Impact of Thrombus Burden in Patients with Acute Coronary Syndrome during Hospital Stay: A Cross-Sectional Study at a Tertiary Center in Nepal

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ABSTRACT

Introduction

Luminal thrombus secondary to coronary plaque rupture is considered as the underlying mechanism for ACS. Intracoronary thrombus burden is a strong predictor for adverse outcomes including stent thrombosis, myocardial re-infarction, and mortality. The main objective of the study was to find the impact of thrombus burden during hospital stay in patients with acute coronary syndrome

Methods

This cross-sectional observational study was conducted at the Manmohan Cardiothoracic Vascular and Transplant Center from June 2024 to October 2024. Information on intracoronary thrombus, cardiovascular risk factors and comorbidities was obtained and analysis was done with respect to thrombus grade. Adverse cardiovascular outcomes during hospital stay, length of hospital stay and in-hospital mortality were analyzed with respect to thrombus grade. Data analysis performed using IBM SPSS Statistics 29.

Results

Among 72 patients studied, the mean age was 58.93 (±14.22 years). Males were 36.1% while 63.9% were females. Regarding the comorbidities, 62.5% were hypertensive and 34.7% were diabetic; 38.9% were active smokers, 15.3% were former smokers, 34.7% were alcohol consumer, 5.6% were tobacco consumer and 1.4% were substance abusers. Among the participants, 6.9% had prior history of myocardial infarction and 4.2% had prior history of stroke. High thrombus burden was associated with longer duration of hospital stay (p-value=0.026).

Conclusion

Higher thrombus burden was associated with longer hospital stays, greater mortality, and more cardiovascular complications. Risk factors such as smoking, hypertension, and diabetes mellitus were more common in patients with a high thrombus burden.

Keywords

Acute coronary syndrome; coronary angiography; thrombus burden

INTRODUCTION

Acute coronary syndrome (ACS) is the leading cardiovascular cause of mortality and requires early diagnosis and treatment. Thrombus is considered as occlusive when it completely blocks the lumen of the artery by naked eye examination.[1]

The underlying mechanism for ACS is considered to be a luminal thrombus secondary to coronary plaque rupture. Preprocedural thrombus was present in 15% of moderate- and high-risk patients with ACS, and intracoronary thrombus burden was a strong predictor for adverse outcomes including stent thrombosis, myocardial re-infarction, and mortality.[2] High and low thrombus burden is defined based on evaluation by coronary angiography, by scores associated with angiographic morphological characteristics, and by Thrombolysis in Myocardial Infarction (TIMI) Risk Scores: TIMI grade 4-5 and TIMI grade 1-3, respectively.[3] In the case of acute myocardial infarction, restoration of coronary flow in the infarct-related artery by PCI reduces the myocardial injury and improves ventricular function and long-term outcomes. However, in the case of a higher thrombotic burden in a coronary artery, despite the restoration of coronary flow, myocardial salvage is reduced.

ACS is the most common cause of death worldwide.[4] In Nepal, there is little research on the thrombus load in ACS patients while they are in the hospital. By examining predictors like smoking, diabetes, and hypertension and their effects on outcomes including heart failure, arrhythmias, hospitalization, and mortality, this study seeks to supply data for future investigations. The objective of the study is to find the impact of thrombus burden during the hospital stay in patients with acute coronary syndrome.

METHODS

This cross-sectional observational study was carried out at the Cardiology Department of Manmohan Cardiothoracic Vascular and Transplant Center (MCVTC) from June 2024 to October 2024. Ethical approval was obtained from the Institutional Review Committee of Institute of Medicine and informed consent was taken from all participants after explaining the study purpose, procedures, and potential risks. The study included patients diagnosed with ACS, specifically those with unstable angina, non-ST elevation myocardial infarction (NSTEMI), and ST elevation myocardial infarction (STEMI), who underwent coronary angiography and were admitted to MCVTC. Patients with a history of coronary artery bypass grafting (CABG), significant comorbidities such as active cancer or terminal illnesses, were excluded from the study.

The sample size was calculated using the formula $n = Z^2p(1-p)/d^2$, considering a 95% confidence interval (Z=1.96), an expected prevalence (p) of 5%, and a precision (d) of 0.05, resulting in 72 participants; purposive non-probability sampling was used. Data were collected using a detailed questionnaire covering demographic and clinical information among the patient admitted at MCVTC. Statistical analysis included descriptive statistics (mean and standard deviation), chi-square tests for categorical variables, and t-tests for continuous variables to assess the association between thrombus burden and clinical factors, with data analysis performed using IBM SPSS Statistics 29.

Using TIMI, the thrombus burden was evaluated during angiography. This is the grading system for the thrombus load:[5]
- Grade 0: No thrombus-related angiographic feature
- Grade 1: Uneven lesion shape, decreased density, and haziness could all be signs of thrombus.
- Grade 2: A distinct thrombus with substantial filling flaws, the greatest of which is half the vessel's diameter;
- Grade 3: A distinct thrombus with a maximum diameter that is greater than ½ to less than 2 vessel diameters
- Grade 4: A noticeable, massive thrombus with a maximum size larger than two vessel diameters
- Grade 5: Total thrombotic occlusion, which is characterized by a convex border that stains with contrast and lasts for many cardiac cycles

RESULTS

Among the 72 patients studied, the highest number of patients had TIMI 5 thrombus burden, whereas the lowest had TIMI grades 1 and 2 (Figure 1).
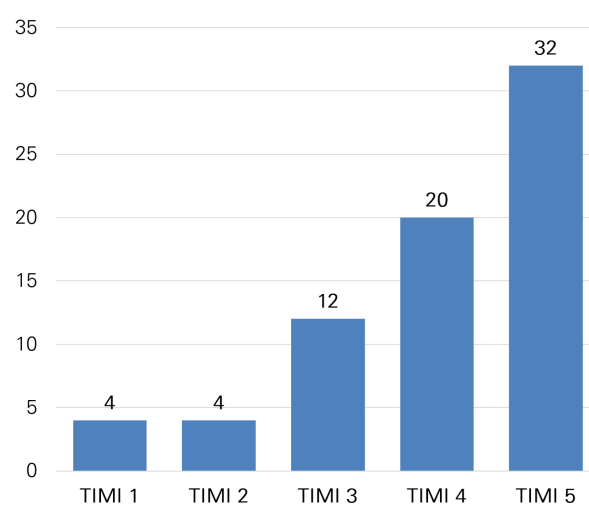
Cardiovascular adverse outcomes, including heart

Figure 1. Thrombus burden grading

Table 1. Cardiovascular outcomes in relation to thrombus grade

Outcomes	Overall	Thrombus burden		p value
		Low	High	
Heart failure	8	0	8	0.001
Ventricular tachycardia	8	1	7	0.048
Cardiogenic shock	5	0	5	0.003
Mortality	2	0	2	0.08

failure, ventricular tachycardia, and cardiogenic shock, were significantly higher among patients with a high thrombus burden (Table 1).

Regarding hospital stay, a higher thrombus grade was associated with longer duration of hospitalization, and two deaths were recorded during the study period (Table 2).

Table 2. Duration of hospital stay as per thrombus burden (thrombus grade)

Grade	Duration of hospital stay (days)					Total	p value
	1-3	4-5	6-7	7-9	>9		
1	0	3	0	0	1	4	
2	1	1	1	1	0	4	
3	2	5	1	3	1	12	0.27
4	0	12	3	3	2	20	
5	10	9	6	4	3	32	
Total	13	30	11	11	7	72	

Among the patients, 94.4% had chest pain at presentation 38.9% had dyspnea at presentation and 4.2% had syncope on presentation. During the hospital stay and treatment course, 5.6% had cardiac arrest, 11.1% had ventricular tachycardia, 2.8% were reported to have stroke, 5.6% had complete heart block, 11.1% had heart failure, 6.9% had cardiogenic shock, 5.6% received cardiopulmonary resuscitation (CPR) and 8.3% received direct current (DC) shock.

On angiographic assessment, 37.5% had single vessel disease, 30.6% had double vessel disease and 31.9% had triple vessel disease. Repeat revascularization done in 6.9% and 1.4% cases had vascular access complication reported. Staged revascularization for additional one vessel was done for 44.4% patients and of additional two vessel done for 5.6% patients. During angiography, 23.6% cases were done with the use of GpIIb/IIIa inhibitors.

Table 3. Cardiovascular risk factors in relation to thrombus grade

Risk factors	Overall	Thrombus burden		p value
		Low	High	
Non-modifiable risk factors				
Age				
<65	49	11	38	0.09
>=65	23	8	15	
Sex				
Male	26	6	20	0.31
Female	46	13	33	
Modifiable risk factors				
Smoking	39	7	32	0.049
Alcohol consumption	25	6	19	0.48
DM	24	7	17	0.49
HTN	45	9	36	0.11
Hypothyroidism	5	1	4	0.50

The mean age of the patients was 58.93±14.22 years, with a female predominance (Table 3). Hypertension and diabetes mellitus were the most common comorbidities. Also, hypothyrodism, smoking, alcohol consumption, and prior history of myocardial infarction were also notable among the participants.

DISCUSSION

In this study, a high thrombus burden i.e. TIMI grade 4 and 5 was found in 27.8% and 44.4% of patients with ACS. A higher thrombus burden was significantly associated with adverse cardiovascular events, including cardiogenic shock, ventricular tachycardia, heart failure, prolonged hospital stay, and increased in-hospital mortality. These findings emphasize the prognostic importance of thrombus burden evaluation in ACS patients. One of the largest challenges facing cardiac interventionists during primary PCI is massive intracoronary thrombus, even with the availability of dual antiplatelets, GP IIb/IIIa inhibitors, and efficient anticoagulation regimens.[6]

High thrombus burden was significantly associated with cardiogenic shock (p = 0.003), heart failure (p = 0.001), and ventricular tachycardia (p = 0.048) during hospital stay. This aligns with findings from Topaz et al.,[7] who suggested that massive thrombus hampers flow dynamics by adhering to atherosclerotic plaques, thus contributing to poor clinical outcomes.

Regarding risk factors, male gender, hypertension,

smoking, and hypothyroidism were associated with a higher thrombus burden in this study. Smoking was found to have a statistically significant correlation, while alcohol consumption did not show a significant association. These observations are consistent with prior findings by Topaz et al.[7] highlighting smoking as an important contributor to thrombus formation in ACS.

Diabetes mellitus was also linked to higher thrombus burden in our cohort, although statistical significance was limited, possibly due to small sample size. Hyperglycemia during acute MI can impair microvascular function and promote a prothrombotic state, as described by Chu et al.[8] Our findings suggest a similar trend, supporting the known role of metabolic dysfunction in thrombus pathophysiology.

In terms of hospital outcomes, patients with a high thrombus burden had significantly longer hospital stays (p = 0.026), similar to findings reported by Nozari et al.[9] Furthermore, in-hospital mortality was higher in the high thrombus burden group, likely secondary to severe adverse cardiovascular events such as cardiogenic shock, heart failure, and arrhythmias, consistent with results from Jolly et al.[10]

Use of glycoprotein IIb/IIIa inhibitors (GPI), was noted predominantly in patients with high thrombus grades in our study. Although GPIs have demonstrated benefits in restoring TIMI flow and thrombus resolution,[8] their use carries risks such as bleeding and thrombocytopenia, as highlighted by Winchester et al.[11] Despite these risks, GPIs remain an important adjunct therapy in patients with significant thrombus burden during PCI.

CONCLUSION

Higher thrombus burden was associated with longer hospital stays, greater mortality, and more cardiovascular complications. Risk factors such as smoking, hypertension, and diabetes mellitus were more common in patients with a high thrombus burden. Early identification and aggressive management of complications associated with high thrombus burden are essential to improve clinical outcomes in patients with acute myocardial infarction.

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CONFLICT OF INTEREST

Regarding the research, writing, and/or publication of this work, the author(s) affirm that they have no conflicts of interest.

AUTHOR CONTRIBUTIONS

Conceptualization: KRB, RMG, Methodology: KRB, HS, SD, Validation: CMP, SaT, BM, Formal analysis: RRK, SmS, SaS, PU, Original draft preparation: KRB, ShT, SJ, Review and editing: KRB, MM, PU, Supervision: RMG.

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