

Thrombocytopenia Following Trans-Catheter Aortic Valve Implantation: Predictors and Clinical Impact

Andaleeb Khan, Muhammad Nadir Khan, Waheed ur Rehman, Ali Muhammad, Adeel Ahmed, Gulzar Ali

Department of Adult Cardiology, Armed Forces Institute of Cardiology, Rawalpindi/National Institute of Heart Diseases/
National University of Medical Sciences (NUMS) Pakistan

ABSTRACT

Objective: To identify the factors associated with thrombocytopenia and to evaluate its clinical consequences among patients undergoing transcatheter aortic valve implantation (TAVI) at a tertiary cardiac care facility in Pakistan.

Study Design: longitudinal study.

Place and Duration of Study: Armed Forces Institute of Cardiology/National Institute of Heart Diseases (AFIC/NIHD), Rawalpindi, Pakistan; from March 2015 to September 2025.

Methodology: A total of 66 patients were included in the study. Patients aged ≥ 65 years with baseline platelet counts $\geq 100 \times 10^9/L$ were included. Thrombocytopenia was defined as $\geq 50\%$ fall from baseline or platelet count $< 150 \times 10^9/L$ within 72 hours post-procedure. Patients with pre-existing thrombocytopenia $< 100 \times 10^9/L$ or conditions that could affect platelet count, such as hematological disorders were excluded. Outcomes included thrombocytopenia, bleeding, acute kidney injury (AKI), vascular complications, hospital stay, and in-hospital mortality.

Results: Among 66 patients with a mean age of 73.00(69.75-78.00) years, 50(75.8%) were male, and thrombocytopenia occurred in 56 (84.8%) cases. Hemoglobin levels [aOR 3.36 (1.13-9.98) $p=0.02$], valve size [aOR 0.62 (0.38-1.01) $p=0.05$] and coronary artery disease [aOR 0.04 (0.001-1.11) $p=0.05$] were independently associated with the development of thrombocytopenia. This was significantly associated with AKI ($p=0.01$) and longer hospital stay ($p=0.04$) but showed no association with mortality or bleeding. **Conclusion:** Thrombocytopenia is a frequent post-TAVI finding, associated with AKI and prolonged hospitalization. Optimization of modifiable factors such as low hemoglobin, valve size and coronary artery disease may mitigate adverse outcomes.

Keywords: Aortic valve stenosis, Platelet count, Predictors, Thrombocytopenia, Transcatheter aortic valve implantation.

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INTRODUCTION

The treatment of severe aortic stenosis (AS) has been improved by transcatheter aortic valve implantation (TAVI), especially in patients who are considered inoperable or at high threat for surgical aortic valve replacement (SAVR).^{1,2} Since its first introduction in 2002, randomized trials have shown that TAVI improves survival and functional outcomes over conservative care.³

TAVI offers several advantages over conventional surgery, including reduced perioperative bleeding, shorter intensive care and hospital stay, and faster recovery.⁴ It has now become the standard of care for high-risk surgical patients and is increasingly being considered for intermediate and even low-risk patients.⁵

Post-TAVI thrombocytopenia is a well-recognized complication, typically within the first few

days after the procedure. A significant platelet-drop ($\geq 40-50\%$) has been known as an independent predictor of early adverse events, including increased 30-day mortality.⁶ Thrombocytopenia—a common post-cardiac surgery complication affecting up to 50% of patients is linked to increased morbidity, mortality, and longer hospital stays.⁷

Globally, post-TAVI thrombocytopenia occurs in ~15% of patients and is consistently associated with worse outcomes, including higher 30-day mortality and increased complication risk.¹ Given the less invasive nature of TAVI, a milder reduction in platelet counts would be expected; however, studies report post-TAVI thrombocytopenia in up to 35% of cases, with significant implications for short- and mid-term outcomes.⁸

Post-TAVI thrombocytopenia develops through several interrelated pathophysiological mechanisms, primarily involving increased platelet consumption and reduced platelet production. Despite its recognized clinical importance, there is a paucity of

Correspondence: Dr Andaleeb Khan, Department of Adult Cardiology, Armed Forces Institute of Cardiology, Rawalpindi Pakistan

data addressing this issue in Pakistan. The Armed Forces Institute of Cardiology/National Institute of Heart Diseases (AFIC/NIHD), Rawalpindi, performed the nation's first TAVI procedure and continues to maintain the largest procedural experience in the country. Thrombocytopenia following TAVI can complicate recovery, increase the likelihood of bleeding, and negatively influence clinical outcomes. Understanding its incidence, predictors, and clinical consequences in the local patient population may contribute to improved patient selection, risk stratification, and management strategies.

METHODOLOGY

An longitudinal study was conducted at the Armed Forces Institute of Cardiology, in collaboration with the National Institute of Heart Diseases (AFIC/NIHD), Rawalpindi, Pakistan. The study period spanned from March 2015 to September 2025, and approval obtained from the Institutional Ethical Review Board of the AFIC/NIHD, Rawalpindi (IERB Letter No. 9/2/R&D/2025/366, dated 26 June 2025). Data were collected using a non-probability consecutive sampling method.

Sample size estimation was performed with the World Health Organization (WHO) sample size calculation tool based on a reported prevalence of severe thrombocytopenia of 2.65% following transcatheter aortic valve implantation (TAVI). With a 95% confidence level and a 5% margin of error, the calculated minimum required sample size was 40 patients.⁹ The sample size is based upon all the procedures carried out during the study period, Mar 2015 to Sep 2025. Based on this timeline and institutional capacity, the sample size of 66 patients was included in study.

Inclusion Criteria: Patients aged 65 years or above who underwent TAVI during the study period and had documented platelet counts more than $\geq 100 \times 10^9/\text{L}$ pre-procedure.

Exclusion Criteria: Patients with pre-existing thrombocytopenia $< 100 \times 10^9/\text{L}$ or conditions that could affect platelet count, such as hematological disorders.

Patients' demographic data (age, BMI, and gender); clinical comorbidities (chronic kidney disease, hypertension, prior stroke, diabetes mellitus, atrial fibrillation, and coronary artery disease); laboratory

investigations (baseline platelet count, hemoglobin, white blood cell count, creatinine, and coagulation profile [PT, aPTT, INR]); and echocardiographic variables, including left ventricular ejection fraction and mean aortic valve pressure gradient, were recorded.

Detailed procedural data were collected, including the vascular access route, type and route of anesthesia planned (general vs conscious sedation), type and size of valve implanted, use of pre- or post-dilatation, contrast volume used, dose of heparin, duration of the procedure, hemodilution (blood product transfusion Intra-Operatively), intra-procedural complications such as vascular injury, bleeding, arrhythmia, need for conversion to open surgery and other peri-procedural complications.

Patients data monitored for post-procedural thrombocytopenia, defined as either a drop in platelet count $\geq 50\%$ from baseline or an absolute count $< 150 \times 10^9/\text{L}$, occurring within 72 hours post-TAVI.^{9,10} Platelet counts were measured at baseline, 24, 48, and 72 hours post-procedure, and at discharge. Any requirement for platelet transfusion, administration of blood products, or modification of anticoagulant or antiplatelet therapy was recorded. Percentage Decrease in Platelet Count (DPC) was calculated using formula $\text{DPC} = \frac{\text{Baseline Platelet Count} - \text{Nadir Platelet Count}}{\text{Baseline Platelet Count}} \times 100$. Postoperative complications including bleeding, vascular complications, acute kidney injury (AKI) and in-hospital mortality were also documented.

Statistical analysis was conducted using Statistical Package for the Social Sciences (SPSS) software version 23. Data normality was evaluated using the Shapiro-Wilk test. Continuous variables were summarized as Mean \pm SD for normally distributed data (hemoglobin, creatinine) and as median with interquartile range for non-normally distributed variables (age, LVEF). Categorical variables were presented as frequencies and percentages (gender, comorbidities). Comparisons between patients with and without thrombocytopenia were made using the chi-square test for categorical data and the Mann-Whitney U test for continuous variables. Binary logistic regression analysis was performed to determine independent predictors of thrombocytopenia. Statistical significance was defined as a *p*-value less than 0.05.

RESULTS

The study included 66 participants receiving TAVI. The average age was 73.00(69.75-78.00) years with majority of the population being male 50(75.8%). Trans femoral access approach was utilized in all patients under conscious sedation. Self-expanding Medtronic Evolut R CoreValve and Evolut Pro+ systems were used, with valve sizes distributed as follows: 34 mm in 12 patients 29 mm in 31 patients, 26 mm in 18 patients, , and 23 mm in 5 patients. The mean contrast volume was 341 mL per case (mean 5 mL/kg; range 200-500 mL), and the mean heparin dose was 6,947 IU per case (mean 105 IU/kg), maintaining an activated clotting time (ACT) of >250 seconds. Pre-dilatation was performed in 43 patients (65.15%), and post-dilatation in 23 patients (34.84%). Table-I summarizes the demographic, clinical, procedural, and baseline characteristics of the study population. Among the 66 patients who underwent TAVI, 10 did not develop thrombocytopenia, whereas 56 patients experienced thrombocytopenia of varying severity, as illustrated in Figure-1.

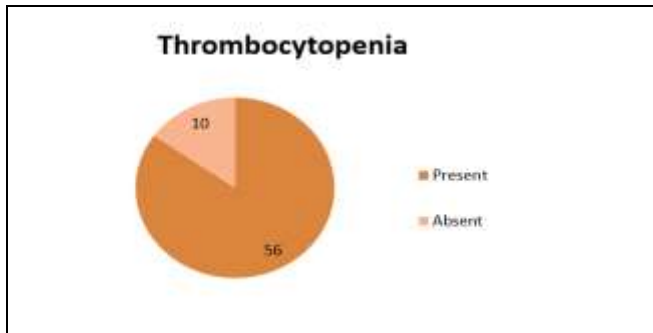


Figure-1: Prevalence of Post- Trans Catheter Aortic Valve Implantation Thrombocytopenia (n=66)

To further classify the severity, 21 patients developed mild thrombocytopenia, 26 had moderate, and 9 experienced severe thrombocytopenia, as shown in Figure-2.

Several factors that bore statistical significance related to post-TAVI thrombocytopenia, as noted at are shown in Table-II. Increased body weight, lower baseline hemoglobin, and valve size presented as significant risk factors with *p*-value <0.05. In the multivariate binary logistic analyses where hemoglobin levels [aOR 3.36 (1.13-9.98) *p*=0.02], valve size [aOR 0.62 (0.38-1.01) *p*=0.05] and coronary artery disease [aOR 0.04 (0.001-1.11) *p*=0.05] were retained as independent predictors, these would be considered potential controls. Other factors within the clinical,

demographic, and procedural contexts explored did not have a significant bearing on the stated outcome.

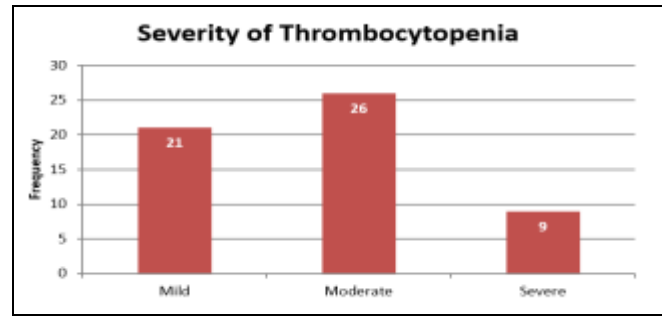


Figure-2: Severity of Post- Trans catheter Aortic Valve Implantation Thrombocytopenia (n=66)

The following table presents a comparison of clinical outcomes after TAVI between patients with thrombocytopenia and those without. A significant relationship between thrombocytopenia and acute kidney injury and thrombocytopenia was noted. However, no statistically significant differences were noted with regards to mortality, major bleeding, vascular complications, blood transfusion, and duration of stay in the ICU (Table-III).

Table-I: Baseline Characteristics of the Study Participants (n=66)

Characteristic		Median(IQR)
Demographics		
Age (years)		73.00(69.75-78.00)
		Frequency (%)
Gender	Male	50 (75.8%)
	Female	16(24.2%)
Comorbidities		
Hypertension		36(54.5%)
Coronary artery disease		35(53.0%)
Diabetes mellitus		32(48.5%)
Chronic kidney disease		18(27.3%)
Stroke		1(1.5%)
Echocardiographic parameters		Median(IQR)
Left ventricular ejection fraction (%)		55.00(40.00-60.00)
Mean aortic gradient (mmHg)		48.00(42.00-52.00)
Pre Procedural details		
Platelet Count (baseline)		185,000 (148,250-252,750)
Hemoglobin (g/dl) (Mean±SD)		12.61±1.82
Creatinine (Mean±SD)		1.14±0.30
Procedural details		
Contrast volume (mL)		350(300-400)
Heparin dose (IU)		7500(6000-8000)
Procedure time (min)		75.00(60.00-90.00)
Valve size (mm)		29(26-29)
		Frequency (%)
Prior balloon valvuloplasty		44 (66.7%)
Balloon post-dilatation		24 (36.4%)
Post procedure details		
		Median(IQR)
Early Nadir platelet count		96,500 (65,500-133,250)
Late Nadir platelet count		144,500 (102,250-187,250)
Thrombocytopenia	Present	56(84.8%)
	Absent	10(15.1%)

IQR = Interquartile Range, SD=standard deviation

Table-II: Predictors of Post- Trans Catheter Aortic Valve Implantation Thrombocytopenia (n = 66)

Variable	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age (years)	0.98 (0.87-1.10)	0.67	-	-
Weight (kg)	1.10 (1.02-1.19)	0.01*	1.14(0.95-1.37)	0.14
Height (cm)	1.04 (0.95-1.13)	0.41	-	-
LVEF (%)	0.95 (0.88-1.03)	0.20	-	-
Aortic valve area (cm ²)	1.17 (0.47-2.94)	0.74	-	-
Mean aortic gradient (mmHg)	1.12 (0.99-1.25)	0.06	-	-
Procedure time	1.08(1.01-1.15)	0.02*	1.00(0.84-1.18)	0.99
Haemoglobin (g/dL)	1.77 (1.10-2.84)	0.01*	3.36 (1.13-9.98)	0.02*
Creatinine (mg/dL)	3.92 (0.32-48.07)	0.28	-	-
Contrast volume (mL)	1.01 (1.00-1.02)	<0.001*	1.02(0.99-1.05)	0.12
Valve size	0.67 (0.52-0.86)	<0.001*	0.62 (0.38-1.01)	0.05*
Acute kidney injury (AKI)	0.10 (0.01-0.87)	0.03*	1.08(0.02-60.03)	0.96
Heparin dose (IU)	1.00 (1.00-1.00)	0.21	-	-
Gender	0.41 (0.09-1.69)	0.21	-	-
Diabetes Mellitus	1.07 (0.28-4.13)	0.91	-	-
Hypertension	0.29 (0.07-1.28)	0.10	-	-
CAD	0.17 (0.03-0.89)	0.03*	0.04 (0.001-1.11)	0.05*
Chronic Kidney Disease	0.63 (0.12-3.27)	0.57	-	-

CI = confidence interval; OR = odds ratio; * = significant variables (p < 0.05);CAD=coronary artery disease

Table-III: Association of Thrombocytopenia with In-Hospital Outcomes (n = 66)

Outcome	Thrombocytopenia n (%)		p-value
	Yes(n=6)	No(n=10)	
In-hospital mortality	Yes	7(10.6%)	0.82
	No	49(74.2%)	
Acute kidney injury (AKI)	Yes	29(43.9%)	0.01*
	No	27(40.9%)	
Major bleeding	Yes	7(10.6%)	0.23
	No	49(74.2%)	
Vascular complication	Yes	8(12%)	0.20
	No	48(72.7%)	
Blood transfusion	Yes	17(25.7%)	0.38
	No	39(59%)	
Median (IQR)			
Length of ICU stay (days)	2.0 (1.0-3.0)	1.0 (1.0-1.0)	0.06
Length of hospital stay (days)	4.0 (3.0-6.0)	3.0 (2.0-3.0)	0.04*

IQR = Interquartile Range

DISCUSSION

This study evaluated the predictors and clinical impact of thrombocytopenia following transcatheter aortic valve implantation (TAVI) in Pakistan, representing one of the first analyses of its kind from the region. In this study, 56(84.84%) of patients developed post-TAVI thrombocytopenia, with 31.81% mild, 39.39% moderate, and 13.63% severe cases. Notably, 34(51.5%) of patients experienced a >50%

reduction in platelet count, highlighting the high magnitude of platelet decline in our study. Internationally, large registries report lower rates of severe platelet drops: in the multicenter OBSERVANT-TAVI registry, 14.8% of patients had a ≥50% decrease in platelet count post-TAVI, with early nadir in 61.5% and late nadir in 38.5%.^{11,12} Similarly, a single-center study by Dvir *et al.*, reported a 25-30% incidence of >50% platelet drop post-TAVI.¹³ These comparisons suggest that our population may have unique patient or procedural risk factors contributing to a higher frequency of significant thrombocytopenia.

In our multivariate analysis, hemoglobin level [aOR 3.36 (1.13-9.98), p=0.02], valve size [aOR 0.62 (0.38-1.01), p=0.05], and the presence of coronary artery disease (CAD) [aOR 0.04 (0.001-1.11), p=0.05] emerged as independent predictors of thrombocytopenia. These results are in line with previous literature. Mangner *et al.*, reported that procedural factors, including contrast volume and device manipulation, significantly contribute to early platelet reduction.¹⁴ The observed inverse relationship with baseline hemoglobin supports the notion that hemodilution or diminished marrow reserve may aggravate post-TAVI thrombocytopenia.¹⁵

Clinically, our study demonstrated a significant association between thrombocytopenia and acute kidney injury (43.9% vs 1.5%, p=0.01), as well as longer hospital stay (median 4 days vs 3 days, p=0.04). No significant differences were observed between groups in terms of in-hospital mortality (10.6% vs. 1.5%, p=0.82), major bleeding, vascular complications, or the need for blood transfusion. These results are consistent with international reports, where acute kidney injury (AKI) following TAVI has been reported in 25-35% of patients and is consistently linked to prolonged hospitalization and poorer clinical outcomes.¹⁶

Data on post-TAVI thrombocytopenia remain limited at the national level. Nonetheless, available evidence indicates considerable platelet reductions among local patient populations. Siddiqui *et al.*, reported post-TAVI thrombocytopenia in 82% of patients at AFIC, Pakistan, showing patterns consistent with our findings.⁶ Similarly, studies in cardiac surgery cohorts have documented thrombocytopenia, defined as a >50% platelet drop, in 42.5% of patients at Aga Khan University,¹⁷ while AFIC/NIHD data revealed postoperative platelet declines of approximately 44% following CABG.¹⁸ These observations suggest that substantial platelet

reductions are not uncommon in invasive cardiovascular procedures in Pakistan and underscore the consistency of our results with prior national experience.

Overall, our findings highlight both the high incidence and clinical relevance of post-TAVI thrombocytopenia, particularly severe cases characterized by >50% platelet reductions. The identification of body weight, baseline hemoglobin, and contrast volume as independent predictors underscores the importance of thorough patient assessment and procedural optimization. Furthermore, the observed strong association with acute kidney injury emphasizes the need for vigilant monitoring and strategies to mitigate potential renal and hematologic complications. Given the scarcity of national data, additional multicenter studies are warranted to validate these findings and inform evidence-based management policies.

LIMITATIONS OF THE STUDY

This study was conducted at a single specialized cardiac center with a relatively modest sample size, which may limit the generalizability and statistical strength of the findings. The lack of platelet function testing and assessment of inflammatory or coagulation biomarkers restricts the ability to draw mechanistic conclusions. Additionally, only in-hospital outcomes were analyzed, preventing evaluation of long-term platelet recovery or delayed complications. The mixed retrospective-prospective design may also introduce the possibility of information bias. Future studies involving larger, multicenter cohorts with extended follow-up and comprehensive laboratory evaluation are warranted.

CONCLUSION

Post-TAVI thrombocytopenia is frequently observed during the early post-procedural period, affecting a considerable proportion of patients. In our study, low hemoglobin, valve size, and the presence of coronary artery disease emerged as significant predictors. While post-TAVI thrombocytopenia was not linked to early mortality, it was associated with acute kidney injury and prolonged hospitalization, underscoring its clinical relevance. Recognizing thrombocytopenia as an indirect indicator of procedural stress and inflammation highlights the need for careful peri-procedural management and optimization of modifiable risk factors.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

AK & MNK: Data acquisition, data analysis, critical review, approval of the final version to be published.

WR & AM: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

AA & GA: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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