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ORIGINAL ARTICLE RESEARCH

Assessment of platelet indices in patients with acute coronary syndrome in tertiary care center in central India: A cross-sectional study

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ABSTRACT

Background:Acute coronary syndrome (ACS) refers to a group of conditions due to decreased blood flow in the coronary arteries such that part of the heart muscle is unable to function properly or dies and that is a consequence of platelet rich coronary thrombus formation.**Objective:**Assessment of platelet indices in patients with ACS in tertiary care centre, also to assess platelet indices to predict in hospital outcome.

Methods: This is a prospective, cross-sectional study which was conducted in ICU of Medicine department in a tertiary care hospital and Medical College situated in the central India.

Results: Majority of the patients had platelet indices in normal range i.e., PC (66.67%), MPV (54.17%), PDW (76.04%), PCT (82.29%), P-LCR (64.58%)and P-LCC (58.33%). Some of the patients had reduced platelet indices i.e. PC (33.33%), MPV (7.29%), PDW (11.46%)and PCT (4.17%). Some of the patients had raised platelet indices i.e.MPV (38.54%), PDW (12.50%), PCT (13.54%), P-LCR (35.42%)and P-LCC (41.67%).

Majority of the patients had STEMI (72.92%) followed by UA (19.79%), and NSTEMI (7.29%). There was no significant association in type of ACS (STEMI, NSTEMI, and UA) with any of the platelet indices (all p-values > 0.05).There was no significant association between outcomes and any of the platelet indices (all p-values > 0.05).

Conclusion: Platelet indices are not significantly associated with ACS and in-hospital mortality . However, further studies with large sample size are required to confirm the findings of the present study.

Keywords: Platelet indices, Acute coronary syndrome, Association, Outcomes

INTRODUCTION

Acute coronary syndrome (ACS) involves a spectrum of coronary artery disease (CAD) from unstable angina to myocardial infarction (MI), both ST elevation MI (STEMI) and non-ST elevation MI (NSTEMI). CAD is mainly caused by atherosclerosis and its complications. Platelets and their activity play an important role in the initiation of atherosclerotic lesions and thrombus formation.[(1,2)] The Global estimate of age-standardized CVD death rate of 272 per 1,00,000 population in India is higher than the global average of 235 per 1,00,000 population.[(3)] In India, there is increasing coronary heart disease (CHD) prevalence over the last 60 years, from

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1% to 9%-10% in urban populations and <1% to 4%-6% in rural populations. Premature mortality in terms of years of life lost because of CVD in India has increased by 59%.[4] ACS is a type of CHD, which is responsible for one-third of total deaths in people older than 35. Some forms of CHD can be asymptomatic, but ACS is always symptomatic.[5]

ACS is a manifestation of CHD and usually a result of plaque disruption in coronary arteries (atherosclerosis). The common risk factors for the disease are smoking, hypertension, diabetes, hyperlipidemia, male sex, physical inactivity, family obesity, and poor nutritional practices. Cocaine abuse can also lead to vasospasm.[6] A family history of early MI (55 years of age) is also a high-risk factor.[6]

Platelets have a major role in the pathogenesis of ACS, which leads decreased blood flow to part of heart musculature which is usually secondary to plaque rupture followed by platelet activation and thrombus formation leading to coronary artery occlusion. Sometimes ACS can be secondary to vasospasm with or without underlying atherosclerosis. The result of decreased blood flow to a part of heart musculature resulting first in ischemia and then infarction of that part of the heart.[6]

Larger platelets are more adhesive and tend to aggregate more as they contain more dense granules. They are metabolically and enzymatically more active than small platelets and produce more thromboxane A2.[7] Increased platelet volume will increase the tendency for coronary thrombus formation in ACS patients.[8] The activated platelet is the major biological risk factor for pathogenesis of ACS, so it was thought that inhibition of this process could play an important role in prevention of ACS.[9] Activated platelets are larger in size, which can be measured by mean platelet volume (MPV) in ACS patients.[10] Large platelets have also been reported in patients with vascular risk factors and have also been associated with myocardial damage in acute coronary syndromes with an unfavorable outcome of acute MI observed in survivors.[11] Increased platelet activation may also represent the net pathophysiological effects of a number of cardiovascular risk factors, such as smoking and dyslipidemia, thus representing a broad marker of CVD risk. Platelet activation leads to a more spherical shape with increased platelet swelling and thereby, leading to an increase in platelet mass and volume.[12]

The diagnostic criteria of ACS are clinical presentation, biochemical markers of acute ischemic injury, and electrocardiographic findings.[13] The present cardiac markers are not sufficiently sensitive at an early stage of ACS. That is why an early and reliable marker is needed for accurate diagnosis of ACS when patients will attend in cardiac emergency department. In laboratory analyses, macroplatelets can be identified in a complete blood count (CBC) by observing blood extension and platelet indices.[14]

Platelet parameters especially MPV is be an important marker in early detection of ACS when other markers are not available.[15] Higher mean platelet volume (MPV) may become useful marker for early detection of ACS along with other biomarkers. MPV had higher sensitivity and specificity when compared to platelet count. MPV may be used as predictor for early detection of ACS and risk stratification when other cardiac biomarkers are negative. It may be of some help in eliciting the pro-thrombotic events, and hence can act as one of the biomarker in detecting and differentiating the occurrence of cardiac or non-cardiac chest pain.(14) Moreover, patients with higher plateletcrit (PCT) and platelet distribution width (PDW) are at higher risk of ACS. These patients can easily be identified during routine hematological examination and the patients could possibly benefit from preventive treatment.[15]

Based on these findings, the use of platelet indices in routine laboratory could be an important complement in the assessment and follow-up of cardiac patients. However, the platelet indices

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have not been evaluated sufficiently in patients with ACS residing central india . Thus, the present study compared platelet indices in patients with ACS.

MATERIALS AND METHODS

After obtaining Institutional Ethics Committee approval and written informed consent from all the patients, this hospital based prospective, cross-sectional study was conducted in the Department of General medicine at ICCU of Tertiary Care Centre of Central India from period of December 2020 to December 2022. A total of 96 patients who were presented to the hospital within 6 hours of onset of symptoms and diagnosed as case of ACS were included in the study

Exclusion Criteria

1. Patients with chest pain > 6hours,
2. Patients with chronic inflammatory disease,
3. Patients with history of chronic renal failure, hepatic failure, myeloproliferative disorderor malignancy,
4. Patients with history of IHD,
5. Patients with known platelet disorders (thrombocytopenia or thrombocytosis)or bleeding or clotting disorder,
6. Patients receiving anti-platelet therapy,
7. Pregnant and breastfeeding women,
8. Patients not willing to sign informed consent form.

At the time of enrolment, following parameters were noted in all the patients.

Included age, gender, and adverse habits

Clinical Characteristics

Included presenting symptoms and signs, comorbidities, vital parameters (heart rate, systolic blood pressure, diastolic blood pressure, respiratory rate, and SpO_2), and findings on systemic examination (abnormal heart sounds, crepitations, and murmur).

Laboratory Characteristics

Included complete blood count (CBC; Hb, and TLC), kidney function test (KFT; urea, and creatinine), liver function test (LFT; total bilirubin, total protein, albumin, AST, ALT, and ALP), troponin I, and platelet indices (PC, MPV, PDW, PCT, P-LCR, and P-LCC).

Electrocardiographic Characteristics

Included features suggestive of ACS (STEMI, NSTEMI, and UA).

Outcomecharacteristics: Included discharge and death.

Study Procedure

A total of 103 patients with ACS were initially screened for the study and were explained the study procedure in their native language. Of these, 3 patients did not give consent, 3 were on anti-platelet therapy, and 1 had platelet disorders. Excluding these 7 patients, those who were willing to participate and signed the informed consent document were enrolled in the study.

Following enrollment, a thorough history was taken. Following documentation of demographics, patients were assessed for presenting symptoms, comorbidities, and adverse habits. Subsequently, patients were subjected to ECG. Under aseptic precaution, 15 ml venous blood was withdrawn from the antecubital vein. Blood was sent for CBC, KFT, LFT, troponin I, and platelet indices. All the findings, including outcome, were recorded in a specifically designed case report form.

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Statistical Analyses

Data was collected and graphics were designed by Microsoft Office Excel 2019. The data was analyzed with SPSS (IBM, Armonk, NY, USA) version 23.0 for windows. The categorical and continuous variables are represented as frequency (percentage) and mean (standard deviation, SD), respectively. The association between continuous variables was assessed with independent sample t-test and one way ANOVA. Correlation between continuous variables was assessed with Pearson's correlation test. A two-tailed probability value of < 0.05 was considered as statistically significant.

RESULTS

Age of the patients ranged from 25 to 82 years with a mean of 56.64 ± 12.69 years. Majority of the patients were in the age group of 41 – 60 years (45.83%) followed by 61 – 80 years (38.54%) and 21 – 40 years (13.54%). While, least number of the patients were in the age group of > 80 years (2.08%). Majority of the patients were males (66.67%) with a male-to-female ratio of 2:1.

Majority of the patients had HTN (37.50%) and DM (4.17%) followed by HTN + DM (15.63%). While, one patient each had Bronchial Asthma (BA), Hypothyroidism (HT), HTN + HT and HTN + DM + HT (1.04%).

Majority of the patients presented with chest pain (95.83%) followed by sweating (69.79%), breathlessness (63.54%)and palpitation (59.38%). While least number of the patients presented with nausea/vomiting (31.25%).

Table 1: Vital parameters on presentation

Vital parameters	Mean ± SD	Minimum	Maximum
Pulse rate (per min)	91.89 ± 18.42	38	160
SBP (mmHg)	130.83 ± 27.89	60	200
DBP (mmHg)	84.79 ± 14.64	60	150
SpO_2 (%)	94.02 ± 12.06	33	99
RR (per min)	19.92 ± 4.56	10	36

The mean pulse rate (91.89±18.42permin), SBP (130.83±27.89mmHg), DBP (84.79±14.64mmHg), SpO2 (94.02±12.06%), and Respiratory Rate (19.92±4.56permin).

Majority of the patients presented with edema feet (18.75%) followed by pallor (9.38%). While, least number of the patients presented with puffiness of face (4.17%).

Of 96 patients, 20 (20.83%) had raised JVP, while remaining had normal JVP (79.17%). Of 96 patients, 23 each (23.96% each) had abnormal heart sounds and crepitations. While, none of the patients had evidence of murmur.

Table 2: Laboratory investigations on presentation

Laboratory investigations		Mean ± SD	Minimum	Maximum
RBS (mg/dL)		171.22 ± 83.29	89	440
CBC	Hb (gm%)	12.17 ± 3.39	3.3	21.9
	TLC (x1000/cu. mm.)	11.28 ± 4.21	2.3	25.3
	PC (x100000/cu. mm.)	185.56 ± 84.51	8.9	434
KFT	Urea (mg/dL)	35.51 ± 35.72	10	226
	Creatinine (mg/dL)	1.32 ± 0.78	0.1	5.3
LFT	Total bilirubin (mg/dL)	1.12 ± 1.38	0.1	10

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	Total protein (g/L)	5.77 ± 0.85	3.3	8.4
	Albumin (g/L)	3.43 ± 0.38	2.1	4.2
	AST (U/L)	67.37 ± 66.39	10	450
	ALT (U/L)	51.20 ± 72.42	5.6	402
	ALP (U/L)	106.11 ± 65.66	6.8	324

The mean RBS was (171.22±83.29mg/dL), HB(12.17±3.39gm%), TLC (11.28±4.21x1000/cu.mm), PLT.COUNT (185.56±84.51x100000/cu.mm), UREA (35.51±35.72mg/dL), CREATININE (1.32±0.78mg/dL), TOTAL BILIRUBIN (1.12±1.38mg/dL), TOTAL PROTEIN (5.77±0.85g/L), ALBUMIN (3.43±0.38g/L), AST(67.37±66.39U/L), ALT(51.20±72.42U/L), and ALP (106.11±65.66U/L).
Of 96 patients, 32 (33.33%) had habit of smoking and 19 (19.79%) had habit of alcohol intake.

Table 3: Distribution of patients according to platelet indices

Platelet indices	**N (=96)**	**%**
Platelet count ($x10^5$/cu.mm)		
< 1.5	32	33.33
1.5 – 4.5	64	66.67
MPV (fL)		
< 7.4	7	7.29
7.4 – 10.4	52	54.17
> 10.4	37	38.54
PDW		
< 10	11	11.46
10 – 17	73	76.04
> 17	12	12.50
PCT (%)		
< 0.1	4	4.17
0.1 – 0.28	79	82.29
> 0.28	13	13.54
P-LCR (%)		
13 – 43	62	64.58
> 43	34	35.42
P-LCC ($x10^9$/L)		
30 – 90	56	58.33
> 90	40	41.67

PC-- Platelet Count, MPV-- Mean Platelet Volume , PDW -- Platelet Distribution Width,
PCT -- Plateletcrit, P-LCR --Platelet-Large Cell Ratio, P-LCC --Platelet Large Cell Count.
Majority of the patients had platelet indices in normal range i.e., PC (66.67%), MPV (54.17%), PDW (76.04%), PCT (82.29%), P-LCR (64.58%), and P-LCC (58.33%). Some of the patients had reduced platelet indices i.e., PC (33.33%), MPV (7.29%), PDW (11.46%), and PCT (4.17%). While some the patients had raised platelet indices i.e., MPV (38.54%), PDW (12.50%), PCT (13.54%), P-LCR (35.42%), and P-LCC (41.67%).

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Table 4: Platelet indices on presentation

Parameters	Mean ± SD	Minimum	Maximum
PC (x100000/cu. mm.)	185.56 ± 84.51	8.9	434
MPV (fL)	10.08 ± 1.76	3.5	18.4
PDW	13.41 ± 3.38	0.2	20.1
PCT (%)	0.21 ± 0.12	0.02	0.81
P-LCR (%)	38.38 ± 11.33	18	67.5
P-LCC ($x10^9$/L)	93.45 ± 28.82	36	155

The mean PC (185.56±84.51x100000/cu.mm), MPV (10.08±1.76fL), PDW (13.41 ±3.38), PCT (0.21±0.12%), P-LCR (38.38±11.33%), and P-LCC (93.45±28.82x10^9/L). Majority of the patients had STEMI (72.92%) followed by UA (19.79%). While, least number of patients had NSTEMI (7.29%).
Majority of the patients were discharged (80.21%). While, 19 (19.79%) patients died.

Table 5: Association of platelet indices with ACS type

Platelet indices Mean	STEMI (n=70)	NSTEMI (n=7)	UA (n=19)	p-value
PC ($x10^5$/cu. mm)	192.26 ± 80.93	169.0 ± 85.38	167.0 ± 97.54	0.448
MPV (fL)	9.99 ± 1.85	10.37 ± 0.88	10.32 ± 1.69	0.708
PDW	13.11 ± 3.38	14.96 ± 3.59	13.94 ± 3.28	0.293
PCT (%)	0.19 ± 0.07	0.16 ± 0.08	0.24 ± 0.22	0.281
P-LCC ($x10^9$/L)	91.33 ± 27.13	91.14 ± 20.79	102.11 ± 36.30	0.347
P-LCR (%)	39.17 ± 11.87	31.91 ± 5.78	37.84 ± 10.37	0.267

On analysis with one-way ANOVA, there was no significant association of STEMI, NSTEMI, and U A with any of the platelet indices(all p-values >0.05)

Table 6: Association of platelet indices with outcome

Platelet indices Mean	Discharged (n=77)	Death (n=19)	p-value
PC ($x10^5$/cu. mm)	188.01 ± 79.75	175.63 ± 103.49	0.570
MPV (fL)	10.03 ± 1.92	10.31 ± 0.86	0.534
PDW	13.24 ± 3.62	14.09 ± 2.14	0.330
PCT (%)	0.21 ± 0.12	0.20 ± 0.09	0.868
P-LCC ($x10^9$/L)	90.94 ± 27.88	103.63 ± 31.04	0.085
P-LCR (%)	39.07 ± 11.32	35.58 ± 11.25	0.231

On analysis with in dependent sample t-test, there was no significant association between outcomes and any of the platelet indices (all p-values >0.05).
On analysis with Pearson's correlation test, there was no significant correlation between outcomes and any of the platelet indices (all p-values > 0.05).

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DISCUSSION

Age of the patients ranged from 25 to 82 years with a mean of 56.64 ± 12.69 years. In agreement with the previous study, **Yadav et al.** observed that patients were predominantly in the age group of 41 – 60 years (53%) followed by 61 – 80 years (36%) and 31 – 40 years (10%).[16] In the present study, majority of the patients were males (66.67%) with a male-to-female ratio of 2. In previou's studies like **Laher et al.** reported that majority of patients were male (56.3%) and male-to-female ratio was 1.29.[17] In their study, **Yadav et al.** observed that 72% patients were males and male-to-female ratio was 2.57.[16]

In the present study, majority of the patients presented with chest pain (95.83%) followed by sweating (69.79%), breathlessness (63.54%), and palpitation (59.38%). Similar findings were observed in previous studies, **Yadav et al.** observed that patients predominantly presented with chest pain (94%) followed by sweating (78%), breathlessness (67%), and palpitation (58%).[16]

In present study, 20.83% patients had raised JVP. In their study, **Padmanaban et al.** observed that 60% patients had raised JVP.[18]

In present study, each 23.96% patients had abnormal heart sounds and crepitations. To the best of our knowledge, very few studies have reported findings on systemic examination. In their study, **Balakumaran et al.** found that 80% patients had crepitations and 12% had muffled heart sounds.[19] Thus, findings of the present study are consistent with the available literature.

In the present study, majority of the patients had most common risk factor as HTN (37.50%) followed by HTN + DM (15.63%), and DM (4.17%). Similarly, **Yadav et al.** observed that patients predominantly had HTN (33%) and DM (16%).[16]

In present study, Majority of the patients had STEMI (72.92%) followed by UA (19.79%). While, least number of patients had NSTEMI (7.29%). In the study done by **Kadam** 63% patients had STEMI, 22% had UA, and 15% had NSTEMI.[20]

In the present study, majority of the patients had platelet indices in normal range. A one third of patients had reduced Platelet Count(33.33%). Moreover, some of the patients had raised platelet indices. In their study, **Islam et al.** observed that mean PC-352.2×10^9/L, MPV-13.9 fL, and PDW-15.6 fL.[21] In another study, **Khode et al.** found that PC-291.10 ± 104.710^9/L, MPV- 9.65 ± 0.9fL, PWD-10.84 ± 2.2fL, PCT-0.28 ± 0.09%, and P-LCR-21.58 ± 6%.[22]

In agreement with the previous study, **Satpathy et al.** demonstrated that STEMI, NSTEMI, and UA did not differ in mean PC, MPV, PDW, PCT, and P-LCR. However, mean PCT was significantly higher in STEMI than UA.[23]

Taking in consideration the role of atherosclerosis it was thought that weather platelet indicies could be use in the diagnosis, or to determine the prognosis in patient with ACS . **Dehghani et al**.[24] and **Mustafa Cetin MD et al**.[25] in there study in 2014 concluded that MPV, PDW, P-LCR may be of benefit in detecting patients with ACS. However **Gururajaprasad et al.**[26] found that STEMi and NSTEMI did not differ in terms of mean PC, MPV, PDW and P-LCR. (90) In another study, **Khandekaretal.** revealed no significant difference between AMI and UA in mean PC , MPV, PDW and P-LCR.[27] Moreover, **Ranjani et al.** reported that mean MPV , PDW and P-LCR was not statistically significant between MI and UA group.[28] In our study also, on anaylsis with one-way ANOVA, there was no signifcant association of STEMI, NSTEMI, and UA with any of the platelet indicies (PC, MPV, PDW, PCT, P-LCR and P-LCC, all p-values >0.05).There was also no significant association between outcomes and any of platelet indicies (PC, MPV, PDW, PCT, P-LCR andP-LCC,allp-values>0.05).

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CONCLUSION

Platelet indices are not significantly associated with ACS and in-hospital mortality. However, further studies with large sample size are required to confirm the findings of the present study.

Study Limitation

This study involved a relatively small number of patients admitted in a single center. Hence, the results cannot be generalized to the community.

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