG gating with dose modulation; 256×0.6-mm collimation; 330 mA; 120 kV) covered the entire aorta and iliofemoral vessels with ~80 mL low-osmolar iodinated contrast at 5–6 mL/s. Measurements included annular diameters/area/perimeter, sinus of Valsalva, sinotubular junction, ascending aorta, aorto-annular angle, membranous septum length, calcium burden and distribution (annulus, LVOT, device landing zone), and annulus geometry (round/elliptical/irregular).

Procedure and follow-up

TAVI was performed per institutional practice using self-expanding, balloon-expandable, or mechanically expandable valves. Recorded intraprocedural data included access route, implantation depth (NCC/LCC), contrast volume, radiation dose, pre/post-dilatation, repositioning/recapture, and concomitant PCI/PTA. Patients were followed at 3, 6, 9, and 12 months for electrical outcomes (new/worsened conduction disturbances, complete AV block (CAVB); temporary vs permanent pacing) and mechanical trauma–related complications (paravalvular leak, valve malposition, annular rupture), as well as stroke, MI, vascular events, ventilation, and mortality.

Outcomes

Primary outcomes were post-TAVI electrical abnormalities (new LBBB, high-grade AV block/CAVB and PPM requirement). Secondary outcomes were mechanical trauma–related complications and other clinical events through 1 year.

Statistical methods

Data analysis was performed with SPSS v29 (IBM, Chicago, IL, USA). Normality was assessed by Shapiro–Wilk and histograms. Parametric data are mean±SD and compared by paired/unpaired t-tests as appropriate; non-parametric data are median (IQR) and compared by Wilcoxon/Mann–Whitney tests. Categorical variables are n (%) and compared by Chi-square or Fisher's exact test. Group contrasts included pre- vs post-procedural electrophysiology, calcification strata, annulus geometry, and valve type. Logistic regression explored predictors of CAVB/complications. Two-tailed P≤0.05 was considered significant.

RESULTS

Demographic data, risk factors, laboratory, and Pre TAVI CT data were presented in **Table 1**.

Table 1: Demographic data, risk factors, laboratory, and Pre TAVI CT data of the studied patients

		(n=60)
Age (years)		43.4 ± 12.75
Sex	Male	33 (55%)
	Female	27 (45%)
Weight (kg)		88.7 ± 9.3
Height (m)		1.68 ± 0.09
BMI (kg/m^2)		32.97 ± 3.46
Hypertension		52 (86.67%)
Diabetes mellitus		25 (41.67%)
Dyslipidemia		31 (51.67%)
COPD		11 (18.33%)
Previous MI		8 (13.33%)
Prior CVA		5 (8.33%)
IHD		24 (40%)
Hb (g/dL)		11.3 ± 0.74
White blood cell count (10^9/L)		13.2 ± 1.96
Platelet count (10^9/L)		238.3 ± 59.44
INR		1.1 ± 0.18
PT (sec)		12.8 ± 0.8
Creatinine clearance (mL/min)		117.9 ± 16.67
Aspartate aminotransferase (IU/L)		22.7 ± 8.75
Alanine aminotransferase (IU/L)		21.8 ± 10.46
Na (mmol/L)		135.3 ± 3.86
Ca (mg/l)		84.3 ± 3.07
AVCS		3569.7 ± 892.23
Membranous septum length (mm)		4.81 ± 0.84
Types of aortic annulus	Round	22 (36.67%)
	Elliptical	20 (33.33%)
	Irregular	18 (30%)
Types of valves	Self-expanding valves	24 (40%)
	Balloon expandable valves	18 (30%)
	Mechanically expandable valves	18 (30%)

Data were presented as Mean ± SD or n (%), BMI: Body mass index, COPD: Chronic obstructive pulmonary disease, MI: Myocardial infarction, CVA: Cerebrovascular accident, and IHD: Ischaemic heart disease, AVCS: Aortic valve calcium scoring

Heart rate, PR interval, QRS duration, mean and peak aortic valve gradients, mean aortic valve area, AH interval, and incidence of left bundle branch block (LBBB) were significantly higher post-procedure compared to pre-procedure ($P < 0.05$). All other parameters, including SNRT, aortic annulus dimensions and area, as well as atrial fibrillation, RBBB, LAHB, LPHB, and first-degree AV block, showed no significant differences. **Table 2**

Table 2: Electrophysiological data of the studied patients pre and post-procedural

	Preprocedural (n=60)	Postprocedural (n=60)	P value
HR (beats/min)	70.98 ± 10.36	81.76 ± 12.47	**<0.001***
PR interval	158.58 ± 12.21	178.12 ± 15.17	**<0.001***
QRS duration (msec)	94.78 ± 9.91	99.62 ± 12.86	**0.038***
SNRT (sec)	1.27 ± 0.31	1.32 ± 0.42	0.484
AH interval (msec)	81.76 ± 11.13	95.7 ± 11.79	**<0.001***
Atrial Fibrillation	10 (20%)	13 (26%)	0.476
RBBB	8 (16%)	10 (20%)	0.603
LBBB	5 (8.33%)	27 (45%)	**<0.001***
LAHB	5 (10%)	9 (18%)	0.249

LPHB	1 (2%)	2 (4%)	0.558
1st-degree AV block	7 (14%)	14 (28%)	0.086

Data were presented as Mean ± SD or n (%), HR: Heart rate, SNRT: Sinus node recovery time, AH: atrium to His, RBBB: Right bundle branch block, LBBB: Left bundle branch block, LAHB: Left anterior hemiblock, LPHB: Left posterior hemiblock, AV: atrioventricular

Complications were insignificantly different between 3 months and (6 months, 9 months and 1 years). **Table 3**

Table 3: Complications of the studied patient.

	3 months (n=60)	6 months (n=60)	9 months (n=60)	1 years (n=60)
Mortality	1 (1.67%)	1 (1.67%)	0 (0%)	1 (1.67%)
P value		---	1	---
Periprocedural MI	2 (3.33%)	0 (0%)	0 (0%)	1 (1.67%)
P value		0.495	0.495	1
In-hospital stroke	5 (8.33%)	2 (3.33%)	1 (1.67%)	2 (3.33%)
P value		0.439	0.206	0.439
Vascular complications	2 (3.33%)	2 (3.33%)	2 (3.33%)	0 (0%)
P value		---	---	0.235
Mechanical ventilation	1 (1.67%)	3 (5%)	1 (1.67%)	3 (5%)
P value		0.618	---	0.618
Paravalvular leaks	4 (6.67%)	1 (1.67%)	1 (1.67%)	1 (1.67%)
P value		0.364	0.364	0.364
Valve malposition	4 (6.67%)	2 (3.33%)	4 (6.67%)	3 (5%)
P value		0.364	---	1
CAVB	8 (13.33%)	3 (5%)	4 (6.67%)	2 (3.33%)
P value		0.120	0.235	0.55
Annular rupture	1 (1.67%)	2 (3.33%)	1 (1.67%)	2 (3.33%)
P value		1	---	1

CAVB: Complete atrioventricular block, P value compared between 3 months and other measurements

Concerning atrioventricular block, 17 (28.33%) patients had CAVB, 7 (41.18%) patients were temporary CAVB, and 10 (58.82%) patients were permanent CAVB. AVCS, types of aortic annulus and types of valves were significantly higher in patient with CAVB than patient without CAVB (P value <0.001). **Table 4**

Table 4: AVCS, types of aortic annulus and types of valves according to CAVB

		Patient with CAVB (n=43)	Patient without CAVB (n=17)	P value
AVCS		4254.71 ± 598.77	3298.88 ± 846.58	**<0.001***
Types of aortic annulus	**Round**	0 (0%)	22 (51.16%)	**<0.001***
	Elliptical	6 (35.29%)	14 (32.56%)	
	Irregular	11 (64.71%)	7 (16.28%)	
Types of valves	**Self expanding valves**	1 (5.88%)	23 (53.49%)	**<0.001***
	Balloon expandable valves	5 (29.41%)	13 (30.23%)	
	Mechanically expandable valves	11 (64.71%)	7 (16.28%)	

Data were presented as Mean ± SD or n (%), CAVB: Complete atrioventricular block. *: Significantly different as (P value <0.05).

Calcification severity was mild calcifications in 28 (46.67%) patients and ≥Moderate calcifications in 32 (53.33%) patients. Radiation dose was significantly higher in patients with ≥moderate calcifications compared to those with mild calcifications (P = 0.011). All other parameters, including ejection fraction, aortic measurements, annular dimensions, calcium volume, procedural characteristics, and clinical outcomes, showed no significant differences between the two groups. Emergent cardiac surgery and the need for a second valve did not occur in any patient. **Table 5**

Table 5: Procedural data according to calcification severity

	Mild calcifications (n=28)	**≥Moderate calcifications (n=32)**	**P value**
Ejection fraction (%)	54.04 ± 4.93	53.84 ± 5.78	0.891
Mean aortic gradient (mmHg)	48.96 ± 6.2	47.84 ± 6.1	0.484
LM height (mm)	15.25 ± 2.46	15.06 ± 2.63	0.777
RCA height (mm)	14.29 ± 2.55	14.66 ± 2.59	0.579
Annulus min diameter (mm)	19.43 ± 4.73	20.78 ± 4.58	0.266
Annulus max diameter (mm)	23.79 ± 3.38	22.84 ± 3.59	0.302
Annulus mean diameter (mm)	22.82 ± 3.48	23.53 ± 3.8	0.456
Annulus perimeter (mm)	75.25 ± 4.17	74.41 ± 3.96	0.425
Annulus area (mm^2)	419.11 ± 40.17	429.13 ± 39.9	0.337
Sinus of valsalva diameter (mm^2)	32.96 ± 3.89	33.19 ± 3.75	0.822
Calcium volume 800 HU (mm3)	402.39 ± 140.72	411.97 ± 139.71	0.793
Aortic angulation (°)	51.86 ± 12.85	47.25 ± 13.23	0.178
Index of eccentricity	0.23 ± 0.07	0.24 ± 0.06	0.744
Ascending aorta (mm)	19.86 ± 5.96	21.31 ± 4.97	0.307
Implantation depth NCC (mm)	4.33 ± 0.36	4.24 ± 0.43	0.411
Implantation depth LCC (mm)	4.84 ± 0.82	4.87 ± 0.77	0.873
Contrast volume (mL)	156.64 ± 9.92	156.84 ± 9.6	0.937
Radiation dose ($Gycm^2$)	73.25 ± 14.31	81.59 ± 10.32	**0.011***
Femoral route	26 (92.86%)	27 (84.38%)	0.432
Subclavian route	2 (7.14%)	3 (9.38%)	1
Embolic protection system	2 (7.14%)	2 (6.25%)	---
Any vascular complications	2 (7.14%)	3 (9.38%)	1
PTA with stenting of access site	2 (7.14%)	3 (9.38%)	1
PCI with stenting	2 (7.14%)	5 (15.63%)	0.432
Predilatation	12 (42.86%)	21 (65.63%)	0.077
Postdilatation	11 (39.29%)	15 (46.88%)	0.554
Repositioning	6 (21.43%)	10 (31.25%)	0.390
Recapture	4 (14.29%)	9 (28.13%)	0.225
Emergent cardiac surgery	0 (0%)	0 (0%)	--
Need for second valve	0 (0%)	0 (0%)	---
AR ≥moderate	6 (21.43%)	7 (21.88%)	0.966

Data were presented as Mean ± SD or n (%), HU, Hounsfield Units; LM, left main; LVOT, left ventricular outflow tract; RCA, right coronary artery; LCC, left coronary cusp; NCC, non-coronary cusp, PCI, percutaneous coronary intervention; PTA, percutaneous transluminal angioplasty

Complications after 1 year were insignificantly different between mild calcifications and ≥moderate calcifications. **Table 6**

Table 6: Complications after 1 year according to calcification severity.

	Mild calcifications (n=28)	**≥Moderate calcifications** (n=32)	**P value**
Mortality	0 (0%)	1 (3.13%)	1
Periprocedural MI	0 (0%)	1 (3.13%)	1
In-hospital stroke	0 (0%)	1 (3.13%)	1
Vascular complications	0 (0%)	0 (0%)	---
Mechanical ventilation	1 (3.57%)	2 (6.25%)	1
Paravalvular leaks	0 (0%)	1 (3.13%)	1
Valve malposition	0 (0%)	3 (9.38%)	0.096

CAVB	0 (0%)	2 (6.25%)	0.178
Annular rupture	0 (0%)	2 (6.25%)	0.178

CAVB: Complete atrioventricular block.

In logistic regression, age, weight, height, BMI, COPD, diabetes mellitus, dyslipidemia, hypertension, IHD, ejection fraction, annulus area, annulus perimeter, aortic angulation, AR ≥moderate, ascending aorta, calcium volume, mean aortic gradient, post dilatation, pre dilatation, previous MI, RCA height, repositioning, sinus of Valsalva diameter, subclavian route, prior CVA, any vascular complications were dependent predictors of complications. **Table 7**

Table 7: Logistic regression of complications versus other parameters

	Logistic regression		
	Odds ratio	**95% CI**	**P value**
Age (years)	1.01	0.95 to 1.05	0.878
Weight (kg)	1.027	0.963 - 1.095	0.416
Height (m)	0.182	0.001 - 180.14	0.628
BMI (kg/m^2)	1.074	0.90 - 1.27	0.414
COPD	0.86	0.19 - 3.79	0.847
Diabetes mellitus	1.09	0.33 - 3.61	0.879
Dyslipidemia	1.3	0.40 - 4.21	0.655
Hypertension	0.387	0.043 - 3.441	0.395
IHD	0.482	0.14 - 1.57	0.228
Ejection fraction (%)	1.01	0.904 - 1.12	0.866
Annulus area (mm^2)	1.01	0.987 to 1.017	0.751
Annulus perimeter (mm)	0.908	0.78 - 1.06	0.211
Aortic angulation	0.977	0.93 - 1.02	0.317
AR ≥moderate	0.432	0.115 - 1.615	0.212
Ascending aorta	1.023	0.918 - 1.14	0.676
Calcium volume (800HU/mm^3)	1.001	0.99 - 1.01	0.743
Mean aortic gradient (mmHg)	1.015	0.92 - 1.11	0.749
Pre dilatation	0.522	0.154 - 1.77	0.298
Post dilatation	0.835	0.25 - 2.70	0.763
Previous MI	1.00	0.17 - 5.57	1
RCA height (mm)	1.0828	0.85 - 1.36	0.500
Repositioning	1.00	0.26 - 3.74	1
Sinus of Valsalva diameter (mm^2)	1.13	0.95 - 1.33	0.143
Subclavian route	0.464	0.069 - 3.086	0.427
Prior CVA	469.006	---	0.948
Any vascular complications	469.06	---	0.998

CI: Confidence interval

DISCUSSION

Valvular heart disease, particularly severe aortic stenosis, remains a significant global health challenge. TAVI has revolutionized treatment, yet post-procedural conduction abnormalities pose a persistent concern for long-term prognosis [7]. Therefore, our study aimed to identify predictors of post-TAVI electrical disturbances and mechanical complications by integrating clinical, electrophysiological, and comprehensive pre-procedural CT data from a prospective cohort of 60 consecutive TAVI patients.

In the present study, the mean age of the cohort was 43.4 ± 12.8 years, notably younger than the populations studied by Mangieri et al. [7] and John et al. [8], who examined elderly, high-risk patients (mean ages 84.4 ± 4.1 years and 82.1 ± 6.3 years, respectively). This difference may reflect variations in referral patterns, disease epidemiology, and local selection criteria. Our population also demonstrated a high mean BMI (32.97 ± 3.46 kg/m²), consistent with the growing recognition of obesity as a cardiovascular risk factor. Kontogeorgos et al. [9] reported that overweight and obesity nearly triple the risk of developing aortic stenosis in women, while Rossi et al. [10] identified elevated BMI as an independent determinant of cardiovascular morbidity and mortality. In addition, our high prevalence of hypertension (86.7%), diabetes (41.7%), and dyslipidemia (51.7%) mirrors the comorbidity burden described by Mangieri et al. [7], who noted similar dominance of metabolic and vascular disorders in TAVI cohorts.

Electrophysiologically, heart rate, PR interval, QRS duration, mean aortic valve area, AH interval, and left bundle branch block (LBBB) increased significantly after TAVI ($P < 0.05$), while mean and peak aortic valve gradients also rose significantly ($P < 0.05$). These findings are in line with Chen et al. [11], who emphasized that TAVR continues to carry a high risk of new conduction abnormalities despite advances in device technology. Manuel et al. [12] similarly observed post-TAVI prolongation of PR and QRS intervals and a significant increase in LBBB incidence (25–33%). Akin et al. [13] corroborated these results, reporting prolongation of AH and HV intervals and a rise in new LBBB from 2% to 54% after TAVI. The pathophysiological basis described by Lee et al. [14] and Hamdan et al. [15] mechanical or ischemic injury to the conduction tissue by the stent frame or catheter manipulation—supports our observations. Moreover, our data accord with Prihadi et al. [16] and Siontis et al. [17], who linked advanced AS severity to higher prevalence of conduction defects, and Auffret et al. [18], who emphasized LBBB and AV block as dominant TAVI complications.

Regarding procedural and hemodynamic effects, our findings of improved mean and peak gradients after valve deployment parallel those reported by John et al. [8] and Ullah et al. [19], who documented marked post-TAVI reductions in transvalvular pressure gradients and expansion of the valve area across AS subtypes.

CAVB occurred in 28.3% of our patients, with significantly higher aortic valve calcium scores (AVCS), non-round annuli, and mechanically expandable valves among affected cases ($P < 0.001$). These results reinforce previous work by Barbe et al. [20], who showed that elevated AVCS predicts PPM after TAVI, especially in patients without pre-existing RBBB. Similarly, Hokken et al. [21] found shorter membranous septum length in patients requiring new PPI, and Espejo-Paeres et al. [22] identified tapered LVOT morphology as an independent predictor of conduction disturbances and pacemaker need. Our association between anatomic features and electrical outcomes underscores the mechanistic link between structural calcification, device-septal contact, and conduction injury noted in these studies.

With respect to calcification severity, our cohort included 46.7% with mild and 53.3% with ≥ moderate calcification. Radiation exposure was significantly higher in patients with ≥ moderate calcification ($P = 0.011$), whereas all other CT, procedural, and clinical parameters were comparable. This observation aligns with Christakopoulos et al. [23] and Michael et al. [24], who showed that increased anatomic complexity and calcium burden correlate with greater fluoroscopic time and radiation dose. In contrast, prior reports such as Gorla et al. [25] and Okuno et al. [26] demonstrated that heavier annular or LVOT calcification was associated with reduced device success and higher rates of paravalvular leak or annular rupture. The absence of such differences in our series may reflect the refinement of current valve systems and procedural planning.

After one year, complication rates—including mortality, stroke, myocardial infarction, and mechanical trauma–related events—remained low and statistically unchanged across follow-up points, consistent with the favorable outcomes reported by John et al. [8], Ullah et al. [19], and Akin et al. [13] in contemporary TAVI populations. Logistic regression in our study did not identify independent predictors of complications, emphasizing that outcomes depend on a multifactorial interplay between patient comorbidities, valve morphology, and procedural technique. Comparable findings were presented by Pollari et al. [27], who linked LVOT calcium load to adverse events, and by Christakopoulos et al. [23], who highlighted BMI and calcification as predictors of higher radiation dose and procedural complexity.

This study was limited by its relatively small sample size and single-center design, which may restrict the generalizability of its findings. The one-year follow-up period may not fully capture late electrical or mechanical complications after TAVI. In addition, the absence of a comparison group with surgical aortic valve replacement or alternative TAVI techniques limits contextual interpretation of predictors. Finally, the lack of advanced imaging modalities such as cardiac MRI precluded further assessment of myocardial injury or fibrosis.

CONCLUSION

TAVI is associated with electrophysiological changes, including prolonged PR interval, QRS duration, AH interval, and decreased aortic valve gradients. Additionally, LBBB was more frequent after the procedure. Furthermore, higher AVCS were associated with the development of complete AV block, while complication rates following TAVI were relatively low.

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