International Journal of Research and Reports in Hematology

5(2): 258-263, 2022; Article no.IJR2H.94690

Iron Deficiency Anemia: An Analysis of Mean Platelet Count Ratio of before and after Treatment in Bangladesh

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Authors' contributions

This work was carried out in collaboration among all authors. Author MMH designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors MMH, SI and SA managed the analyses of the study. Author MSI managed the literature searches. All authors read and approved the final manuscript.

Article Information

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/94690

Original Research Article

Received 06 October 2022
Accepted 10 December 2022
Published 14 December 2022

ABSTRACT

Background: The most prevalent dietary-related anemia, iron deficiency anemia (IDA), is a significant global public health issue. IDA causes micro thrombosis because iron inhibits megakaryopoiesis. Thrombocytosis is improved with iron therapy.
Objective: The aim is to evaluate the role of mean platelet count ratio in iron deficient anemia diagnosis.
Methods: A retrospective analysis was conducted in the pediatric ward of the Chuadanga Sadar hospital between 11 November 2021 and 27 June 2022. 52 people in all have had iron deficiency anemia identified (35 were males, and 17 were female).
Result: The age of the patients ranged from (3-240.1) months and was 4.8 years on average. The average Hb was 8.1 g/dl, the average MCV was 60.8 fL, the average MPV was 5.7 fL, and the average MPV/PLT ratio was 0.012. The mean Hb was 10.8 g/dl, the mean MCV was 68.3 fL, the MPV was 6.6 fL, the MPV/PLT ratio was 0.02 and the p value was (0.01), considerably higher in the post-therapy group than in the pre-treatment group, and all patients responded to the treatment.

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Conclusion: Based on the data at hand, the MPV/ PLT ratio demonstrated an exceptional level of performance in the diagnosis of IDA; the doctor should take note of this number. It is probable that it will be used in panels alongside more traditional biochemical markers like iron, TIBC, and serum ferritin.

Keywords: IDA; Mean Platelet Count; MPV ratio; Bangladesh

1. INTRODUCTION

Iron is a key component of many molecular systems and is known to be an essential cofactor for many different molecular structures [1]. It is a necessary component for the formation of new red blood cells (RBC). It is retained as protein or pigment if it is not used in an organic process [2]. According to estimates, 30% of the world's population has IDA, with the majority living in poor nations [3]. In poorer nations, inadequate nutritional intake, blood loss due to enteral worm infection, or both often induce iron deficiency and iron-deficiency anemia. Consumption patterns (such as a vegetarian diet or avoiding red meat) and pathological disorders (such as chronic blood loss or malabsorption) are the most prevalent reasons in high-income nations. Ironically, high-income countries seem to have a greater incidence of iron deficiency anemia than low-income nations. The high prevalence of iron insufficiency in aged people is one cause of this [4].

The majority of the daily iron need (approximately 25 mg) is given by macrophages, which phagocytose aging erythrocytes to supply the body with the remaining 1 to 2 mg of iron that is necessary. However, because excess amounts of iron are often hazardous, their absorption is limited. The endocrine hepcidin regulates the latter two systems and keeps total body iron levels within normal limits, preventing both iron deficiency and excess [5]. Blood arteries benefit greatly from platelets. Platelets function primarily as a regulator of hemostasis and thrombosis during their 5-7 day stay in the circulation after being generated by megakaryocytes. The platelets in the blood are activated as a result of a vascular insult or injury, which leads to adhesion to the extracellular matrix exposed under the endothelium, the formation of platelet plugs, and ultimately the formation and consolidation of a thrombus made up of a core and a thrombus membrane [6].

Circulating platelets come in a variety of sizes and functional states. Younger, more active, and producing more thrombotic factors may be larger platelets. The size of platelets is reflected by their mean platelet volume (MPV). It serves as a crucial indicator of platelet function [7]. Even though MPV assessment offers data that is valuable for clinical decision-making, it is still a research tool that hasn't been used to routine clinical decision-making [8]. Iron is not just connected to erythropoiesis; it also inhibits megakaryopoiesis. Iron levels control, along with genetic variables, the lineage commitment of megakaryocytic/ erythroid progenitors toward either bone cell or blood cell progenitors during hematopoiesis and thrombopoiesis [9].

A common finding with unusually low total body iron reserves is thrombocytosis, which may encourage vascular thrombosis [10]. The MPV/PLT ratio quantitative relationship has been proposed as a new parameter for the prediction of long-term mortality in patients with cardiac diseases. Iron therapy should be administered precisely because it causes an increase in thrombocytes in peripheral blood, even though it corrects the symptoms and normalizes peripheral thrombocytes. Patients who have ischemic stroke, heart disease, or thrombosis should use care while receiving iron treatment.

2. MATERIALS AND METHODS

2.1 Study Design and Sampling Technique

A retrospective analysis was carried out in the pediatric department of the Chuadanga Sadar hospital in Bangladesh from November 11, 2021, to June 27, 2022.

2.2 Data collection

As instances of undetected anemia, the patients in this research were sent to a hematology facility. Investigations were performed on a total of 52 individuals (35 men and 17 women), and the diagnosis of anemia was confirmed. Information about patients, including gender, age, and other factors, was taken from their medical records. The patients were categorized

as IDA instances based on the data. Depending on normal iron values and/or abnormal Hb electrophoresis, individuals with hypochromic microcytic anemia other than IDA were eliminated.

2.3 Statistical analysis

Computerized statistical software for social sciences (SPSS) version 25.0 was used to compile and analyze the data. P values 0.05 were regarded as significant when using the SPSS program to find the paired sample test and the independent sample T test. To represent data, mean and standard deviation (SD) were utilized. The cutoff MPV/PLT point's level was determined using the Roc curve.

3. RESULTS

Based on clinical information and laboratory tests such CBC, blood film, iron profile, and Hb electrophoresis, the patients were identified as IDA cases (in some cases). The ratio of men to women was 2.1:1. (35 patients were male and 17 patients were female). Patients ranged in age from 3 to 240.1 months, with a mean age of 59.4 months (4.8 years).

With a range of 4.5 to 15.2 g/dl, the mean Hb is 8.1 g/dl, while the mean RBC was 4.61. The average MCV was 60.8 fL, the average MCH was 17.7 pg, and the average MCHC was 28.61 g/dl. The average MPV was 5.7, the average PLT count was 464,000, and the average MPV/PLT ratio was 0.017. (Table.1).

Blood parameter changes after iron treatment have been recorded and documented. The mean Hb level was 10.8 g/dl and the mean RBC level was 4.8. The average MCV was 68.3 fL, the average MCH was 21.5 pg, and the average MCHC was 31.3 g/dl.

The platelet count was 377,200, the mean RDW was 17.8%, and the MPV was 6.6. The average MPV/PLT ratio is 0.02 percent. Table 2 displays these results.

Additional statistical analysis has revealed that the MPV/PLT ratios changed statistically significantly; it was 0.017 before treatment and became 0.02 after treatment (Table 3).

Table 1. RBCs: IDA before treatment

Item	N	Minimum	Maximum	Mean	SD
Age in months	52	3.11	240.1	59.4	62.3
RBC $X10^{12}$/L	52	2.73	6.12	4.61	0.67
Hb g/dl	52	4.52	15.21	8.12	2.3
HCT %	52	17.81	44.70	27.8	5.5
MCV (fL)	52	48.1	86.81	60.8	7.7
MCH (pg)	52	11.2	30.11	17.7	3.8
MCHC g/dl	52	22.11	34.71	28.61	3.1
RDW %	52	11.31	29.2	17.8	4.5
MPV (fL)	52	4.34	9.01	5.7	1.2
Platelet ($X10^3$/L)	52	99.1	1698	464.09	256.8
MPV/PLT ratio	52	0.0029	0.055	0.017	0.008

Table 2. RBCs: IDA after treatment

Item	N	Minimum	Maximum	Mean	SD
RBC $X10^{12}$/L	45	3.15	6.28	4.8	0.6
Hb g/dl	45	5.99.1	21.30	10.8	2.7
HCT %	45	21	42.30	33.8	4.8
MCV (fL)	45	55.5	84.81	68.3	6.9
MCH (pg)	45	14.5	28.61	21.5	3.8
MCHC g/dl	44	24.2	37.71	31.3	2.7
RDW %	44	11.5	35.21	18.3	6.1
MPV (fL)	42	4.37	9.72	6.6	1.3
Platelet ($X10^3$/L)	45	188.1	1147	377.3	173.1
MPV/PLT ratio	45	0.0033	0.03	0.02	.0082

Table 3. Means of blood parameters

	Pre-treatment	Post-treatment	P value
RBC $X10^{12}$/L	4.61	4.8	0.0001
HB (g/dl)	8.12	10.8	0.0001
HCT %	27.8	33.8	0.0001
MCV (fL)	60.8	68.3	0.0001
MCH (pg)	17.7	21.5	0.0001
MCHC (g/dl)	28.61	31.3	0.0001
RDW %	17.8	18.3	0.9
MPV	5.7	6.6	0.001
Platelet ($X10^3$/L)	464.09	377.3	0.06
MPV/PLT ratio	0.017	0.02	0.01

Table 4. RBCs according to gender

Item	Gender	N	Mean	SD	SE	P value
MPV/PLT ratio						
Before treatment	Male	35	0.0158	0.011	0.001	0.007
After treatment	Male	31	0.0207	0.0077	0.001	
MPV/PLT ratio before treatment	Female	17	0.0178	0.008	0.002	0.6
After treatment	Female	14	0.0196	0.0079	0.002	

Before and after therapy, there is no discernible correlation between MPV/PLATE COUNT and gender, either male or female, according to Table 4.

4. DISCUSSION

The results show that oral iron treatment in individuals with IDA increases Hb, MCV, and MPV levels and decreases platelet count. The most typical form of anemia, iron deficiency anemia, poses a threat to close to 25% of the global population. IDA often appears in young women during menstruation and in children as a consequence of inadequate nutrition. During the pretreatment phase of the laboratory test, the lowest Hb level detected was 4.5 (g/dl), with a mean of 8.1 (g/dl). Averages for HCT, MCV, and MPV were 27.8 L/L, 60.8 L/L, and 5.7 L/L respectively (fL). The mean Hb level over the post-treatment period was 10.8 (g/dl), with the lowest Hb level being 5.8 (g/dl). On average, the HCT was 33.8 (L/L), the MCV was 68.3 (fL), and the MPV was 6.6. (FL). Another study conducted at Adnan Mendere University found that the Hb was 101.4(g/dl), MPV was 8.71.4(FL), and MCV was 70.71.4(FL). It is conceivable that the late diagnosis in the current research, which led to such a diverse outcome, is what caused these results. Reactive thrombocytosis rapidly recovers after iron supplementation [11]. Due to the fact that intracellular iron is kept there, ferritin is a protein that is essential for preserving iron levels in humans. Some of the hematologic features of IDA include low serum ferritin, low iron, increased total iron binding capacity, increased erythrocytes, protoporphyrin, and improved transferrin binding receptor levels [12].

In a previous study, kids received oral ferrous sulfate for eight weeks at a dose of 4 mg/kg/day while their MPV and thrombocyte levels were measured before and after. Although there were fewer thrombocytes following iron therapy, the current study demonstrated an increase in MPV [13]. The duratio and severity of the IDA may affect how the process of platelet production is discovered. It reportedly promotes megakaryogenesis in IDA. 1) In moderate IDA, thrombocytosis may be brought on by a higher primary cell inflow rate and increased flow rate into the megakaryocyte compartment. Giant cell maturatio is accelerated, erythropoiesis inhibition causes stem cells to change, increasing the generatio of other pluripotent cells (a hemostatic compensatory mechanism), transferrin stimulator impacts the development of nuclei, and iron prevents megakaryocyte maturatio [14].

With iron treatment, there may be a release of big, active thrombocytes into the peripheral circulation. Iron-induced elevated oxidative stress may cause a rise in MPV. Megakaryocyte development may be sped up, normal, or increased when iron is present. Additionally, an excess of iron may contribute to excessive

platelet aggregation. Too much iron may make oxidative stress worse, which encourages platelet aggregation [15]. According to the most recent survey, there were more men than women. The relationship between sex and IDA in children has been the subject of contradictory studies. In contrast to our research, data from Yemen and India revealed that females were more likely than boys to have IDA [16]. Boys are more susceptible, nevertheless, according to evidence from Western Kenya and Haiti [17]. 7,148 children, ranging in age from 6 to 59 months, were recorded in the 2011–2012 Pakistan National Nutrition Survey, which also contained a variety of quantitative data. 3449 females and 3699.1 males were counted. 70 of the 80 IDA patients who participated in the trial were female, whereas 10 were male, according to another study [16,17]. The difference could have been caused by the tiny sample size. At a 95% confidence level, the probability that the real value will not fall inside the error bar's range is merely 5%. The tolerance was 74% and the accuracy was 45% based on the MPV/PLT ratio of the ROC curve analysis in both the pre- and post-treatment periods. The AUC is 0.67 and the P-value is 0.002 at the 0.015 cutoff. Another research from Korea found that the tolerance was 72.7% and specificity was 79.6% for the MPV/PLT ratio in the before and after treatment periods at a cut-off rate of 0.0318 with a significant p-value (0.001) [16,17]. The pediatrician may have a strong index of suspicion to diagnose IDA if the MPV/PLT ratio is at level 0.015.

5. CONCLUSION

Based on the data at hand, the MPV/ PLT ratio demonstrated an exceptional level of performance in the diagnosis of IDA; the doctor should take note of this number. It is probable that it will be used in panels alongside more traditional biochemical markers like iron, TIBC, and serum ferritin.

CONSENT

It is not applicable.

ETHICAL APPROVAL

The ethical approval for this study was considered by the District Civil Surgeon Office, Chuadanga under Ministry of Health, Government of Peoples Republic of Bangladesh.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Gunawardena S, Dunlap ME. Anemia and iron deficiency in heart failure. Curr Heart Fail Rep. 2012;9:319 -27.
2. Winter WE, Bazydlo LA, Harris NS. The molecular biology of human iron metabolism. Lab Med. 2014;45:92-102.
3. Jameel T, Baig M, Ahmed I, Hussain MB, Alkhamaly MBD. Differentiation of beta thalassemia trait from iron deficiency anemia by hematological indices. Pak J Med Sci. 2017;33(3):665-669.
4. Kassebaum NJ, Jasrasaria R, Naghavi M, et al. A systematic analysis of global anemia burden from 199.10 to 2010. Blood. 2014;123(5):615-624.
5. Goodnough LT, Nemeth E, Ganz T. Detection, evaluation, and management of iron-restricted erythropoiesis. Blood. 2010; 117(23):4754-4761.
6. Holinstat M. Normal platelet function. Cancer Metastasis Rev. 2017;36(2):195-198.
7. Park Y, Schoene N, Harris W. Mean platelet volume as an indicator of platelet activation: Methodological issues. Platelets. 2002;14(5-6):301-306.
8. Lancé MD, van Oerle R, Henskens YM, Marcus MA. Do we need time adjusted mean platelet volume measurements?. Lab Hematol. 2010;17(3): 28-31.
9. Park MJ, Park PW, Seo YH, et al. The relationship between iron parameters and platelet parameters in women with iron deficiency anemia and thrombocytosis. Platelets. 2014;24(5):348-352.
10. Brissot E, Troadec MB, Loréal O, Brissot P. Iron and Platelets: A subtle, under - recognized relationship. American Journal of Hematology. 2021;96(8):1008-1017.
11. Kadikoylu G, Yavasoglu I, Bolaman Z, Senturk T. Platelet parameters in women with iron deficiency anemia. J Natl Med Assoc. 2006;98(3):398-402.
12. van Tellingen A, Kuenen JC, de Kieviet W, van Tinteren H, Kooi ML, Vasmel WL. Iron deficiency anaemia in hospitalised patients: value of various laboratory parameters. Differentiation between IDA and ACD. Neth J Med. 2001;59:270-279.

13. Kürekçi AE, Atay AA, Sarící SU, Zeybek C, Köseoðlu V, Ozcan O. Effect of iron therapy on the whole blood platelet aggregati on in infants with iron deficiency anemia. Thromb Res. 2000;97:281-5.
14. Stenberg PE. Hill RJ. Clusters and giant cells. In: Lee GR. Foerster J. Lukens J, et al, eds. Clinical Hematolog y. Baltimore, Williams and Wilkins, 10th ed. 199.19. 1178-1199.1.
15. Praticó D, Pasin M, Barry OP, et al. Iron-dependent human platelet activation and hydroxyl radical formation: involvement of protein kinase C. Circulation. 199.19;99. 1(24):3118-3124.
16. Keikhaei B, Zandian K, Ghasemi A, Tabibi R. Iron-deficiency anemia among children in Southwest Iran. Food Nutr Bull. 2007; 28(4):406-421.
17. Kaur IP, Kaur S. A Comparison of Nutritional Profile and Prevalence of Anemia among Rural Girls and Boys; 2011.

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