

RELATIONSHIP BETWEEN RED BLOOD CELL AND PLATELET INDICES IN IRON DEFICIENCY ANEMIA

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ABSTRACT

Objective: To find out the correlation between the red blood cell and platelet indices in patients presenting with iron deficiency anemia at a tertiary care hospital of Pakistan.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Hematology, Combined Military Hospital Lahore, from Sep 2018 to Mar 2019.

Methodology: The patients of age 1-70 years of either gender presenting with IDA were included in the study. The blood sample of patients were sent to laboratory to assess the red blood cell and platelet indices. SPSS-23 was used to analyze data.

Results: Two hundred and seven patients fulfilling the inclusion criteria were included in this study. The mean age was 25.6 ± 17.8 years. Correlation was weak and insignificant between haemoglobin and packed cell volume ($r=-0.385^{**}$, $p<0.01$), haemoglobin and mean cell volume ($r=-0.225^{**}$, $p<0.01$), packed cell volume and mean cell haemoglobin ($r=0.263^{**}$, $p<0.01$), & mean cell haemoglobin and mean platelet volume ($r=0.143^{*}$, $p<0.05$). Correlation was moderate and significant between platelet distribution width and mean platelet volume ($r=0.511^{**}$) & platelet distribution width and platelet large cell ratio (0.502^{**} , $p<0.01$). Correlation was strong between mean platelet volume and platelet large cell ratio ($r=0.759^{**}$, $p<0.01$).

Conclusion: In conclusion, there was significant relation between red blood cell and platelets indices in iron deficiency anemia. Furthermore, haemoglobin and packed cell volume are weakly correlated, platelet distribution width and mean platelet volume are moderately correlated and mean platelet volume and platelet large cell ratio are strongly correlated.

Keywords: Iron deficiency anemia, Platelet indices, Red blood cells.

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INTRODUCTION

Iron deficiency anemia (IDA) is a global health problem affecting people of all age groups, being most prevalent in children, women and elderly where it complicates different underlying medical conditions. IDA is among the five leading causes of disability among humans. It's aetiology is multifactorial involving physiologic, pathologic, genetic and environmental causes¹. Anemia in elderly is associated with multiple comorbidities which makes its diagnosis and management a challenge². A worldwide wide survey in 2010 estimated that approximately 1.24 billion people are affected with iron deficiency anemia with variations in low and high income countries³. More than 500 million women of reproductive age group are affected by anemia globally which contributes to mortality and morbidity in pregnancy^{4,5}.

Iron deficiency anemia adversely affects the growth, cognition, mortality and morbidity of children in Pakistan. According to a national survey 33.2% of children aged >5 years are iron deficient leading to

stunted growth⁶. In Pakistan several factors contribute to IDA which include poverty, illiteracy, malnutrition and lack of proper policies and infrastructure. A multi-pronged approach is required to combat all these issues in women and children which are the most affected⁷. Iron is an important micro nutrient whose deficiency in pregnancy is prevalent in Pakistani women living in urban areas up to 29-50%. It is most common during second trimester⁸.

The causes of IDA include increase in red blood cell destruction or reduction in red cell production, blood loss due to injury or trauma and alterations of platelet count⁹. Moderate IDA is often associated with thrombocytosis and severe IDA, when haemoglobin level is <7g/dl mostly accompanies thrombocytopenia¹⁰. In different studies conducted in mice showed that iron deficiency contributed to increased erythropoietin activity leading to secondary activation of megakaryopoiesis. This observation lead clinicians to notice that in humans iron deficiency anemia is associated with normal, high or rarely low platelet count as compared to beta thalassemia where there is no such change in spite of increased EPO activity. Therefore, estimating the changes in platelet and red blood cell indices is important in IDA.

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Hence the present study was conducted to find out the correlation between the red blood cell and platelet indices in patients presenting with iron deficiency anemia at a tertiary care hospital of Pakistan.

METHODOLOGY

It was a cross-sectional conducted at the department of hematology of Combined Military Hospital Lahore, from Sept 2018 to Mar 2019. The sample size was estimated using online sample size for correlation calculator by taking statistics for correlation between Haemoglobin and platelet count as $r=-0.249$, power of test as 80% and 95% confidence level in IDA patients, the calculated sample size came out as 204. However, we enrolled 217 IDA patients using non-probability consecutive sampling technique. The patients of age 1-70 years of either gender presenting with IDA were included in the study. Patients with chronic disease, comorbid (hypertension, diabetes mellitus, obesity & ischemic heart disease) & renal dysfunctions were excluded from the study.

The ethical review committee approval (Number 132/2019) was sought before the conduct of study. Informed written and verbal consent was taken from all the patients. Information regarding age and gender were obtained from all the patients. The blood sample of patients were sent to laboratory to assess the hemoglobin level (g/dl), hematocrit (HCT%), Mean cell volume (MCV fL), mean cell hemoglobin (MCH pg), red cell distribution width (RDW fL), Platelet count (PLT $\times 1000/\mu\text{L}$), Platelet distribution width (PDW fL), Mean platelet volume (MPV fL) & Platelet larger cell ratio (PLCR%).

SPSS-23 was used to analyze data. Mean & SD was reported for all continuous variables whereas frequencies & percentages were computed for all qualitative variables. Pearson correlation was applied to see the relationship between red blood cell & platelet indices. A $p \leq 0.05$ was taken as statistically significant.

RESULTS

Two hundred and seventh patients fulfilling the inclusion criteria were included in this study. The mean age was 25.6 ± 17.8 years. Majority of the patients were adults (38.7%) followed by children (22.6%) (table-I). Out 217 IDA patients, most of them were females (51.6%) as compared to males (48.4%).

Out of 217 IDA patients, majority of the patients had Hb < 10g/dl (63.6%), low Hct% (91.2%), normal RDW fL (80.2%), normal platelet count ($\times 1000/\mu\text{L}$) (71.9%), normal PDW fL (84.3%), normal MPV fL (88%)

& normal PLCR% (90.8%) whereas all the patients had low MCV fL (100%) as shown in table-II.

Table-I: Frequency distribution of age.

Variables	n (%)
Age Groups	
Children (1-12 yrs)	49 (22.6)
Teenagers (13-19 yrs)	34 (15.7)
Adults (20-35 yrs)	84 (38.7)
Older adults (36-55)	35 (16.1)
Elders (>55 years)	15 (6.9)
Mean \pm SD	25.6 \pm 17.8

Table-II: Hematologic parameters.

Variable	n (%)
Haemoglobin (g/dl)	
<10 g/dl	138 (63.6)
10-13.5 g/dl	79 (36.4)
Haematocrit or packed cell volume (%)	
Normal	19 (8.8)
Low	198 (91.2)
Mean cell volume (fL)	
Normal	-
Low	217 (100)
Mean cell haemoglobin (pg)	
Normal	9 (4.1)
Low	208 (95.9)
Red cell distribution width (fL)	
Normal	174 (80.2)
Low	43 (19.8)
Platelets ($\times 1000/\mu\text{L}$)	
Normal	156 (71.9)
Low	3 (1.4)
High	58 (26.7)
Platelet distribution width (fL)	
Normal	183 (84.3)
Low	23 (10.6)
High	11 (5.1)
Mean platelet volume (fL)	
Normal	191 (88.0)
Low	24 (11.1)
High	2 (0.9)
Platelet large cell ratio (%)	
Normal	197 (90.8)
Low	18 (8.3)
High	2 (0.9)

Correlation was weak and significant between Hb & PCV ($r=-0.385^{**}$, $p < 0.01$), Hb & MCH ($r=-0.225^{**}$, $p < 0.01$), PCV & MCH ($r = 0.263^{**}$, $p < 0.01$), & MCH & MPV ($r=0.143^{*}$ $p < 0.05$). Correlation was moderate and significant between PDW & MPV ($r=0.511^{**}$, $p < 0.01$) & PDW & PLCR (0.502^{**} , $p < 0.01$). Correlation was strong between MPV & PLCR ($r=0.759^{**}$, $p < 0.01$) (table-III).

Table-III: Pearson's correlation between red blood cell & platelet indices

	Hb	Packed cell volume	Mean cell haemoglobin	Red cell distribution width	Platelet	Platelet distribution width	Mean platelet volume	Platelet large cell ratio
Haemoglobin	1	-0.385**	-0.225**	-0.113	-0.092	-0.003	-0.072	-0.042
Packed cell volume	-0.385**	1	0.263**	-0.010	0.047	0.041	-0.041	-0.018
Mean cell haemoglobin	-0.225**	0.263**	1	0.045	0.130	-0.041	-0.143*	-0.099
Red cell distribution width	-0.113	-0.010	0.045	1	0.006	-0.018	-0.038	-0.036
Platelet count	-0.092	0.047	0.130	0.006	1	0.026	0.086	0.050
Platelet distribution width	-0.003	0.041	-0.041	-0.018	0.026	1	0.511**	0.502**
Mean platelet volume	-0.072	-0.041	-0.143*	-0.038	0.086	0.511**	1	0.759**
Platelet large cell ratio	-0.042	-0.018	-0.099	-0.036	0.050	0.502**	0.759**	1

** $p < 0.01$

DISCUSSION

Around the globe, iron deficiency anemia is the most prevalent disease. The biochemical markers are variable among population. Complete blood count is therefore most significant test to rule out other anemias. Keeping this biochemical variation in view, the present study is conducted to ascertain correlation among different hematological markers in patients lacking serum ferritin. According to sociodemographic variables of this study are similar to study conducted in China; however, the participants enrolled in the study had mean age of 52 years^{11,12}. On contrary, Kadikoylu *et al* and Park *et al* conducted study among female population only^{12,13}. There is disagreement between findings of platelet count. The results of our study showed that 71.9% has normal platelet count while 26.7% had high platelet count ($58 \times 1000/\text{ul}$) whereas other study showed normal platelet count ($400 \times 1000/\text{ul}$)¹⁰.

Recent studies reported that IDA can be associated with either thrombocytopenia or thrombocytosis. The results of our study are similar with the study of Yung *et al* and Kadikoylu *et al* where it was found that there exists a significant difference between IDA and platelet count. It was statistically significant between IDA and thrombocytosis and normal platelet count ($p < 0.01$)^{13,14}. A study showed mean red cell distribution width in IDA pregnant women $12.83 \pm 1.03\%$ in contrast with our study there was a negative correlation between Hb and RDW but a negative correlation between haemoglobin level and platelet count i.e. -0.09215.

In a Turkish study¹⁶ and a study conducted by Dan *et al*¹⁸, MPV and Platelet count showed positive correlation similar to present findings¹². In another study, Cho *et al* assessed MPV/platelet ratio in IDA group. The results reported are same with slight fluctuation

in numbers. This provides great support to our findings. There was reported thrombocytosis that is quite comparable with our findings and subjects showed less MPV/platelet count ratio ($p < 0.001$) in addition, ROC curve analysis of MPV/platelet count ratio showed 73% sensitivity and 80% specificity 79.6% at a cut-off level of 0.031812.

The results of our study is also comparable with Semmelrock *et al* study that reported there is strong evidence of statistical relation of IDA and red blood cell parameters. Supporting these results, a study tested 917 blood donors suffering from IDA. The results showed that hemoglobin was impaired in 17% females which are highly variable as compare to our study¹⁷. Another study supporting the statement reported that reticulocyte count is directly proportional with haemoglobin, mean corpuscular volume, mean corpuscular haemoglobin¹⁸. A correlational study among PCT, RDW, MPV, MCV, HCT and PDW was carried out. The study showed no correlation between platelet crit and hematocrit. Moreover MCV and MPV also had not correlation between them. However, on the contrary, PDW and RDW were found significantly correlated with each other¹⁹.

CONCLUSION

In conclusion, there was significant relation between red blood cells and platelets indices in iron deficiency anemia. Furthermore, haemoglobin and haematocrit are weakly correlated, platelet distribution width & mean platelet volume are moderately correlated and mean platelet volume and platelet large cell ratio are strongly correlated. There is immense literature available yet no strategies to treatment planning are devised. Platelet indices and red cell parameters have great impact upon quality of life. If better treatment strategies are devised, there will be a great reduction in

morbidity rate and patient's quality of life can be enhanced. There is a need of proper screening and monitoring of the patients presenting with IDA to avoid anemia and to improve health status and quality of life in these patients.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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