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Original Article

Hemogram components and platelet count variation in anemic patients attending Birat Medical College and Teaching Hospital

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ABSTRACT

Background: Anemia being the expression of the underlying disease is a global public health problem affecting both developing as well as developed countries. The RBC indices and platelet count variation among anemic patients are important to know their association for clinical implications.

Materials and Methods: A hospital-based cross-sectional study among anemic patients with hemoglobin <10 gm%, attending Birat Medical College Teaching Hospital, Nepal from 15 May to 15 July 2020 were analyzed for RBC indices and platelet count variation. Demographic data, RBC indices, platelet count variation, and types of anemia were evaluated. Pearson's correlation coefficient was used for correlating the platelet count with RBC indices. A Chi-square test was used to know about the association between the types of anemia and platelet count variation.

Results: Out of 150 anemic patients, the female to male ratio was 1.5:1, with the most common age group between 40-49 years. There exist high differences between minimum and maximum individual RBC indices (Hb, MCV, MCH, MCH) and platelet count values. The platelet count variation with RBC values and MCV had a statistically significant positive and negative correlation respectively. However, the correlation between platelet count variation with hemoglobin concentration level and type of anemia was positive but statistically not significant.

Conclusion: Findings suggest that platelet count variation with RBC indices and types of anemia correlated well among anemic patients. Such association will enable the clinicians for diagnosing and treatment purposes.

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INTRODUCTION

Anemia can be defined as a condition in which the number of red blood cells (RBC) or the hemoglobin (Hb) concentration within them is lower than normal and consequently their oxygen-carrying capacity is insufficient to meet the body's physiologic needs. The physiologic need varies with a person's age, gender, altitude, ethnicity, and different stages of pregnancy.[1] The World Health Organization defines anemia in adult men as hemoglobin concentration <13gm/dl, in non-pregnant (>15 years) <12gm/dl, in teens (12-15 years) <12gm/dl and children (5-12 years) <11.5gm/dl.[2] It is further categorized according to severity into mild (11-12.9gm/dl), moderate (7-10.9gm/dl), and severe (<7gm/

dl) degree of anemia for adult men.[3] For non-pregnant women (15 years of age and above), 11.9–11gm/dl for mild, 10.9-8gm/dl for moderate, and <8gm/dl for severe anemia.[1] Anemia is a public health problem that affects populations in both rich and poor countries (1.62 billion people corresponding to 24.8% of the population globally). Anemia is the result of a wide variety of causes that can be isolated, but more often coexist.[4] However, the etiological factors for anemia vary geographically.[5]

Globally, the most significant contributor to the onset of anemia is iron deficiency.[6] The presence of other micronutrient deficiencies, including vitamin B12, folate, riboflavin, vitamin A and copper can increase the risk of anemia.[4] Morphologically, anemia can be classified as microcytic hypochromic anemia which shows reduced MCV (mean corpuscular volume) values (<80fl) as well as reduced MCHC (mean corpuscular hemoglobin concentration) values (<30gm/dl), normocytic normochromic which has normal MCV (82-100fl) values, macrocytic anemia which shows characteristics increased MCV values (>100fl) and normal MCHC.[10] Anemia being the expression of underlying diseases, hence the different hemogram components and platelet count with its variation may be evaluated further to know about their association if any.[7]

The normal count of platelet in the blood is 1.5 to 4 lakhs/mm^{3}.[12] They are formed in the bone marrow and have a role in platelet plug formation, clot retraction, and repair of damaged blood vessels.[8] However, there is less information on the relation between low or high Hb level on platelet count. One of the study[9] showed a statistically significant inverse linear relationship between hemoglobin concentration and platelet count. There are only a few reports in the literature regarding the correlation of platelet and red blood cell parameters. Such study is important, as many anemic patients are associated with platelet disorders. The objective of this study is to evaluate the correlation of different RBC values and platelet count variation in anemic patients with Hb<10 gm/dL.

MATERIALS AND METHODS

This was a hospital-based cross-sectional study conducted in the Department of Pathology, Birat Medical College Teaching Hospital (BMCTH), Morang, Nepal commencing from 15 May to 15 July 2020, after receiving permission from the institutional review committee.

The sample size for the study was calculated by using following formula:

Sample size (n) = z2 x (pq)/e2 = 1.96x1.96x0.5(1-0.5)/0.12 = 96

where, z= 1.96 at 95% CI,

p= prevalence proportion in target population to have certain character,

q= (1-p),

e= allowable error.

The minimum sample size calculated was 96. 50%, additional samples were taken to address incompleteness in the sample size resulting in a total of 144. Maintaining this, a final sample size of 150 was thus taken for study.

The study included 150 anemic patients irrespective of age and sex whose hemoglobin concentration was below 10gm%. The different hematological parameters including Hb, MCV, mean corpuscular hemoglobin (MCH), MCHC and platelet count were taken into account. The white blood cell evaluation among hemogram components was excluded from the study. The study blood samples were received from patients either from inpatient or outpatient hospital services in the sample collection room of the Central Laboratory Service (CLS) unit at Birat Medical College Teaching Hospital (BMCTH), Morang, Nepal. All of the different hematological parameters included in the study were estimated by an automated blood cell counter (Beckman Coulter DxH 500 and BeneSphera H33s) after the samples were collected in an Ethylene Diamine Tetra Acetic Acid (EDTA) vial by the technician and sent along with the requisition form to the pathology laboratory (hematology unit). A peripheral blood smear was also done for each of these patients and smears were prepared and stained using Jenner Giemsa stains. The age and sex of the patients along with results of the investigation including that of peripheral blood smears were taken into account. The collected data were entered in Microsoft Office Excel and converted into SPSS version 16 for statistical analysis. Pearson's coefficient was calculated to see the correlation between the platelet count and RBC indices components. The descriptive and inferential statistics were done by using the Chi-square test to know about the association between the types of anemia and platelet count variation. A p-value <0.05 was considered significant.

RESULTS

Out of the total study population of one hundred and fifty cases, the female (n=92; 61.34%) population was predominant over the male (n=58; 38.66%) with the highest frequency in the fourth decade of life (Table 1).

The minimum and maximum values of Hb level, MCV, MCH, MCHC, RBC concentration, and platelet count along with its mean and standard deviation were calculated (Table 2).

Microcytic hypochromic anemia was the most common type followed by normocytic and macrocytic anemia. Similarly, total platelet count variation was calculated via an automated blood cell colter machine (counter-checked manually via peripheral blood smear findings for the flagged

Table 1: Frequency of age groups of the anemic patients among the study population

Age group (years)	Frequency n (%)
0-9	**16 (10.7%)**
10-19	19 (12.7%)
20-29	20 (13.3%)
30-39	18 (12.0%)
40-49	24 (16.0%)
50-59	18 (12.0%)
60-69	15 (10.0%)
≥70	20 (13.3%)

ones). The majority revealed normal count followed by thrombocytopenia and thrombocytosis respectively (Table 3).

The correlations between RBC indices and platelet count variations were examined using the Pearson correlation coefficient. Among these, the platelet count and RBC values had a statistically significant positive correlation (r 0.224, p-value 0.006). Likewise, platelet count and MCV revealed a statistically significant negative correlation (r -0.224, p-value 0.006). However, the platelet count correlation with hemoglobin concentration level though had positive correlation was not statistically significant (r 0.085. p-value 0.302) (Table 4).

The different types of anemia were cross-tabulated with the platelet count variation obtained in the study (using chi-square test) revealing a positive association between them but were statistically not significant (p-value = 0.051).

DISCUSSION

Our study included anemic patients with Hb levels below 10 gm% irrespective of any age group and sex. Among which female (61.34%) gender was predominant over the male (38.66%) with commonest age group within 40-49 years (Table 1). A similar kind of study conducted by Jadhav SU et al10 also had the inclusion criteria of anemic patients with Hb level below 10gm%, but the study population was within the age group of 20-40 years. The RBC indices and platelet count were taken into account individually in our study (Table 2). A study done by Jadhav SU et al[10] had the result of hemoglobin concentration range more among 59 females with 9.1-10 gm/dl and 41 males of 6.1-7gm/dl. The maximum percentage of anemic patients showed the platelet count in the range of 1.5-2.5 lakhs/mm^3. Likewise, the least percentage of patients showed a platelet count less than 0.5 lakhs/ mm^3. In contrast, our study revealed 103 (88.7%), 29 (19.3%) and 18 (12.0%) anemic patients with normal platelet count of range from 1.5-4.5 lakhs/mm^3, decrease platelet count below 1.5 lakhs/mm^3 and increase platelet count above 4.5 lakhs/mm^3 respectively.

Similarly, the types of anemia were classified by evaluating MCV and MCH components. Among them, most of them were microcytic hypochromic with 82(54.70%) cases followed by normocytic normochromic and macrocytic anemia respectively. A study done by Jadhav SU et al[10]

Table 2: Showing RBC indices and platelet count with range values

RBC indices & platelet count (units)	Minimum	Maximum	Mean	Std. Deviation
Hb Level (gm/dl)	**2.5**	**9.9**	**7.718**	**1.7143**
MCV (fl)	47.60	158.00	79.7415	16.65500
MCH (pg)	13.7	330.4	28.796	30.9026
MCHC (gm/dl)	17.9	40.3	31.240	2.7466
RBC (million/mm3)	0.2	5.3	3.125	0.8938
Platelet (lakh/mm3)	0.19	6.74	2.5231	1.31357

Table 3: Showing the different types of anemia and platelet count variation

Types of anemia	Platelet count variation		
	Thrombocytopenia	**Normal count**	**Thrombocytosis**
Microcytic hypochromic	09(11.0%)	60(73.2%)	13(15.9%)
Normocytic normochromic	15(30%)	31 (62.0%)	04(8.0%)
Macrocytic anemia	05(27.8%)	12(66.7%)	01(5.6%)

Table 4: Correlation of RBC indices with platelet count variation

	RBC and indices values				
Platelet count variation	Hb	MCV	MCH	MCHC	RBC
Pearson's correlation coefficient (r)	0.085	-0.224	-0.049	-0.078	0.224
p-value	0.302	0.006*	0.555	0.345	0.006*

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also revealed the same kind of result with a maximum number of study cases being microcytic hypochromic anemia (28%) followed by normocytic normochromic (20%) and macrocytic anemia (10%) respectively. On the other hand, the platelet count variation in our study revealed predominantly a normal count of 103 (68.70%) cases followed by thrombocytopenia and thrombocytosis respectively. Unlike our study findings, the study done by Jadhav SU et al[10] revealed thrombocytopenia as the most common outcome within total platelet count variation. Likewise, thrombocytopenia and thrombocytosis are also observed in normocytic and microcytic hypochromic anemia as 15 (30%) and 13 (15.9%) respectively in our study. Such variation of platelet count among anemic patients may be related to erythropoietin (EPO) and thrombopoietin (TPO). The EPO, regulator of erythropoiesis has structural similarity with TPO, the stimulator of megakaryopoiesis. Increased EPO and its structural analogy to TPO have been considered as a possible mechanism for such platelet count variation.7

The different RBC indices of anemic patients in our study correlated with the platelet count. Among them, MCV had a statistically significant negative correlation with platelet count (r -0.224, p-value 0.006). This finding was similar to the study conducted by Ray S et al[11], however, the correlation was statistically not significant revealing a p-value of 0.197. Similarly, the RBC components in our study strongly correlated with the platelet count, which was statistically significant (r 0.224, p-value 0.006 each). This significant correlative finding thus reflects the directly proportional relationship between the platelet count and RBC values in anemic patients, reflecting the relation between EPO and TPO, as stated above. Likewise, the hemoglobin concentration level of our study population had a positive correlation with the platelet count but was not statistically significant (r 0.085. p-value 0.302). However, in the study done by Ray S et al[7], the platelet count had a statistically significant negative correlation with hemoglobin concentration (r-value -0.157 and p-value 0.042). Similarly, a study done by Ram Mohan A et al[11] yielded inverse correlations between the hemoglobin concentration and the platelet count. Likewise, in the study conducted by Jadhav SU et al[10] the platelet count was found to be decreasing along with the reduction in the hemoglobin concentration level. The remaining other RBC indices (MCH and MCHC) in our study revealed the negative correlation between platelet count with MCH (r -0.049, p-value 0.555) and MCHC (r -0.078, p-value 0.345) level, which was statistically not significant.

Similar kind of correlative findings between platelet count and hemoglobin concentration level was also found in the study done by Brad AS and team.[12] Result of their study showed that the lower side of platelet count revealed more Hb concentration level and vice-versa.

This study revealed a positive but statistically insignificant relationship between platelet count and hemoglobin concentration. This signifies the minor effects between these two parameters. The reason for the relationship between low and high platelet count on hemoglobin level may be linked to the normal physiology of hematopoiesis where the origin of all blood components occurs in the bone marrow. Similarly, there was a statistically significant positive association between platelet count and RBC values. Hence, if the bone marrow gets affected, it would affect all of the blood cells including hemoglobin and platelet concentration level.

Similarly, the individual types of anemia in our study were associated with the platelet count variation made by cross tabulating between these parameters. The result was achieved using Pearson's Chi-square test, revealing a positive association with statistically not significant (p-value 0.051).

CONCLUSIONS

The correlation between RBC indices and types of anemia with platelet count among anemic patients re-enforces the importance of their association. This will enable the clinicians for diagnosis and treatment purposes, as cases of anemia are associated with platelet disorders. The different RBC indices are valuable for the morphological classification of anemia. As different etiologic factors result in different RBC morphology characteristically, the attending physicians or clinicians can generate adequate treatment plans for an anemic patient if the blood counts are interpreted as per RBC indices.

Limitation of the study

The study would have been more informative if we had looked after the other associated systemic complications among the study population. Complete hemogram components including white blood cell evaluation should have been evaluated to understand the correlation better.

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Conflict of interest: None

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