Original Paper

Effects of Preoperative Mean Platelet Volume on Early Outcomes of Patients after Conventional Coronary Artery Bypass Graft Surgery

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Abstract

Introduction: The Mean Platelet Volume (MPV) is a marker of platelet size with increased platelet activation. An elevated MPV is associated with major cardiac adverse events after Coronary Artery Bypass Graft (CABG) surgery. Effect of preoperative MPV on outcome of in-hospital patients after coronary artery bypass graft surgery was investigated in this study.

Objective: To investigate the association of preoperative MPV with in-hospital outcome of patients after CABG surgery.

Materials and Methods: An observational prospective study was carried out in the Department of Cardiovascular Surgery, National Institute of Cardiovascular Diseases (NICVD), Dhaka during the period from July 2012 to June 2014. Preoperative mean platelet volume was obtained prospectively in 81 consecutive patients undergoing conventional coronary artery bypass surgery. The patients were divided into two groups according to normal and elevated MPV at 10.60 femtolitre (fL) cut off level. Postoperative mortality and major adverse events were recorded in the early postoperative period.

Results: Combined adverse events including post operative Myocardial Infarction (MI), arrhythmia, bleeding and death occurred in 27 patients (33.3%) during the early follow-up. The preoperative mean platelet volume levels were found to be associated with postoperative adverse events ($p<0.05$). In multivariate logistic regression models, the preoperative mean platelet volume levels was found strong independent predictor of combined adverse events after surgery (OR 1.968, $p=0.008$).

Conclusion: Mean platelet volume is simple, readily available and cost effective tool and useful in predicting the postoperative adverse events in patients undergoing coronary artery bypass graft surgery.

Key-words: Conventional coronary artery bypass graft (CABG), Mean platelet volume (MPV), Early outcomes after CABG surgery.

Introduction

Recent advances in clinical laboratory techniques have opened new horizons for a better understanding of the role of platelets in thrombosis, immunity, inflammation and angiogenesis[1]. Platelets play a pivotal role in the development of atherosclerotic lesions, plaque destabilization, and atherothrombosis[2].

Assessment of platelet function with mean platelet volume (MPV) level gained popularity in recent years. The MPV is a marker of platelet size and activation. It is more reliable measurement of platelet function than the platelet count alone. Increased MPV reflects active and large platelets. Elevated levels of MPV have been demonstrated to be an independent predictor for ischemic vascular events, recurrent MI or death from coronary artery disease[3,4,5].

Coronary artery bypass graft (CABG) is the definitive surgical treatment of the coronary artery disease. In recent years, Overall mortality rate of coronary artery surgery is low, at around 2%–3%, although this benefit is offset by a complication rate[6] of 20%–30%.

There are limited data emphasizing the association of platelet activation with adverse outcomes following CABG[7]. Preoperative elevated MPV level was a strong independent predictor of combined adverse events, postoperative MI and major adverse cardiac events (MACE)[8]. Estimation of MPV is an easy and cost effective test. Therefore, within the single center registry of patients undergoing CABG surgery MPV was detected for prediction of outcome.

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Materials and methods

An observational prospective study was carried out in the Department of Cardiovascular Surgery, National Institute of Cardiovascular Diseases (NICVD), Dhaka during the period from July 2012 to June 2014. Purposive convenient sampling technique was employed and inclusion criteria was patient undergoing conventional CABG surgery during the specified period. Exclusion criteria included (1) emergent surgery, (2) redo CABG, (3) off-pump CABG, (4) myocardial infarction within a week, (5) preoperative severe anemia (hemoglobin level <10 g/dl and/or hematocrit level <30%), (6) Patients with poor LV function (LVEF<30%) and (7) patients with stroke.

The patients were divided into two groups according to normal and elevated MPV at 10.60 femtolitre (fL) cut off level. Baseline clinical details and preoperative mean platelet volume were obtained prospectively in 81 consecutive patients. Blood samples were analyzed by automated hematology analysis system "SYSMEX Analyzer", Model–XT1800i. All patients' samples were processed within 2 hours after venipuncture to avoid bias due to excessive platelet swelling[9].

Conventional CABG surgery was performed using standard procedures. Standard moderate hypothermic (30º-32ºC) cardiopulmonary bypass (CPB) used. Postoperative ACT was recorded after neutralization with Protamine and kept between 80-120 sec[10]. In all cases hemodynamic optimization was attempted by volume management, pacing support, catecholamines and other drugs administration when necessary. Postoperative mortality and major adverse events were recorded in the early postoperative period. Postoperative outcome variables were (1) Postoperative MI, (2) arrhythmia, (3) bleeding and (4) Death.

Results

Baseline characteristics were recorded in Table-I. Mean age of the studied patients were 53.22±7.88. Among them 70 were male and 11 were female. According toNew York Heart Association (NYHA) functional class 39(48.1%) were found class II and 42(51.9%) were class III. Maximum patients 69(85.2%) of this study had triple vessel disease and maximum patients 69(85.2%) were treated with 3 bypass grafts.

Table-I: Clinical and operative characteristics of patients

Characteristics		Group A (n=34)	Group B (n=47)	t-value	p v
Age		51.37±8.356	54.63±7.286	1.463	0.2
Sex	M	29	41	1.463*	0.2
	F	5	6		
LV EF %		57.97±4.260	56.72±6.908	4.003	0.
CPB time		135.85±19.158	145.64 ± 21.465	0.009	0.9
Bleeding		350.59±91.352	470.32±128.174	4.895	0

Group A=Pre-operative MPV< 10.6 fL, Group B=Pre-operative MPV≥ 10.6 fL; NS=Not significant, S=significant, M=Male, F=Female, *=x^2 test

Major adverse events observed early after CABG surgery is shown in table-II. Three patients (3.7%) died during hospital stay, 11 patients (13.5%) developed post operative myocardial Infarction (MI) and 09 patients (11.1%) developed post operative arrhythmia. Major post operative bleeding (>500 ml) occurred in 15(18.5%) study patients. Regarding post operative arrhythmia and post operative death no significant association found (p >0.05). Only strong association of post operative MI (p <0.05) and post operative bleeding (p <0.05) (OR 1.313, 95% CI 0.352 to 4.896 and OR 1.51, 95% CI 0.350 to 6.526 respectively).

Univariate analysis showed significant difference of left ventricular ejection fraction (LVEF%), Mean platelet volume (MPV) and total cardio pulmonary bypass time (CPB) found with adverse events (p=0.037, p=0.011, p=0.035 respectively).

Receiver operating characteristic curve (Fig-1) of the mean platelet volume (MPV) in the study sample for predicting post CABG adverse events demonstrated an area of 0.738 (95% CI, 0.621–0.855) under it. At 10.60 fL cut off point sensitivity 77.48% and specificity 63.6%.

Table-II: Adverse events observed in study patients

Characteristics	GroupA (n=34)	GroupB (n=47)	Total (n=81)	?2	p valu
Post – operative MI					
No	31	39	70	4.99	0.027
Yes	3	8	11		
Post operative arrhythmia					
No	31	41	72	0.04*	0.842
Yes	3	6	9		
Post operative state					
Alive	34	44	78	0.819*	0.365
Death	0	3	3		
Post operative bleeding					
Upto 500 ml	32	34	66	4.84*	**0.028**
>500 ml	2	13	15		

*=continuity correction. Group A=Pre-operative MPV< 10.6 fL, Group B= Pre-operative MPV≥ 10.6 fL; NS=Not significant, S=Significant

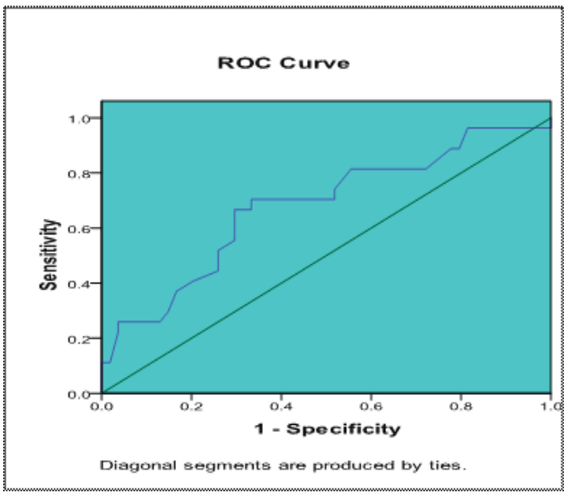

Fig-1: A receiver-operating characteristic (ROC) curve of MPV of the study sample for the prediction of post CABG adverse events.

In logistic regression analysis(Table-III) mean platelet volume found strong predictor of early major adverse event after CABG surgery (OR=1.968 including 95% CI 1.193 – 3.305 and p=0.008).

Table-III: Logistic regression analysis of multivariable predictors of post CABG adverse events

endent iable	Standardized Coeficient(β)	OR	95% CI	P value
nstant	-2.645	-	-	-
V (fL)	0.686	1.968	1.193 – 3.305	0.008[S]
EF%	-0.123	0.884	0.799-0.979	0.058[NS]
in min	0.010	1.010	0.979 -1.042	0.527[NS]
endent iable	**Standardized Coeficient(β)**	**OR**	**95% CI**	**P value**
nstant	-2.645	-	-	-
V (fL)	0.686	1.968	1.193 – 3.305	0.008[S]
EF%	-0.123	0.884	0.799-0.979	0.058[NS]
in min	0.010	1.010	0.979 -1.042	0.527[NS]

Discussion

Platelet activity is a major responsible process in atherothrombosis[2]. MPV level reflects the platelet production rate and activation. It is a more reliable measurement of platelet function than the platelet count alone. Elevated levels of MPV have been demonstrated to be an independent predictor for ischemic vascular events, recurrent MI or death from coronary artery disease[3,4,5]. Higher MPV levels have been also found to be associated with adverse outcome after acute coronary syndrome[11]. Therefore, increased MPV is a potentially useful biomarker for thromboembolic complications in cardiovascular disorders.

A total 34 patients who had MPV<10.60 fL were included in group A and a total of 47 patients who had MPV≥10.6 fL were included in group B. The mean age of the studied patients were 53.22±7.88 years ranging from 32 to 70 years. It was found that middle aged people were most commonly underwent CABG surgery in this study. Similar result was reported by Slavka et al[12] mentioned that after age of 50 years patients are most commonly suffered from ischemic heart disease.

During the follow-up after CABG operation, combined adverse events occurred in 27 patients (33.3%). This is an acceptable range of adverse events as it is estimated combined. Mortality rate was found3.7%. Statistically significant association of adverse events were found between group A and group B in the study population (p=0.011). Univariate analysis showed statistically significant difference of left ventricular ejection fraction (LVEF), Mean platelet volume (MPV) and total cardio pulmonary bypass time (CPB) with post CABG adverse events (p=0.037, p=0.011, p=0.035 respectively). Unal et al has shown statistically significant difference of MPV and total CPB time but no difference with LVEF[8].

Preoperative MPV level over 10.60 fL was associated and a strong independent predictor only with combined adverse events, postoperative MI and MACE. These outcomes of the study population were mainly composed of events that may be associated with thrombosis such as postoperative MI, reoperation, early repeat revascularization and mortality. This finding may indicate that the increased MPV value may show predisposition to thrombosis.Similar findings were observed in Unal et al study even in lower level of MPV that is 8.75 fL[8].

ROC curve of MPV for predicting post CABG adverse events at 10.60 fL cut off point showed sensitivity 77.48% and specificity 63.6%. This cut off point level will further guide us for predicting outcome. Chu et al3 has shown similar result of cut off point with sensitivity 78.6% and specificity 77.6%.

In logistic regression analysis mean platelet volume was found as a strong predictor of early postoperative major adverse events after CABG surgery (OR=1.968 including 95% CI 1.193–3.305 and p=0.008). This finding indicates the independent predictive value of the pre-operative MPV level with post-CABG adverse events.

Unal et al[8] has shown that preoperative MPV level remained a powerful independent predictor of early postoperative major adverse events after CABG surgery (OR 2.53, 95% CI 1.02 to 6.31, p=0.045).

MPV baseline values vary in different population groups and in different geographical areas[13]. There has always been a need to establish baseline haematological values of indigenous population. Due to lack of standard local reference values we rely on normal standards of western countries. Our aim was to establish reference MPV values for predicting early outcomes in our population group. During CABG surgery if we pay attention to this elevated MPV we could avoids adverse effects and save many lives.

Conclusion

Preoperative elevated MPV level was found a strong independent predictor only with combined adverse events. Mean platelet volume is an important, simple, readily available, and cost effective tool. MPV is obtained by routine investigation Complete Blood Count (CBC). CBC is done to every patient as a part of preoperative preparation and can be useful in predicting the postoperative adverse events in patients undergoing CABG surgery by MPV. So that early precaution can be taken for prevention of those adverse events and appropriate management can be arranged. Since the cause-and-effect relationship of thesemeasures and the outcome might be variable and we thought that this might be a subject of a different study. Further large scale comparative studies should be carried out in future for prediction analysis of MPV between conventional and off pump CABG (OPCABG) surgery.

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