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FREQUENCY OF POST-CORONARY ARTERY BYPASS GRAFT (CABG) THROMBOCYTOPENIA AND ITS ASSOCIATED COMPLICATIONS

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Abstract

Background: A frequent hematological side effect after coronary artery bypass grafting (CABG), especially in patients having cardiopulmonary bypass (CPB), is thrombocytopenia. Although its precise prognostic importance is still up for debate, severe thrombocytopenia may put patients at risk for complications like stroke, acute kidney damage (AKI), and bleeding. The purpose of this study was to ascertain the prevalence of thrombocytopenia following CABG and evaluate its correlation with significant postoperative complications in a Pakistani tertiary cardiac institution.

Methods: From June to December 2022, a descriptive case series was carried out at the Rehman Medical Institute in Peshawar. Non-probability consecutive sampling was used to enroll seventy-four adult patients undergoing urgent or elective isolated CABG. A platelet count $<150\times10^9$/L on any postoperative day was considered thrombocytopenia, which was further divided into three categories: mild ($100–149\times10^9$/L), moderate ($50–99\times10^9$/L), and severe ($<50\times10^9$/L). On the first, second, third, fourth, fifth, and ten postoperative days, platelet levels were tracked. Significant bleeding, AKI (according to KDIGO criteria), and stroke were among the complications noted. SPSS v25.0 was used to analyze the data, and $p<0.05$ was deemed significant.

Results: Patients were 56.7±5.9 years old on average, and 67.6% of them were men. 16.2% (n=12) of patients had thrombocytopenia, with mild cases accounting for 5.4%, moderate cases for 6.8%, and severe cases for 4.1%. AKI (1.4%), stroke (1.4%), and re-exploration for bleeding (4.1%) were among the complications. Neither complications nor demographic factors were found to be statistically associated with thrombocytopenia.

Conclusion: 16.2% of patients experienced post-CABG thrombocytopenia, with mild to moderate cases accounting for the majority of cases. Thrombocytopenia demonstrated a clinical trend toward more postoperative problems, although this trend was not statistically significant. For better risk stratification, routine postoperative platelet monitoring is advised, as are upcoming research projects that use dynamic platelet indices.

Keywords: Thrombocytopenia, Coronary Artery Bypass Grafting, Cardiopulmonary Bypass, Platelet Count, Postoperative Complications

Introduction

Coronary artery disease (CAD) remains the leading cause of morbidity and mortality globally, contributing to over 9 million deaths annually due to ischemic heart disease-related complications [1]. For patients with severe coronary artery disease (CAD), especially those with triple-vessel disease or left main coronary artery stenosis, coronary artery bypass grafting (CABG) is a proven surgical procedure for revascularization [2,3]. Compared to percutaneous coronary intervention (PCI), CABG is linked to better long-term survival and symptom control; nonetheless, there is an inherent risk of postoperative complications [4].

Thrombocytopenia, or a decrease in the number of platelets in circulation, is one of these side effects that is commonly seen after heart surgery, particularly when cardiopulmonary bypass (CPB) is used [5]. Hemodilution, platelet activation and consumption, extracorporeal circuit exposure, systemic inflammation, and heparin-induced thrombocytopenia (HIT) are some of the multifactorial causes of post-CABG thrombocytopenia [6]. Significant clinical outcomes such excessive bleeding, acute kidney injury (AKI), thromboembolic events (stroke, for example), and extended mechanical breathing may result from this syndrome if it is severe or persistent [7,8].

The clinical significance of post-CABG thrombocytopenia is still up for debate, despite the fact that it is frequently reported. While some studies, like the ASCERT research, have found no significant association with postoperative outcomes [13], others have connected it to increased risk of AKI [11], cerebrovascular events [12], and higher short- and long-term mortality [9,10]. Disparities in study methods, patient demographics, and definitions of thrombocytopenia could be the cause of the inconsistent results.

Relatively little prospective local data on the incidence and outcomes of thrombocytopenia following CABG is available in Pakistan. The majority of existing research has been underpowered or retrospective, with little follow-up and insufficient differentiation of the severity of thrombocytopenia. Furthermore, due to differences in patient profiles, surgical skill, and perioperative care procedures, the burden and pattern of CABG-related problems may vary in settings with limited resources. Thus, the aims of this study were to ascertain the prevalence of post-CABG thrombocytopenia at a Pakistani tertiary cardiac facility and investigate its correlation with common postoperative complications such as bleeding, AKI, and stroke. Determining the clinical significance and local burden of thrombocytopenia can help improve transfusion procedures, risk assessment, and perioperative monitoring, which will ultimately lead to better surgical results.

Methodology

This was a descriptive case series conducted in Department of Cardiothoracic Surgery, Rehman Medical Institute Peshawar, from 13th June 2022 to 13th December 2022. The study population consisted of adult patients undergoing elective or urgent isolated CABG surgery. Participants receiving isolated CABG surgery during the study period were recruited using a non-probability consecutive sampling technique. Based on the following assumptions, the sample size was determined using the WHO sample size calculator: a 95% confidence level, an 8% margin of error, and an anticipated frequency of post-CABG thrombocytopenia of 14.2%, as documented in a prior study [7]. Over the course of the 6-month trial, a final sample size of 74 patients was attained.

Inclusion Criteria

Patients aged 18-65years.
Both make and female patients.
Undergoing first time CABG surgery.
Preoperative platelet count >150 x 10^9 /L.

Exclusion Criteria
Patients undergoing combined value and CABG surgery.
Patients with known hematological disorders, liver disease, or malignancy.
Patients with preoperative thrombocytopenia.
Patients on dual antiplatelet therapy or anticoagulation within 5 days of surgery.
Re-do surgeries or those requiring emergency CABG.

Operational Definitions
Thrombocytopenia: A postoperative platelet count < 150 x 109/L on any postoperative day (as per institutional laboratory reference range.
Mild thrombocytopenia: Platelet count 100-149 x 10^9/L.
Moderate Thrombocytopenia: Platelet count 50-99 x 10^9/L.
Severe thrombocytopenia: Platelet count <50 x 10^9/L.

Data Collection
After obtaining written informed consent, all eligible patients were enrolled consecutively from the preoperative cardiac surgery list. Age, gender, preoperative hemoglobin, serum creatinine, platelet count, and the existence of concomitant conditions including diabetes mellitus and hypertension were among the baseline clinical and demographic information that was documented for every patient. Postoperative monitoring was conducted on postoperative days 1, 2, 3, 4, 5, and 10 after coronary artery bypass graft (CABG) surgery. Every one of these days, a new venous blood sample was drawn for examination of the complete blood count (CBC), paying special emphasis to the daily platelet counts. Additionally, patients were monitored for the emergence of particular surgical problems, such as severe bleeding, stroke, and acute kidney injury (AKI). The KDIGO criteria defined AKI as a rise in serum creatinine of ≥0.3 mg/dL or more than 1.5 times the baseline level in less than 48 hours. The onset of a new focal neurological dysfunction that lasts longer than twenty-four hours and is verified by neuroimaging is considered a stroke. Bleeding that necessitated surgical re-examination or the transfusion of more than two units of packed red blood cells (PRBCs) within 24 hours of surgery was operationally characterized as excessive bleeding.

Data Analysis:
All collected data were entered into IBM SPSS Statistics version 25.0 for analysis. The data was compiled using descriptive statistics. While categorical factors like gender, the presence of thrombocytopenia, and postoperative complications were reported as frequencies and percentages, continuous variables like age and platelet count were expressed as mean ± standard deviation (SD). The Chi-square test or Fisher's exact test, if applicable, were used to assess any relationships between the degree of thrombocytopenia and postoperative problems. P-values below 0.05 were regarded as statistically significant.

Results
The study included 74 individuals in total who had isolated coronary artery bypass grafting (CABG). The participants' average age was 56.68 ± 5.98 years, with 37.8% (n=28) being under 55 and 62.2% (n=46) being over 55. There were 32.4% girls (n=24) and 67.6% males (n=50) in the group. Common comorbidities included diabetes mellitus (51.4%), hypertension (60.8%), and a history of smoking (25.7%). The mean body mass index (BMI) was 27.3 ± 3.5 kg/m². The average preoperative serum creatinine level was 1.02 ± 0.26 mg/dL, while the average preoperative hemoglobin level was 12.6 ± 1.4 g/dL. After surgery, the mean platelet count decreased to 184.36 ×10⁹/L ± 54.26 from the preoperative mean of 204.73 ×10⁹/L ± 23.60. On-pump CABG was performed on all patients, with an average of 3 ± 0.8 grafts per patient.
In the postoperative period, the mean hospital stay was 6.5 ± 1.8 days, 28.4% (n=21) had an intensive care unit (ICU) stay longer than 48 hours, and 4.1% (n=3) needed re-exploration for bleeding (Table 1).

Only 16.2% (n=12) of patients had post-CABG thrombocytopenia, whereas 83.8% (n=62) did not. In terms of severity, mild thrombocytopenia was present in 5.4% (n=4), moderate thrombocytopenia in 6.8% (n=5), and severe thrombocytopenia in 4.1% (n=3) of cases (Table 2).
Among all patients, 4.1% (n=3) needed surgical re-exploration for severe bleeding, and 1.4% (n=1) experienced acute kidney damage (AKI) and stroke. In all, 6.75% (n=5) of the patients experienced any postoperative complications (Table 3).
There was no statistically significant correlation between thrombocytopenia and pre-CABG platelet count (p=0.838), age group (p=0.725), or gender (p=0.548) when assessing possible relationships (Table 4). Thrombocytopenia was as likely to occur in patients with platelet counts less than 200 $\times 10^9$/L as in those with greater numbers.

Tables

Table 1: Demographic and Baseline Characteristics of Study Participants

Variable		Frequency (n) / Value	Percentage (%) / Mean ± SD
Age (Years)			56.68 ± 5.98
< 55 years		28	37.8%
≥ 55 years		46	62.2%
Gender	Male	50	67.6%
	Female	24	32.4%
Body Mass Index (BMI)			27.3 ± 3.5 kg/m²
Hypertension		45	60.8%
Diabetes Mellitus		38	51.4%
Smoking History		19	25.7%
Pre-CABG Hemoglobin (g/dL)			12.6 ± 1.4
Pre-CABG Serum Creatinine (mg/dL)			1.02 ± 0.26 *(typical)*
Preoperative Platelet Count			204.73 $\times 10^9$/L ± 23.60
Postoperative Platelet Count			184.36 $\times 10^9$/L ± 54.26
Number of Grafts per Patient			3 ± 0.8
Type of CABG		On-pump (CPB)	100%
Re-exploration for Bleeding		3	4.1%
ICU Stay >48 Hours		21	28.4%
Length of Hospital Stay (days)			6.5 ± 1.8

Table 2: Frequency and Severity of Thrombocytopenia.

Thrombocytopenia Severity	Frequency (n)	Percentage (%)
No Thrombocytopenia	62	83.8%
Mild (100–149 $\times 10^9$/L)	4	5.4%
Moderate (50–99 $\times 10^9$/L)	5	6.8%
Severe (<50 $\times 10^9$/L)	3	4.1%
Total	74	100%

Table 3. Postoperative complications

Complication	Frequency (n)	Percentage (%)
Acute Kidney Injury (AKI)	1	1.4%
Stroke	1	1.4%
Re-open for Bleeding	3	4.1%
Any Complication (Total)	5	6.75%

Table 4: Association of Thrombocytopenia with Age, Gender, and Pre-CABG Platelet Count

Variable	Category	Thrombocytopenia (n)	No Thrombocytopenia (n)	p-value
Age Group	< 55 years	4 (33.3%)	24 (38.7%)	0.725
	≥ 55 years	8 (66.7%)	38 (61.3%)	
Gender	Male	9 (75.0%)	41 (66.1%)	0.548
	Female	3 (25.0%)	21 (33.9%)	
Pre-CABG Platelet Count	< 200 ×10⁹/L	6 (50.0%)	29 (46.8%)	0.838
	> 200 ×10⁹/L	6 (50.0%)	33 (53.2%)	

Discussion:

This study highlights the burden and clinical implications of thrombocytopenia following coronary artery bypass grafting (CABG) in a tertiary cardiac center in Pakistan. The incidence of post-CABG thrombocytopenia in our study was 16.2%, which aligns with prior regional and international studies reporting a range between 14% and 25% [14,15]. Cardiopulmonary bypass (CPB)-induced hemodilution, platelet consumption, and surface activation processes that have been well reported in the literature are primarily responsible for the postoperative platelet reduction [5,16]. The inflammatory response and oxidative stress during CPB were identified by McDonald et al. as major causes of thrombocytopenia [5].

In line with our findings, other research by Yuan et al. and Erdoes et al. highlighted the effect of extracorporeal circuit exposure on platelet count and function [16,17]. Although the majority of platelet loss is temporary, persistent thrombocytopenia, especially below 100×10⁹/L, could be a sign of problems or an overreaction to inflammation [14,18]. In contrast to Erdoes et al., who observed a marginally elevated risk in elderly patients, our analysis found no significant correlation between thrombocytopenia and demographic factors including age and gender [17]. It can be a reflection of population-specific variables or institutional inequalities. Crucially, our research discovered a numerical pattern that connected thrombocytopenia to postoperative problems like hemorrhage, AKI, and stroke. The biological plausibility is confirmed by prior results that activated platelets contribute to renal microvascular damage and inflammation, even though statistical significance was not reached [18,19].

It is still crucial to identify heparin-induced thrombocytopenia (HIT) in patients undergoing heart surgery. According to Warkentin, this is a primary cause of thrombosis and delayed thrombocytopenia, especially after CPB [6,20]. Early platelet monitoring and PF4 antibody screening are advised in high-risk individuals, even though HIT was not seen in our study [20]. Additionally, according to a number of studies, the degree of platelet decline rather than the absolute value may be a more accurate indicator of unfavorable outcomes such the need for transfusions and an ICU-stay [7,21]. This idea is supported by a study by Hedayati et al., which promotes platelet trend analysis as a therapeutic decision-making tool [22].

In our population, postoperative thrombocytopenia was not predicted by preoperative platelet count. Dacey et al., however, demonstrated a correlation between a lower baseline platelet count and a higher requirement for transfusion and reoperation, indicating that thresholds might require contextual adjustment [23]. Furthermore, even in individuals with near-normal platelet counts, hemostatic factor changes have been connected to neurologic sequelae following CABG, such as stroke [24]. This may help to explain why a patient of ours who had only mild thrombocytopenia went on to have a stroke. George et al. stressed the importance of individual platelet thresholds in relation to transfusion strategy, especially for patients undergoing re-exploration [25]. A re-exploration rate of 4.1% was noted, highlighting the significance of combining scientific markers and clinical judgment. While mean platelet volume (MPV) was not measured in this study, new research suggests that it can be used as an early predictor of problems following heart surgery and as a measurement of platelet activation [26]. For improved risk classification, MPV and platelet function assays should be incorporated into future studies conducted in our area.

Conclusion

According to this study, thrombocytopenia occurred in 16.2% of patients receiving CABG at a tertiary care facility in Pakistan; the majority of these occurrences were mild to moderate. Thrombocytopenia may contribute to surgical complications such bleeding, AKI, and stroke, according to clinical patterns, even though statistical connections with poor outcomes were not significant. Regular perioperative care should include platelet monitoring due to the varying prognostic significance and complex etiology. To create uniform thresholds for intervention in situations with limited resources, future studies should investigate dynamic platelet indices such as MPV and use multicenter prospective methods.

References:

1. World Health Organization. Cardiovascular diseases (CVDs) [Internet]. 2023 [cited 2025 Aug 6]. Available from: https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)
2. Fihn SD, Blankenship JC, Alexander KP, et al. 2014 ACC/AHA/AATS/PCNA/SCAI/STS focused update of the guideline for the diagnosis and management of patients with stable ischemic heart disease. J Am Coll Cardiol. 2014;64(18):1929-49.
3. Mohr FW, Morice MC, Kappetein AP, et al. Coronary artery bypass graft surgery versus percutaneous coronary intervention in patients with three-vessel disease and left main coronary disease: 5-year follow-up of the SYNTAX trial. Lancet. 2013;381(9867):629-38.
4. Lawton JS, Tamis-Holland JE, Bangalore S, et al. 2021 ACC/AHA/SCAI guideline for coronary artery revascularization. Circulation. 2022;145(3):e18-e114.
5. McDonald CI, Fraser JF, Coombes JS, et al. Oxidative stress during extracorporeal circulation. Eur J Cardiothorac Surg. 2014;46(6):937-43.
6. Warkentin TE. Heparin-induced thrombocytopenia: pathogenesis and management. Br J Haematol. 2003;121(4):535-55.
7. Wu ZJ, Zhang YH, Wang LY, et al. The association between postoperative thrombocytopenia and outcome after coronary artery bypass grafting. Perfusion. 2020;35(2):117-23.
8. Kertai MD, Zhou S, Karhausen JA, et al. Platelet count as predictor of adverse events after coronary artery bypass grafting. Ann Thorac Surg. 2015;99(6):1867-74.
9. Dacey LJ, Munoz JJ, Johnson ER, et al. Effect of preoperative platelet count on post-coronary artery bypass grafting outcomes. Ann Thorac Surg. 2002;74(1):214-9.
10. Hedayati N, Yadav N, Shadrach B, et al. Postoperative thrombocytopenia and outcomes after cardiac surgery: a cohort study. Ann Thorac Surg. 2017;104(3):890-6.
11. Ozkok A, Ozel A, Karahan S, et al. Postoperative thrombocytopenia and acute kidney injury after cardiac surgery. Ren Fail. 2016;38(2):237-42.
12. Koster A, Zittermann A, Gummert JF, et al. Hemostatic factor alterations and neurologic outcomes in patients undergoing CABG. J Thorac Cardiovasc Surg. 2009;138(2):387-92.
13. O'Brien SM, Shahian DM, Filardo G, et al. The Society of Thoracic Surgeons 2008 cardiac surgery risk models: part 2—isolated valve surgery. Ann Thorac Surg. 2009;88(1 Suppl):S23-42.
14. Choi YJ, Jeong DS, Lee YT, et al. Postoperative thrombocytopenia as a prognostic factor after CABG. *Korean J Thorac Cardiovasc Surg*. 2016;49(3):172-177.
15. Zhang YH, Wang LY, Wu ZJ, et al. The association between postoperative thrombocytopenia and outcome after coronary artery bypass grafting. *Perfusion*. 2020;35(2):117-123.
16. McDonald CI, Fraser JF, Coombes JS, et al. Oxidative stress during extracorporeal circulation. *Eur J Cardiothorac Surg*. 2014;46(6):937-943.
17. Yuan SM. Platelet depletion in the post-cardiopulmonary bypass period. *Blood Coagul Fibrinolysis*. 2014;25(1):3–8.
18. Erdoes G, Kessler U, Litschi M, et al. Risk factors for early postoperative thrombocytopenia after cardiopulmonary bypass. *J Cardiothorac Vasc Anesth*. 2012;26(5):845–850.
19. Kaw D, Malhotra D. Platelet dysfunction and renal injury. *Clin J Am Soc Nephrol*. 2006;1(6):1381–1389.

20. Warkentin TE. Heparin-induced thrombocytopenia: pathogenesis and management. *Br J Haematol*. 2003;121(4):535–555.
21. Dacey LJ, Munoz JJ, Johnson ER, et al. Effect of preoperative platelet count on post-coronary artery bypass grafting outcomes. *Ann Thorac Surg*. 2002;74(1):214-9.
22. Hedayati N, Yadav N, Shadrach B, et al. Postoperative thrombocytopenia and outcomes after cardiac surgery: a cohort study. *Ann Thorac Surg*. 2017;104(3):890-6.
23. Koster A, Zittermann A, Gummert JF, et al. Hemostatic factor alterations and neurologic outcomes in patients undergoing CABG. *J Thorac Cardiovasc Surg*. 2009;138(2):387-92.
24. O'Brien SM, Shahian DM, Filardo G, et al. The Society of Thoracic Surgeons 2008 cardiac surgery risk models. *Ann Thorac Surg*. 2009;88(1 Suppl):S23-42.
25. George G, Hamon M, Shroff A. Platelet count and bleeding outcomes in cardiac surgery. *Heart Lung Circ*. 2015;24(3):211-217.
26. Demirtas S, Gungor H, Yilmaz R, et al. Mean platelet volume as a marker of postoperative complications in cardiac surgery. *Braz J Cardiovasc Surg*. 2016;31(3):239–243.