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Original Research Paper

General Medicine

STUDY OF PLATELET AND ITS INDICES IN ACUTE CORONARY SYNDROME

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ABSTRACT

Background: Approximately 10-15% of acute chest pain is secondary to ACS which occur due to sudden blockage in a coronary artery the blood supply to the heart muscles get reduced significantly or cuts off completely. ACS is a life-threatening condition that requires urgent intervention where saving time in diagnosis means saving cardiac muscles. **Aims and Objectives:** To study platelet indices in acute coronary syndrome and non acute coronary syndrome and to explore the role of mean platelet volume as an additional marker in diagnostic workup of acute coronary syndrome. **Material and Methods:** This cross-sectional, comparative & observational study was conducted in Department of Medicine, MGM Medical College and Hospital, Navi Mumbai from December 2018 – October 2020. A total of 102 patients presented with chest pain in the Emergency Department and diagnosed as having either ACS or NON-ACS were included. **Results:** ACS predominantly affects the male population i.e. 73.53% in the present study. STEMI was present in 78.43% than NSTEMI 19.61%. Diabetes was present in 20.59% and hypertension in 27.45% patients. Mean Hb was higher in the ACS group than in the NON-ACS group (p value: 0.001). Similarly, mean TLC, MPV, PDW, P-LCR and Mean Trop T was higher in the ACS group than in the NON-ACS group (p value: 0.001). Mean EF was lower in the ACS group than in the NON-ACS group (p <0.0001). The area under the ROC curve for classifying ACS and Non-ACS using Platelets as marker was 57.3% (p value: 0.206). A threshold value of Platelets ≥ 2.59 for ACS patients yields a sensitivity of 54.90%, Specificity of 50.98%, PPV of 52.83%, NPV of 53.06% and Accuracy of 52.94%. The area under the ROC curve for classifying ACS and Non-ACS using MPV as marker was 74.7% (P value: < 0.001). A threshold value of MPV ≥ 10.1 for ACS patients yields a sensitivity of 76.47%, Specificity of 64.71%, PPV of 68.42%, NPV of 73.33% and Accuracy of 70.59%. For MPV ≥ 10.1, the odds in favour of ACS was 5.958 i.e., the chances of ACS is 5.95 times that of Non-ACS. **Conclusion:** It can be concluded from the present study that the platelet indices, viz, MPV, PDW and P-LCR, are higher in ACS than in NON-ACS. Thus, they may be used to differentiate the ACS cases. More research needs to be done in this regard, to develop the platelet indices as an early diagnostic tool for the ACS cases, especially in a limited resource country, like India.

KEYWORDS :

INTRODUCTION

Acute chest pain is one of major presentations in the emergency department which can be due to some fatal cardiac conditions. Major challenge in emergency department is to segregate non-fatal conditions from life threatening conditions like Acute Coronary Syndromes (ACS). These include ST elevation MI, Non ST elevation MI and Unstable Angina. Cardiovascular diseases cause approximately one-third of all deaths in the world, of which 7.5 million deaths are estimated to be due to ischaemic heart disease (IHD). ACS and sudden death cause most IHD-related deaths, which represent 1.8 million deaths per year. The incidence of IHD in general, and of ACS, increases with age although, on average, this occurs 7–10 years earlier in men compared to women. ACS occurs far more often in men than in women below the age of 60 years but women represent the majority of patients over 75 years of age.[1]

ACS results in significant morbidity and mortality, accounting for half of all deaths due to cardiovascular disease. Approximately one third of STEMI patients die within 24 hours of onset of ischemia, thus emphasizing the need for prompt and effective treatment.[2] The morbidity and mortality is lower in UA/NSTEMI patients, but is still substantial, and about 15% of patients die or experience a reinfarction within 30 days of diagnosis.[3]

ACS requires early identification, adequate risk stratification and management: patients with ongoing chest pain and persistent ST-segment elevation (or new-onset left bundle branch block) require immediately recanalization by fibrinolytic treatment or primary angioplasty in patients with chest pain and ECG abnormalities suggesting acute ischemic heart disease, the strategy is to value the likelihood of ACS and to confirm or rule out myocardial necrosis, to alleviate ischemia and symptoms, to observe with serial ECG, to repeat measurements of markers of myocardial necrosis and to initiate appropriate therapy.

Though the biomarkers are of considerable importance in the diagnosis of ACS, it has also been known that platelets are also involved in ACS. It has been recently realised that platelet activation is a hallmark of ACS.[4-6] Drug trials have demonstrated that antiplatelet drugs including aspirin, clopidogrel and glycoprotein (GP) IIb/ IIIa inhibitors provide substantial therapeutic benefit in patients with ACS. High shear rates prevail in stenotic arteries: under these conditions, platelet adhesion to the injured vessel walls requires von Willebrand factor (VWF).[7] Interestingly, VWF is also a well-characterized marker of cardiovascular risk:[8,9] Platelet function is increased under high shear stress in ACS patients.[10,11]

Thus, clearly, early diagnosis and prompt initiation of management protocols have a huge impact on the reduction of morbidity and mortality in the cases of ACS. Readily available and economical methods for diagnosis of ACS; with acceptable sensitivity and specificity, are the need of the hour, especially in a developing country like ours. Hence, this study was conducted to evaluate the role of platelet indices in the diagnosis of ACS.

MATERIAL AND METHODS

This cross-sectional, comparative & observational study was conducted under the Department of Medicine, MGM Medical College and Hospital, Navi Mumbai from December 2018 – October 2020. Prior approval of Institutional Ethics Committee was taken before start of the study. A written signed informed consent was taken from all the patients prior to their enrolment in the study. A total of 102 patients presented with chest pain in the Emergency Department during the study period and were diagnosed as having either ACS or NON-ACS, were included in the study.

Inclusion Criteria:

1. Patients of either gender, belonging to the age group of 36 to 60 years.
2. Patients presented within 6 hours of chest pain.

Exclusion Criteria:

1. Patients with Bleeding disorder and other haematological disorder
2. Patients with history of recent blood transfusion within 6 weeks
3. Receiving drugs causing thrombocytopenia
4. Hepatic and Renal impairment
5. Patients whose relatives/legal guardians did not consent to participate in the study.

Methodology:

Detailed history of present illness alongwith personal and past history were taken from the all the patients and recorded. ECG was done for the diagnosis of ACS. Ejection Fraction (EF) was measured by 2D ECHO. Venous blood was collected for laboratory investigations. Various investigations were carried out viz. CBC was done by automated analyser and Platelet indices (MPV, PDW, P-LCR) were noted. Cardiac Biomarkers (CKMB and Troponins) were estimated.

Statistical Analysis:

The data was analysed using statistical software (IBM SPSS, IBM Corporation, Armonk, NY, USA). The Numerical/ Continuous data were analysed by the 'Unpaired t test' and the Categorical data were analysed by the Chi square test/ Fischer's exact test. Pearson correlation coefficient was used for identifying association between two continues variables. Receiver operating characteristic (ROC) curve was also constructed to detect the accuracy of platelet volume indices for diagnosing ACS along with Sensitivity, Specificity, PPV and NPV.P value of less than 0.05 was considered as statistically significant

RESULTS

The mean age in the present study was 49.08 ± 7.80 years with the difference between the NON-ACS and ACS groups being statistically significant (p=0.028). Male preponderance was 73.53%. STEMI was the most common. Diabetes was present in 20.59% and Hypertension in 27.45% cases.

Table 1: Distribution of the laboratory findings and Ejection Fraction (EF) in the NON-ACS and ACS groups in the study population

PARAMETER	NON-ACS GROUP	ACS GROUP	TOTAL	P Value
Hb (gm%)	12.83 ± 2.16	14.36 ± 2.50	13.60 ± 2.45	0.001*
TLC (per mm3)	8906.96 ± 5314.85	12003.27 ± 4170.00	10455.12 ± 5001.29	0.001*
PLC (l/mm3)	2.63 ± 0.74	2.73 ± 0.65	2.68 ± 0.69	0.455
MPV(fL)	9.92 ± 0.68	10.59 ± 0.73	10.25 ± 0.78	<0.0001*
PDW (%)	11.08 ± 1.57	12.31 ± 1.68	11.70 ± 1.73	<0.0001*
P-LCR (%)	24.89 ± 5.27	29.61 ± 5.84	27.25 ± 6.03	<0.0001*
CPK-MB	16.12 ± 4.99	64.31 ± 66.73	40.22 ± 52.94	<0.0001*
Troponin T	6.94 ± 3.92	934.59 ± 1240.68	470.77 ± 989.60	<0.0001*
EF (%)	51 ± 60.10	51 ± 42.29	51.20 ± 11.31	<0.0001*

Table 1 shows the distribution of the laboratory findings and Ejection Fraction (EF) in the NON-ACS and ACS groups of the study population. It was observed that all the parameters (except PLC) were significantly higher in the ACS group than the NON-ACS group (P value less than 0.05).

Table 2: Distribution of Diabetes and Hypertension in the NSTEMI and STEMI cases in the study population

PARAMETER	NSTEMI		STEMI		TOTAL		P value
	N	%	N	%	N	%	
DIABETICS	3	30%	12	30%	15	30%	0.999
NON-DIABETICS	7	70%	28	70%	35	70%	
HYPERTENSIVES	4	40%	15	37.5%	19	38%	0.999
NON-HYPERTENSIVES	6	60%	25	62.5%	31	62%	

Table 2 shows the distribution of comorbidities in the NSTEMI and STEMI groups. The difference between the groups was statistically insignificant (P value was more than 0.05).

Table 3: Distribution of the laboratory findings and Ejection Fraction (EF) in the NSTEMI and STEMI cases in the study populations

PARAMETER	NSTEMI	STEMI	TOTAL	P Value
Hb (gm%)	12.92 ± 3.64	14.72± 2.07	14.36 ± 2.53	0.043*
TLC (per mm3)	11584 ± 3112.73	12189.17± 4439.29	12068.14± 4186.26	0.687
PLC (l/mm3)	2.65 ± 0.68	2.75 ± 0.65	2.73 ± 0.65	0.672
MPV(fL)	10.73 ± 0.73	10.55 ± 0.74	10.59 ± 0.73	0.494
PDW (%)	12.80 ± 1.81	12.18± 1.66	12.30± 1.69	0.301
P-LCR (%)	30.85 ± 5.87	29.22± 6.01	29.55± 5.96	0.445
CPK-MB	41.90 ± 24.14	71.22± 72.98	65.36± 66.98	0.219
Troponin T	276.12 ± 229.38	1122.18± 1338.81	952.97± 1246.25	<0.0001*
EF (%)	53.50 ± 5.80	39.05± 6.24	41.94± 8.44	<0.0001*

Table 3 shows the distribution of the laboratory findings and Ejection Fraction (EF) in the NSTEMI and STEMI groups of the study population. It was observed that Hb, Trop T and EF were higher in the STEMI group than the NSTEMI group (P value less than 0.05).

Table 4: Distribution of Diabetes and Hypertension in the AWMI and IWMI cases in the study population

PARAMETER	AWMI		IWMI		TOTAL		P value
	N	%	N	%	N	%	
DIABETICS	9	30%	3	30%	12	30%	0.999
NON-DIABETICS	21	70%	7	70%	28	70%	
HYPERTENSIVES	11	36.67%	4	40%	15	37.50%	0.850
NON-HYPERTENSIVES	19	63.33%	6	60%	25	62.50%	

Table 4 shows the distribution of comorbidities in the AWMI and IWMI groups. The difference between the groups was statistically insignificant (P value was more than 0.05).

Table 5: Distribution of the laboratory findings and Ejection Fraction(EF) in the AWMI and IWMI cases in the study population

PARAMETER	AWMI	IWMI	TOTAL	P Value
Hb (gm%)	14.64 ± 2.27	14.95 ± 1.38	14.72 ± 2.07	0.688
TLC (per mm3)	12046.23 ± 4624.60	12618.00 ± 4026.45	12189.17 ± 4439.29	0.729
PLC (l/mm3)	2.75 ± 0.7	2.74 ± 0.52	2.75 ± 0.65	0.969
MPV(fL)	10.45±0.72	10.86±0.74	10.55±0.74	0.128
PDW (%)	11.90±1.54	13.00±1.83	12.18±1.66	0.069
P-LCR (%)	28.35±5.66	32.05 ± 6.19	29.27±5.94	0.088
CPK-MB	72.00±79.93	68.90±49.87	71.22±72.98	0.909
Troponin T	1267.57 ± 1434.53	686.01 ± 924.32	1122.18 ± 1338.81	0.239
EF (%)	38.23 ± 6.12	41.50 ± 6.26	39.05 ± 6.24	0.154

Table 5 show the distribution of the laboratory findings and Ejection Fraction (EF) in the AWMI and IWMI groups of the study population. There was no significant difference between the two groups (P value more than 0.05).

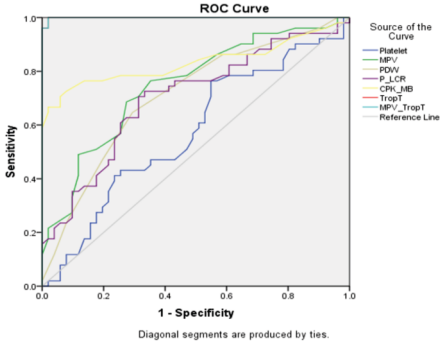

Figure 1: ROC Curve

Area Under the Curve

Test Result Variable(s)	Area	Std. Errora	Asymptotic Sig.b	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
Platelet	.573	.057	.206	.461	.685
MPV	.747	.048	<0.001	.652	.842
PDW	.709	.051	<0.001	.608	.810
P_LCR	.701	.052	<0.001	.599	.803
CPK_MB	.833	.044	<0.001	.746	.920
TropT	.999	.001	<0.001	.997	1.000
MPV_TropT	.999	.001	<0.001	.997	1.000

a. Under the nonparametric assumption
b. Null hypothesis: true area = 0.5

Table 6: Distribution of Sensitivity, Specificity, PPV and NPV

		ACS		Non-ACS		P-value	Sensitivity	Specificity	PPV	NPV	Diagnostic Accuracy
		n	%	n	%						
Platelet	<2.595	23	45.10%	26	50.98%	0.276	54.90%	50.98%	52.83%	53.06%	52.94%
	≥2.595	28	54.90%	25	49.02%						
MPV	< 10.1	12	23.53%	33	64.71%	<0.001	76.47%	64.71%	68.42%	73.33%	70.59%
	≥ 10.1	39	76.47%	18	35.29%						
PDW	< 11.5	18	35.29%	36	70.59%	<0.001	64.71%	70.59%	68.75%	66.67%	67.65%
	≥ 11.5	33	64.71%	15	29.41%						
P-LCR	<26.15	13	25.49%	34	66.67%	<0.001	72.55%	66.67%	68.52%	72.34%	70.30%
	≥26.15	37	72.55%	17	33.33%						
CPK MB	< 22	12	23.53%	44	86.27%	<0.001	76.47%	86.27%	84.78%	78.57%	81.37%
	≥ 22	39	76.47%	7	13.73%						
Trop T	<14.89	0	0.00%	50	98.04%	<0.001	100.00%	98.04%	98.08%	100.00%	99.02%
	≥14.89	51	100.00%	1	1.96%						
MPV + Trop T	<25.71	0	0.00%	50	98.04%	<0.001	100.00%	98.04%	98.08%	100.00%	99.02%
	≥25.71	51	100.00%	1	1.96%						

Figure 1 shows the ROC curve and Table 6 shows the distribution of Specificity, Sensitivity, PPV and NPV. The area under the ROC curve for classifying ACS and Non-ACS using Platelets as marker was 57.3% (P value: 0.206). A threshold value of Platelets ≥ 2.595 for ACS patients yielded a sensitivity of 54.90%, Specificity of 50.98%, PPV of 52.83%, NPV of 53.06% and Accuracy of 52.94%. The area under the ROC curve for classifying ACS and Non-ACS using MPV as marker was 74.7% (P value: < 0.001). A threshold value of MPV ≥ 10.1 for ACS patients yielded a sensitivity of 76.47%, Specificity of 64.71%, PPV of 68.42%, NPV of 73.33% and Accuracy of 70.59%. The area under the ROC curve for classifying ACS and Non-ACS using PDW as marker was 70.9% (P value: < 0.001). A threshold value of PDW ≥ 11.5 for ACS patients yielded a sensitivity of 64.71%, Specificity of 70.59%, PPV of 68.75%, NPV of 66.67% and Accuracy of 67.65%. The area under the ROC curve for classifying ACS and Non-ACS using P-LCR as marker was 70.1% (P value: < 0.001).

A threshold value of P-LCR ≥ 26.15 for ACS patients yielded a sensitivity of 72.55%, Specificity of 66.67%, PPV of 68.52%, NPV of 72.34% and Accuracy of 70.30%. The area under the ROC curve for classifying ACS and Non-ACS using CPK MB as marker was 83.3% (P value: < 0.001).A threshold value of CPK MB ≥ 22 for ACS patients yielded a sensitivity of 76.47%, Specificity of 86.27%, PPV of 84.78%, NPV of 78.57% and Accuracy of 81.37%. The area under the ROC curve for classifying ACS and Non-ACS using TropT as marker was 99.9% (P value: < 0.001).

A threshold value of TropT ≥ 14.89 for ACS patients yielded a sensitivity of 100%, Specificity of 98.04%, PPV of 98.08%, NPV of 100% and Accuracy of 99.02%. The area under the ROC curve for classifying ACS and Non-ACS using MPV + TropT as marker was 99.9% (P value: < 0.001). A threshold value of MPV + TropT ≥ 25.71 for ACS patients yielded a sensitivity of 100%, Specificity of 98.04%, PPV of 98.08%, NPV of 100% and Accuracy of 99.02%.

Table 7: Distribution of odds ratio

		ACS		Non-ACS		-value	Odds Ratio	95% CI for Odds Ratio	
		n	%	N	%			Lower	Upper
Platelet	<2.595	23	45.10%	26	50.98%	0.276	0.790	0.363	1.719
	≥2.595	28	54.90%	25	49.02%		1.266	0.582	2.756
MPV	< 10.1	12	23.53%	33	64.71%	<0.001	0.168	0.073	0.387
	≥ 10.1	39	76.47%	18	35.29%		5.958	2.584	13.738

PDW	< 11.5 ≥ 11.5	18	35.29 %	36	70.59%	<0.001	0.227	0.101	0.513
		33	64.71 %	15	29.41%		4.400	1.951	9.923
P -LCR	<26.15 ≥26.15	13	25.49 %	34	66.67%	<0.001	0.171	0.075	0.392
		37	72.55 %	17	33.33%		5.286	2.417	11.557
CPK MB	< 22 ≥ 22	12	23.53 %	44	86.27%	<0.001	0.049	0.019	0.124
		39	76.47 %	7	13.73%		20.429	8.071	51.706
Trop T	<14.89 ≥14.89	0	0.00 %	50	98.04%	<0.001	-	-	-
		51	100.00%	1	1.96 %		-	-	-
MPV +TropT	<25.71 ≥25.71	0	0.00 %	50	98.04%	<0.001	-	-	-
		51	100.00%	1	1.96 %		-	-	-

Table 7 shows the distribution of odds ratio. For MPV ≥ 10.1, the odds in favour of ACS was 5.958 i.e., the chances of ACS were 5.958 times that of Non-ACS. For PDW ≥ 11.5, the odds in favour of ACS was 4.4 i.e., the chances of ACS were 4.4 times that of Non-ACS. For P-LCR ≥ 26.15, the odds in favour of ACS was 5.286 i.e., the chances of ACS were 5.286 times that of Non-ACS. For CPK MB ≥ 22, the odds in favour of ACS was 20.429 i.e., the chances of ACS were 20.429 times that of Non-ACS.

DISCUSSION

ACS is a life-threatening condition that requires urgent intervention where saving time in diagnosis means saving cardiac muscles. Despite the availability of various investigation modalities like ECG, cardiac biomarkers, 2D ECHO and stress test, approximately 2% of ACS cases are missed especially in the developing countries like India, where at many places advanced investigations are not available.

In the present study, most of the patients belonged to the age group of 56 to 60 years. The mean age was 49.08 ± 7.80 years. The mean age was significantly higher in the patients with ACS 50.76± 7.68 years than the patients with NON-ACS 47.39 ± 7.62 years; p value: 0.028. A male preponderance i.e. 73.53% was noted in the study population. In the NON-ACS group, the M:F ratio was 1.55:1 and in the ACS group the ratio was 6.28:1. Khode et al[12] conducted a study to assess the MPV in patients with coronary artery disease. A total of 128 patients were included. They found that the mean age of the CAD group was 55.14 ± 9.8 years and of the Control group was 54.46 ± 8.65 years. This was almost similar to the present study, except that the difference in ages was statistically not significant (P value: 0.677). They also found a male preponderance 86.7% in the study population; as found in present study. Gururajaprasad et al[13] conducted a comparative study of platelet indices in coronary artery disease. They included a total of 300 patients. They found that the mean age of patients with MI was 64.2 ± 11.52 years. They also observed a male predominance with a M:F ratio of 1.77:1 in the MI group. These findings were almost equivalent to the present study. Thus, it can be effectively concluded that ACS mostly affects the elderly population - more than 51 years and NON-ACS affects comparatively younger population. There is a male predominance in the affected population.

Majority of the cases had STEMI i.e. 78.43% followed by NSTEMI 19.61% and UA 1.96%. Gururajaprasad et al[13] conducted a comparative study of platelet indices in coronary artery disease. They found that amongst the patients having MI, majority of them had STEMI 78% and 22% had NSTEMI. This was almost equivalent to the present study.

In the present study, a total of 20.59% of the study population was Diabetic. The prevalence of diabetes was significantly higher in the ACS group 31.37% than in the NON-ACS group 9.80% (p value 0.007). There was no significant difference in the prevalence of Diabetes in the NSTEMI and STEMI groups (p value 0.999) and the AWMI and IWMI groups (P value: 0.999). In the study by Eswaran A. et al[14], conducted to assess the relationship between platelet indices and CHD in Malaysian population, they included a total of 155 cases. They found that the prevalence of Diabetes in the study population was 31.5%. This was almost equivalent to the present study.

A total of 27.45% of the study population was Hypertensive. The prevalence of Hypertension was significantly higher in the ACS group 37.25% than in the NON-ACS group 17.65%; P value: 0.027. There was no notable difference in the prevalence of Hypertension in the NSTEMI and STEMI groups (P value 0.999) and the AWMI and IWMI groups (P value: 0.850). In the study by Eswaran et al[14], conducted to assess the relationship between platelet indices and CHD in Malaysian population, they included a total of 155 cases. They found that the prevalence of Hypertension in the study population was 51%. This was higher than our present study.

Present study found that the mean Hb was higher in the ACS group 14.36 ± 2.50 gm% than the NON-ACS group 12.83±2.16 gm%; P value 0.001. When assessed in terms of NSTEMI and STEMI groups, it was observed that the mean Hb was higher in the STEMI group 14.72± 2.07 gm% than the NSTEMI group (12.92 ± 3.64 gm%); with a P value of 0.043.

In the present study, mean TLC was higher in the ACS group (12003.27 ± 4170.00 per mm^3) than the NON-ACS group (8906.96 ± 5314.85 per mm^3); P value of 0.001. When assessed in terms of NSTEMI and STEMI groups, it was observed that the mean TLC was almost similar in the NSTEMI group (11584 ± 3112.73 per mm^3) and the STEMI group (12189.17± 4439.29 per mm^3); with a P value of 0.687. Khode et al[12] conducted a study to assess the MPV in patients with coronary artery disease. A total of 128 patients were included. They found that the mean WBC was higher in the CAD group (11.68 ± 4.3 x 10^9 per L) than in the Control group (9.29 ± 3.8 x 10^9 per L); P value: 0.001. This was equivalent to the present study. Thus, it can be concluded that the mean TLC is higher in the ACS group than NON-ACS group and comparable in the NSTEMI and STEMI groups.

In the present study, mean PLC was almost similar in the NON-ACS group (2.63 ± 0.74 l/mm^3) and the ACS group (2.73 ± 0.65 l/mm^3); P value of 0.455. When assessed in terms of NSTEMI and STEMI groups, it was observed that the mean PLC was almost similar in the NSTEMI group (2.65 ± 0.68 l/mm^3) and the STEMI group (2.75 ± 0.65 l/mm^3); with p value 0.672. Khode et al[12] conducted a study to assess the PLC in patients with coronary artery disease. They found that the mean platelet count was almost similar in the CAD group (288.04 ± 108.6 x 10^9 per L) and the Control group (282.4 ± 87.77 x 10^9 per L); P value: 0.747. This was equivalent to the present study. Thus, it can be concluded that the mean PLC is comparable in the ACS and NON-ACS groups and in the NSTEMI and STEMI groups.

Mean MPV was significantly higher in the ACS group (10.59 ± 0.73 fL) than the NON-ACS group (9.92 ± 0.68 fL); p <0.0001. When assessed in terms of NSTEMI and STEMI groups, it was observed that the mean MPV was almost similar in the NSTEMI group (10.73 ± 0.73 fL) and the STEMI group (10.55 ± 0.74 fL); with a P value of 0.494. In a study by Ranjani et al[15] conducted to assess the platelet volume indices in ACS, they

found that the mean MPV was higher (9.6 fL) in the MI/UA/NSTEMI group than the NON-ACS/chronic stable angina group (8.3 fL). The difference in the groups was statistically significant (P <0.001). This was similar to the present study. They also found that mean MPV was almost similar in the UA/NSTEMI group (9.5 ± 0.8 fL) and the STEMI group (9.8 ± 0.9 fL); with a P value of 0.284. This was also similar to the present study. Thus, it can be concluded that the mean MPV is higher in the ACS group than NON-ACS group and comparable in the NSTEMI and STEMI groups.

In the present study, it was found that the mean PDW was significantly higher in the ACS group (12.31 ± 1.68%) than the NON-ACS group (11.08 ± 1.57%); p <0.0001. When assessed in terms of NSTEMI and STEMI groups, it was observed that the mean PDW was almost similar in the NSTEMI group (12.80 ± 1.81%) and the STEMI group (12.18± 1.66%); with a P value of 0.301. In the study by Khode et al[12], it was observed that the mean PDW was higher in the CAD group (10.77 ± 2.0 fL) than the Control group (10.35 ± 1.3 fL). This was almost similar to the present study, except that the difference was statistically insignificant (P value: 0.182). Thus, it can be concluded that the mean PDW is higher in the ACS group than NON-ACS group and comparable in the NSTEMI and STEMI groups.

In the present study, it was found that the mean P-LCR was significantly higher in the ACS group (29.61 ± 5.84%) than the NON-ACS group (24.89 ± 5.27%); P <0.0001. When assessed in terms of NSTEMI and STEMI groups, it was observed that that the mean P-LCR was almost similar in the NSTEMI group (30.85 ± 5.87%) and the STEMI group (29.22± 6.01 %); with a P value of 0.445. In the study by Khode et al[12], it was observed that the mean P-LCR was higher in the CAD group (21.33 ± 6.1%) than the Control group (19.93 ± 4.6%). This was almost similar to the present study, except that the difference was statistically insignificant (P value: 0.147). Thus, it can be concluded that the mean P-LCR is higher in the ACS group than NON-ACS group and comparable in the NSTEMI and STEMI groups.

In the present study, it was found that the mean CPK-MB was significantly higher in the ACS group (64.31 ± 66.73) than the NON-ACS group (16.12 ± 4.99); with a P value of less than 0.0001. When assessed in terms of NSTEMI and STEMI groups, it was observed that the mean CPK-MB was almost similar in the NSTEMI group (41.90 ± 24.14) and the STEMI group (71.22± 72.98); with a P value of 0.219.

In the present study, it was found that the mean Trop T was significantly higher in the ACS group (934.59 ± 1240.68) than the NON-ACS group (6.94 ± 3.92); p <0.0001. When assessed in terms of NSTEMI and STEMI groups, it was observed that the mean Trop T was significantly higher in the STEMI group (1122.18± 1338.81) than the NSTEMI group (276.12 ± 229.38); with a P value of less than 0.0001.

In the present study, it was found that the mean EF was significantly lower in the ACS group (51 ± 42.29%) than the NON-ACS group (51 ± 60.10%); p <0.0001. When assessed in terms of NSTEMI and STEMI groups, it was observed that the mean EF was significantly lower in the STEMI group (39.05± 6.24%) than the NSTEMI group (53.50 ± 5.80%); with a P value of less than 0.0001.

ROC Curve and Odds Ratio:

In the present study, it was found that the area under the ROC curve for classifying ACS and Non-ACS using Platelets as marker was 57.3% (P value: 0.206). A threshold value of Platelets ≥ 2.595 for ACS patients yielded a sensitivity of 54.90%, Specificity of 50.98%, PPV of 52.83%, NPV of 53.06% and Accuracy of 52.94%. The area under the ROC curve for classifying ACS and Non-ACS using MPV as marker was 74.7% (P value:< 0.001). A threshold value of MPV ≥ 10.1 for ACS patients yielded a sensitivity of 76.47%, Specificity of 64.71%, PPV of 68.42%, NPV of 73.33% and Accuracy of 70.59%. The area under the ROC curve for classifying ACS and Non-ACS using PDW as marker was 70.9% (P value:< 0.001).A threshold value of PDW ≥ 11.5 for ACS patients yielded a sensitivity of 64.71%, Specificity of 70.59%, PPV of 68.75%, NPV of 66.67% and Accuracy of 67.65%. The area under the ROC curve for classifying ACS and Non-ACS using P-LCR as marker was 70.1% (P value:< 0.001). A threshold value of P-LCR ≥ 26.15 for ACS patients yielded a sensitivity of 72.55%, Specificity of 66.67%, PPV of 68.52%, NPV of 72.34% and Accuracy of 70.30%. The area under the ROC curve for classifying ACS and Non-ACS using CPK MB as marker was 83.3% (P value:< 0.001).

A threshold value of CPK MB ≥ 22 for ACS patients yielded a sensitivity of 76.47%, Specificity of 86.27%, PPV of 84.78%, NPV of 78.57% and Accuracy of 81.37%. The area under the ROC curve for classifying ACS and Non-ACS using TropT as marker was 99.9% (P value:< 0.001). A threshold value of TropT ≥ 14.89 for ACS patients yielded a sensitivity of 100%, Specificity of 98.04%, PPV of 98.08%, NPV of 100% and Accuracy of 99.02%. The area under the ROC curve for classifying ACS and Non-ACS using MPV+TropT as marker was 99.9% (P value:< 0.001).

A threshold value of MPV+TropT ≥ 25.71 for ACS patients yielded a sensitivity of 100%, Specificity of 98.04%, PPV of 98.08%, NPV of 100% and Accuracy of 99.02%. For MPV ≥ 10.1, the odds in favour of ACS was 5.958 i.e., the chances of ACS were 5.958 times that of Non-ACS. For PDW ≥ 11.5, the odds in favour of ACS was 4.4 i.e., the chances of ACS were 4.4 times that of Non-ACS. For P-LCR ≥ 26.15, the odds in favour of ACS was 5.286 i.e., the chances of ACS were 5.286 times that of Non-ACS. For CPK MB ≥ 22, the odds in favour of ACS was 20.429 i.e., the chances of ACS were 20.429 times that of Non-ACS. In the study by Dehgani et al[16], the ROC curve analysis demonstrated that the admission values of MPV, PDW, and P-LCR were useful diagnostic tools to detect MI cases among patients suffering from an acute chest discomfort (area under the curve [AUC]=0.563, 95% confidence interval [CI] 0.519-0.607, P value: 0.006; AUC=0.557, 95% CI 0.513-0.601,P value: 0.013; and AUC=0.560, 95% CI 0.515-0.604,P value: 0.010; respectively). The best cut-off points, sensitivities, and specificities for identifying MI were 9.15 fL, 72%, and 40%; 11.35 fL, 73%, and 37%; and 20.25%, 68%, and 44% for MPV, PDW, and P-LCR, respectively. The higher cut-offs for MPV and P-LCR in the present study yielded higher specificities and sensitivities.

Limitations:

This study was limited by the inclusion of the patients having ACS presented within 6 hours of chest pain.

CONCLUSION

ACS is the most ominous manifestation of CAD. The burden of ACS and its impact are striking. Cardiovascular disease is now the most common cause of mortality worldwide, and among cardiovascular deaths, the majority are attributable to CAD. As a result, although CAD in general is a major global public health concern, ACS is particularly worrisome because it is both prevalent but at the same time portends a poor prognosis. It can be effectively concluded from the present study that the platelet indices, viz, MPV, PDW and P-LCR, are higher in ACS than in NON-ACS. Thus, they may be used to differentiate the ACS cases. More research needs to be done in this regard, to develop the platelet indices as an early diagnostic tool for the ACS cases, especially in a limited resource country, like India.

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