STUDY OF PLATELET COUNT AND PLATELET INDICES IN PATIENTS WITH CORONARY ARTERY DISEASE AND ACUTE MYOCARDIAL INFARCTION

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ABSTRACT

Introduction: Coronary heart disease (CHD) is among the top five causes of morbidity worldwide, and is increasingly becoming common in India as well. Platelets are known to play a critical role in conversion of a chronic atherosclerotic plaque into an occluding thrombus. The present study is an attempt to comprehensively evaluate utility of platelet parameters in coronary artery diseases which are less labour intensive and inexpensive methods.

Objectives: 1) To study the platelet indices and platelet count in patients with coronary artery disease. 2) Assess diagnostic accuracy of platelet indices in acute coronary syndrome.

Materials And Methods: After obtaining institutional ethical clearance present case control study was done in RCSMGMC&CPRH, Kolhapur, Maharashtra. 130 patients of coronary artery diseases and 130 age and gender matched control with non-cardiac complaints were enrolled as study group. Values of platelet parameters (platelet count, MPV, PDW and PLCR) were recorded immediately.

Results: There were 130 patients of CAD. Most of the cases (n=89, 68.46%) were in 45-65year age group. There were 89 males (68.46%). There was statistically significant difference in the mean value of MPV, PDW P-LCR and Platelet count in various types of coronary artery diseases and MI when compared to control group. There was statistically significant difference seen in mean of MPV, PDW and P-LCR in between all groups but in case of STEMI v/s NSTEMI and ACS v/s CSA. The mean of platelet count was almost similar. On further analysis it was found that 42 out of 51 cases of CAD (72%) with giant platelets showed higher values for PLCR than the highest limit of control PLCR with range of 22.5-29 fL. ROC curve showed that the highest sensitivity and specificity was found out for MPV (89.6 % and 89.6%) followed by PLCR (77.1% and 55) and PDW (72.9% and 50) respectively.

Conclusions: The platelet indices namely MPV, PDW, P-LCR of CAD were significantly raised when compared with control. The rise was progressive amongst various groups from CSA to STEMI, the difference between these groups being statistically significant. All platelet indices (MPV, PLCR and PDW) were the good indicator to detect patients with UA and MI (ACS).

KEYWORDS : Coronary heart disease, Unstable Angina, Mean Platelet Volume, Platelet distribution width.

INTRODUCTION:

Coronary heart disease (CHD) is among the top five causes of morbidity worldwide, and is increasingly becoming common in India as well. Cardiovascular diseases accounts for approximately 12 million deaths annually and is the commonest cause of death globally.[1] Coronary artery disease (CAD) is a group of disorders which involves thrombotic lesion in coronary artery. This includes chronic coronary syndrome of chronic stable angina and acute coronary syndrome (ACS) which includes acute myocardial infarction with or without ST-segment elevation (STEMI and NSTEMI) and unstable angina diagnosed on electrocardiogram.[1,2] Diagnosis of such disorders is still a challenge despite the considerable progress in the diagnostic modalities .[1,2]

Atherosclerosis which is the most frequent etiological factor for CAD is multi-factorial and chronic process. Platelets have been implicated in the pathogenesis of atherosclerosis and its complications [3,4].Platelets are known to play a critical role in conversion of a chronic atherosclerotic plaque into an occluding thrombus. Larger the platelets, they are more likely to be metabolically and enzymatically active than small platelets and produce more thromboxane A2 [5,6].

Activated platelets interact with endothelium and other inflammatory cells by the action of different molecules present on the platelet surface and/or stored in platelets granules, as P-selectin[7].

The present study is an attempt to comprehensively evaluate utility of platelet parameters in coronary artery diseases including its chronic and acute form with automated hematology analyzer and peripheral blood smear which are less labour intensive and inexpensive methods.

OBJECTIVES:

1) To study the platelet indices and platelet count in patients with coronary artery disease,
2) To compare platelet indices with each other and between various groups of coronary artery diseases

3) Assess diagnostic accuracy of platelet indices in acute coronary syndrome.

MATERIALS AND METHODS:

After obtaining institutional ethical clearance present case control study was done in Rajarshee Chhatrapati Shahu Maharaj Govt. Medical College, Chhatrapati Pramila Raje Hospital, Kolhapur, Maharashtra.

Total of 130 such patients of coronary artery diseases including myocardial infarction as well as unstable angina patients and chronic stable angina patients admitted due to chest pain were enrolled as study group. 130 age and gender matched patients with non-cardiac complaints were acted as control. Patients with bleeding disorders, preeclampsia, sepsis, recent blood transfusion (within 6 weeks), major operations, trauma(within 6 weeks), or receiving drugs which can cause thrombocytopenia were excluded from the study.

Data was analyzed using SPSS Vs. 20 (IBM Corp) ® and Microsoft excel (Microsoft corp. pvt. ltd.™) expressed as percentage and mean ± standard deviation. Statistical tests used were chi-square test, Fisher exact test, student t test and ANOVA test. ROC curve was plotted to assess the diagnostic significance of the parameters. Sensitivity and specificity were used to assess the accuracy of diagnostic significance of the parameters. P<0.05 was treated as statistically significant.

RESULTS:

Distribution Of Cases:

There were total of 130 patients of CAD which included 30 chronic stable angina, 34 unstable angina and outright myocardial infarction in the form of 16 NSTEMI and 50 STEMI. Though the CAD includes all types of coronary artery diseases for convenience we restricted the term CAD for chronic stable angina (CSA) and unstable angina (UA) and considered MI (with outright necrosis) as separated group further classifying it into NSTEMI and STEMI.

Age And Sex Distribution Of CAD And MI Cases :-
Most of the cases (n=89, 68.46%) were in 45-65year age group. The Mean age was-55.76±9.2 and that of UA, STEMI, NSTEMI and CSA cases was 55.38, 54.82, 56 and 57.66 respectively. There were 89 males (68.46 %) and 41(31.53 %) females in the whole group of CAD and MI. In males UA was commonest (73.52%) followed by NSTEMI (68.75%), CSA (63.33%) and STEMI (51.52%) while in females chronic stable angina was commonest 36.66% followed by UA 26.48%, STEMI 24.25% and NSTEMI 14.70%.

PLATELET STUDIES IN CAD AND MI:-
The platelet parameters, which were taken into account in the study were Mean platelet volume (MPV), Platelet distribution width (PDW), Platelet large cell ratio (P-LCR) and Platelet count (PC) obtained by automated hematology analyzer and study of platelet morphology in Peripheral Blood Smear (PBS).

Table 1:- Comparison Of Mean And Standard Deviation Of Various Platelet Parameters In CAD And MI And Control.

GROUPS	MPV (Fl)	PDW(fL)	P-LCR(fL)	Platelet count (Lacs/cm³)
CSA	9.49±0.7	10.27±.88	18.53± 0.70	3.52±0.61
UA	10.48±0.64	11.44± 0.76	20.29±1.9	2.97± 0.59
NSTEMI	10.86± 0.7	12.20±0.91	22.89±0.70	2.29±0.44
STEMI	12.08±0.66	13.82±1.01	24.11± 1.95	2.22± 0.54
Control	8.96±1.13	9.64±0.70	18.01±0.55	3.13±0.76
p-value	<0.001	<0.001	<0.001	<0.05

There was statistically significant difference in the mean value of MPV, PDW P-LCR and Platelet count in various types of coronary artery diseases and MI when compared to control group. The mean value of MPV, PDW and P-LCR were increased in all groups of CAD compared to control. Highest increased of all three platelet indices in STEMI followed by NSTEMI then UA and CSA. The mean value of platelet count was low in UA, NSTEMI and STEMI compared to control. Lowest value of platelet count was in STEMI (2.22±0.5382 lacs/cm³) followed by NSTEMI (2.29 ±0.4407 lacs/cm³) and UA (2.97±0.5862 lacs/ cm³).In case of chronic stable angina(CSA) mean value of platelet count(3.52±0.6048 lacs/ cm³) was higher compared to control (3.13± 0.7553lacs/ cm³).So above table suggested that all three platelet indices were raised more in MI group followed by UA and CSA and platelet count was lowest in MI group compared UA.

Table 2:-comparison Of Means Of Different Platelet Parameters Among The Different Groups Of Coronary Artery Diseases And Myocardial Infarction (PValues)

Comparison Groups	P values			
	MPV	PDW	P-LCR	Platelet Count
UA v/s STEMI	<0.01	<0.01	<0.01	<0.01
UA v/s NSTEMI	0.083	<0.01	<0.01	<0.01
CSA v/s UA	<0.01	<0.01	<0.01	<0.01
CSA v/s NSTEMI	<0.01	<0.01	<0.01	<0.01
CSA v/s STEMI	<0.01	<0.01	<0.01	<0.01
STEMI v/s NSTEMI	<0.01	<0.01	<0.01	0.635
ACS v/s CSA	<0.01	<0.01	<0.01	0.58

There was statistically significant difference seen in mean of MPV,PDW and P-LCR in between all groups but in case of STEMI v/s NSTEMI and ACS v/s CSA the mean of platelet count was almost similar and statistically not significant.

Platelet Morphology:
Cases with larger platelets in CAD and MI and Control:
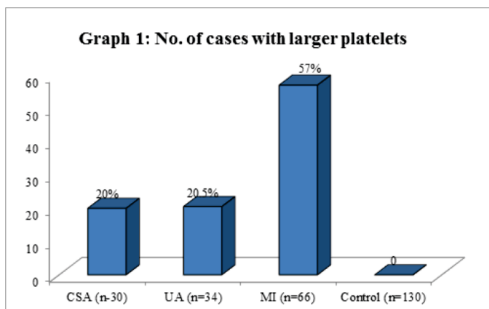
It can be inferred from above graph that cases with larger platelets were more frequent in MI (57%) followed by UA (20.5%) and CSA (20%) and range of PLCR for CSA was almost similar to control. On further analysis it was found that 42 out of 51 cases of CAD (72%) with giant platelets showed higher values for PLCR than the highest limit of control PLCR with range of 22.5-29 fL. While as 45 out of 79 (56.9%) case of CAD without giant platelets had raised PLCR than the highest limit of control. The range of PLCR in this group was 20.1-27.7 fL.

ROC curve:
Receiver Operating Characteristic (ROC) curves were constructed to find out cut off values and to detect diagnostic utility of platelet indices in MI and UA (ACS) comparing with control.
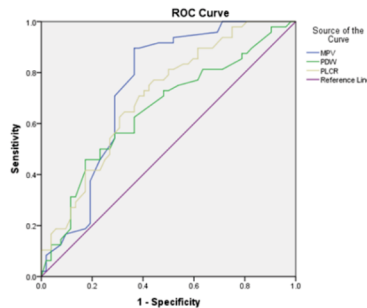

Figure 2:- Receiver operating characteristic (ROC) curves constructed to detect diagnostic utility of acute myocardial infarction (MI) and Unstable angina when compared with healthy controls. AUC: area under the curve, CI: confidence interval, MPV: mean platelet volume, PDW: platelet distribution width, P-LCR: platelet large cell ratio; Sens: sensitivity, Spec: specificity.

Table 3:- Diagnostic Accuracy Of Platelet Indices In ACS:

Parameters	AUC	95%CI	Cut-off	Sensitivity %	Specificity %	p-value
MPV	0.740	0.640-0.841	10.94	89.6	89.6	<0.05
PDW	0.652	0.543-0.760	12.05	72.9	50	0.009
P-LCR	0.704	0.603-0.805	21.89	77.1	55.8	<0.05

All platelet indices (MPV, PLCR and PDW) were the good indicator to detect patients with UA and MI (ACS).

DISCUSSION
Importance of atherosclerosis in CAD is well established. The multifactorial and chronic nature of the atherosclerotic process has been discussed quite extensively in literature[3,4,8,9]. Most of the authors have restricted themselves to few groups of CAD for comparison or have done comparison of platelet parameters in control and some groups of CAD. There is hardly any study which has mention platelet morphology. In present study we have comprehensively used most of the parameters in all types of CAD and compare these parameters in amongst the various groups of CAD.

In our study all the platelet indices namely MPV, PDW, P-LCR were significantly raised in CAD as compared with control. They showed progressively rise with increasing severity of CAD from CSA to STEMI. The difference between these groups was statistically significant. As far as the platelet count was concerned, when study population was considered as a whole group of CAD and compared with control, the platelet count was significantly decreased in CAD. Interestingly, the platelet count was raised significantly in CSA when compared with control, while it showed progressive decline from UA, NSTEMI and STEMI. This indicates that the decline in platelet count is comparatively severe in ACS. The experience of rise in platelet indices like MPV, PDW and P-LCR has been shared by authors like Khandekar et al, Khode et al and Desai KN et al[4,10,11]. The rupture of atherosclerotic plaque results in reactivation of platelets along with platelet adhesion. This explains increase in their mean volume (MPV) and distribution width (PDW). The invitation to morphologically large platelets to site of rupture explains increased platelet large cell ratio (PLCR)[10,12].

The experience of the declining platelet count in ACS has been shared by Marcan et al[13] and Costa et al[14]. We assume that the critical events of rupture of atherosclerotic plaque which is associated with platelet adhesion to the ruptured site may result in overconsumption of

platelets and hence lead to the decline in platelet count. Similar view is expressed by some authors like Pzzuli et al, Marcan et al and Costa et al[13,14,15]. However, there are some studies in which platelet count was raised in MI compared to control. There is no explanation offered for this finding.[16,10]

In our series we have studied morphology of platelet on Peripheral Blood Smear. Intestinally about 57.5% cases of MI showed larger platelets which indicate increased and hurried thrombopoiesis. The PLCR range for this case was highest with values of 22.5-29 fL when compared with UA and CSA. Unfortunately, none of the studies that we have considered for comparisons have attempted morphological studies of platelets.

Comparison of diagnostic utility of platelet indices using ROC in various studies

Very few authors have attempted estimation of diagnostic utility of platelet indices like sensitivity and specificity using ROC. Pervin et al[17] had highest AUC for MPV and PDW and hence sensitivity and specificity was good but they not included PLCR in their study. So in our study we had highest AUC & hence highest diagnostic utility for all three platelet indices compared to Dehghani et al[12] and Pipliwal et al[10]. Dehghani et al[18] have attributed their low sensitivity and specificity to low AUC with values lying very near to control line.

Strength:

The strength of present study lies in its comprehensive nature wherein we have studied all groups of coronary artery diseases and with all platelet indices, platelet count and platelet morphology. As also we have done the detail study of diagnostic utility of platelet indices.

Limitation:

The limitation and constraint of present study is its moderate sample size and failure to study the correlation of these parameters with morbidity and mortality.

CONCLUSIONS:

The platelet indices namely MPV, PDW, P-LCR of CAD were significantly raised when compared with control. The rise was progressive amongst various groups from CSA to STEMI, the difference between these groups being statistically significant. There was progressive decrease in platelet count from UA to STEMI. The platelet count is raised significantly in individual group of CSA when compared with control. In the group of ACS the highest sensitivity and specificity was found out for MPV (89.6 % and 89.6%) followed by PLCR (77.1% and 55) and PDW (72.9% and 50%) respectively.

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