

## Estimation of impedance platelet count and mean platelet volume in cases of severe microcytosis – A prospective study

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### Abstract

**Introduction:** Microcytosis is a condition in which red blood cells are unusually small as measured by their mean corpuscular volume.<sup>1</sup> The most common cause of microcytosis is iron deficiency anemia.<sup>2</sup> In severe microcytosis, both thrombocytosis and thrombocytopenia may be seen although thrombocytosis is more frequently seen.

**Aim and Objectives:** To study the values of platelet count and mean platelet volume in cases of severe microcytosis.

**Materials and Methods:** A 1 year prospective study (1<sup>st</sup> January 2017 to 31<sup>st</sup> December 2017) of 200 patients was carried out in the Post Graduate Department of Pathology, Acharya Shri Chander College of Medical Sciences (ASCOMS) and Hospital, Sidhra after obtaining due clearance from Institutional Ethical Committee. Platelet count and mean platelet volume (MPV) of 200 patients with low mean corpuscular volume (MCV) was done.

**Results:** A total of 200 patients with severe microcytosis (MCV <60 fl) were evaluated for platelet counts and mean platelet volume. Thrombocytosis was seen in 160 patients (80%), thrombocytopenia in 5 patients (2.5%), whereas normal platelet count was seen in 35 patients (17.5%). The mean platelet volume was low in 141 patients (70.5%), high in 4 patients (2.0%) and normal in 55 patients (27.5%).

**Conclusion:** Both thrombocytosis and thrombocytopenia may occur in severe microcytosis although the incidence of thrombocytosis was very high (80%) in our study. There is an inverse relationship of mean platelet volume and platelet count in severe microcytosis.

**Keywords:** Microcytosis, Mean corpuscular volume, Mean platelet volume, Thrombocytosis, Thrombocytopenia.

### Introduction

Microcytosis is a condition in which red blood cells are unusually small as measured by their mean corpuscular volume. Normal MCV is 80 – 100 fl.<sup>1</sup>

The most common cause of microcytosis is iron deficiency.<sup>2</sup> Iron deficiency is due to a defect in hemoglobin synthesis that results in microcytic red blood cells and decreased amount of hemoglobin. In addition to changes in RBC indices iron deficiency anemia is also known to cause mild to moderate thrombocytosis.<sup>3</sup> Thrombocytopenia can also be seen in patients with severe iron deficiency anemia especially when hemoglobin level is <7 g/dl and MCV <60 fl.<sup>4,5</sup>

Recently, mean platelet volume (MPV) has been suggested as a useful platelet index for platelet volume. It correlates directly with megakaryocyte DNA content (ploidy) and megakaryocyte ploidy is reduced in reactive thrombocytosis.<sup>6</sup> MPV is a machine calculated measurement of the average size of platelets found in blood.<sup>7</sup> Mean platelet volume is comparable to the mean corpuscular volume (MCV) of red blood cells.<sup>8</sup>

### Aim and Objectives

To study the values of platelet count and mean platelet volume in patients with severe microcytosis.

### Materials and Methods

A prospective study of 200 patients was carried out in the Post Graduate Department of Pathology, Acharya Shri Chander College of Medical Sciences (ASCOMS) and Hospital, Sidhra after obtaining due clearance from Institutional Ethical Committee.

Platelet count and mean platelet volume (MPV) of 200 patients with low mean corpuscular volume (MCV) was done.

The samples for platelet count, mean platelet volume and mean corpuscular volume were collected under sterile conditions in ethylene diamine tetracetic acid (EDTA) tubes and were analysed using automated cell counter.

### Inclusion Criteria

1. Male and female patients >18 years.
2. Patients with severe microcytosis.

### Exclusion Criteria

1. Children and adolescents.
2. Patients with neutrophilia.

## Results

A total of 200 patients with severe microcytosis (MCV<60 fl) were evaluated for platelet counts and

mean platelet volume. The results are summarized in Table 1.

**Table 1:**

Platelet Count	Range	No. of patients n=200 %age of Patients	Mean Platelet Volume Normal 6 -13 fl Low <6 fl High > 13 fl
Normal	1.5 – 4 lac/cumm	35 (17.5%)	35 (17.5%)Normal
Mild thrombocytosis	4.5 - 7 lac/cumm	80 (40%)	20(10 %) – Normal 60(30%) - Low
Moderate thrombocytosis	7 - 9 lac/cumm	60 (30%)	60(30%) – Low
Severe thrombocytosis	9 - 10 lac/cumm	20 (10%)	20(10%) – Low
Extreme thrombocytosis	>10 lac/cumm	---	-
Thrombocytopenia	<1.5 lac/cumm	5 (2.5 %)	4(2%) – High 1(0.5%) - low

35 patients (17.5 %) had platelet counts within normal limit.

160 patients (80%) had thrombocytosis. Patients of thrombocytosis were divided into four grades - Mild, moderate, severe and extreme.<sup>9</sup>

80 patients (40%) had mild thrombocytosis. Out of these 80 patients, 20(10%) patients had normal mean platelet volume and 60 had low mean platelet volume.

60 patients (30%) had moderate thrombocytosis and 20 patients (10 %) had severe thrombocytosis. No case of extreme thrombocytosis was seen. Mean platelet volume was low in all of them.

5 patients (2.5%) had platelet count of less than 1.5 lac. 4 (2%) out of these had high mean platelet volume and 1(0.5%) patient had low mean platelet volume.

The results of mean platelet volume are summarized in Table 2.

**Table 2:**

Mean Platelet volume	Range (Ref 6/18)	No. of patients n=200	% age
Normal	6 – 13 fl	55	27.5%
Low	<6fl	141	70.5%
High	>13 fl	4	2.0%

**Table 3:**

Mean Platelet volume Normal (6 -13fl)		No. of patients 55 (27.5 %)
Platelet count	Normal	35 (17.5 %)
	Mild thrombocytosis	20 (10 %)

55 patients (27.5 %) had normal mean platelet volume. Among these, 35 patients (17.5%) had normal platelet

count and 20 patients (10 %) had mild thrombocytosis (Table 3).

**Table 4:**

Mean platelet volume Low (<6 fl)		Number of patients 141 (70.5%)
Platelet count	Thrombocytosis (4.5 – 10 lac/cumm)	140 (70 %)
	Thrombocytopenia (<1.5 lac/cumm)	1 (0.5 %)

141 patients (70.5%) had mean platelet volume less than 6 fl. Among these 141 patients, 140 (70%) had platelet counts between 4.5 -10 lac.

One case (0.5 %) had platelet count of less than <1.5 lac/cumm. This case was further evaluated and was diagnosed as a case of aplastic anemia (Table 4 and 5).

**Table 5:**

Thrombocytopenia Platelet Count < 1.5 lac/cumm		No. of Patients 5 (2.5 %)
Mean Platelet Volume	High (>13 fl)	4 (2 %)
	Low (<6 fl)	1 (0.5 %)

Thrombocytopenia was seen in 5 (2.5%) patients. Out of these 4 cases (2.0 %) had mean platelet volume >13 fl and all the four cases had platelet count less than 1.5 lac/cumm (Table 5).

## Discussion

The results of the present study showed that platelet counts were increased in majority of the patients i.e 160 (80%) with severe microcytosis.

The mean platelet volume was low in 140 patients (87.5%) out of 160 patients of thrombocytosis. In 20 patients i.e, (12.5%) of thrombocytosis, the mean platelet volume was normal. An inverse relation was found between mean platelet volume and platelet count in cases of severe microcytosis.

In reactive thrombocytosis, mean platelet volume and platelet count vary inversely. Mean platelet volume correlates directly with megakaryocyte DNA content (ploidy).<sup>10</sup> Mean platelet volume is directly proportional to the DNA content of megakaryocyte. In reactive thrombocytosis, megakaryocyte ploidy is reduced. Thus, reduced mean platelet volume in reactive thrombocytosis reflects an alteration in megakaryocytopoiesis, more megakaryocytes less endoreduplication, less DNA content and low mean platelet volume.<sup>11</sup>

In the study done by Gurhan K and Irfan Y,<sup>12</sup> the incidence of thrombocytosis was 27.9 % in cases of microcytosis due to iron deficiency anemia. This discrepancy could be attributed to inclusion of all grades of microcytosis in their study. Our study included only cases of severe microcytosis. In another study done by Sun Y.C and John J. Y,<sup>11</sup> results similar to our study were seen. They also found low mean platelet volume and thrombocytosis in cases of microcytosis due to iron deficiency anemia. Suleyman Y and Medine C C. et.al<sup>13</sup> in their study found that mean platelet volume was low in cases of thrombocytosis due to iron deficiency anemia.

Shah A R and Chaudhari S N<sup>8</sup> also found an inverse relationship between mean platelet volume and platelet counts in cases of anemia.

The relationship between platelet counts and mean platelet volume has been of special interest in microcytosis in literature.<sup>14</sup> The studies done by Lozano. M. et.al,<sup>15</sup> Kurekci A.E.et.al<sup>16</sup> and Stenberg. P.E. et. al<sup>17</sup> have found an inverse relation between mean platelet volume and platelet counts. In cases of severe microcytosis due to iron deficiency anemia, a 35 % increase in megakaryocyte number can cause a 40% decrease in megakaryocyte size and ploidy.<sup>17</sup>

Thrombocytopenia was seen in 5 cases (2.5%). Among these 4 cases (2.0%) had mean platelet volume more than 13 fl. Gurhan K and Irfan Y<sup>12</sup> found thrombocytopenia in 2 (2.3%) patients of severe microcytosis.

The results of our study are in concordance with them. Beguin Y<sup>18</sup> in his study found that thrombocytopenia associated with severe microcytosis could be related to high serum erythropoietin level in such patients.

Loo M and Beguin Y<sup>19</sup> in their studies reported that increased levels of endogenous erythropoietin stimulate Megakaryopoiesis in moderate iron deficiency anemia whereas high erythropoietin response caused thrombocytopenia in severe iron deficiency anemia.

In our study the platelet counts were normal in 35 patients (17.5%) with normal mean platelet volume.

## Conclusion

1. Both thrombocytosis and thrombocytopenia may occur in severe microcytosis although the incidence of thrombocytosis was very high (80%) in our study as compared to thrombocytopenia (2.5%).
2. There is an inverse relationship of mean platelet volume and platelet count in severe microcytosis.
3. Thrombocytopenia associated with severe microcytosis could be done to high erythropoietin response in severe iron deficiency anemia.

## References

1. Mach-Pascual S, Darbellay R, Pilotto PA, Beris P. Investigation of Microcytosis. A comprehensive approach. *Eur. J. Hematol.* 1996;57(1):5461.
2. Aulakh R, Sohi I, Singh T, Kakkar N. Red cell distribution width (RDW) in the diagnosis of iron deficiency with microcytic hypochromic anemia. *Indian J. Pediatr.* 2009;76:265-268.
3. Kadi Koylu G, Yavasglu I, Bolaman Z, Senturk T. Platelet parameters in women with iron deficiency anemia. *J. Nati. Med. Assoc* 2006;98:398-402.
4. Periman MK, Schwab JG, Nachman JB. Thrombocytopenia in children with severe iron deficiency. *J. Pediatr, Hematol. Oncol.*2002;24:380-384.
5. Briggs C, Harrison P, Machin SJ. Continuing developments with the automated platelet counter. *Int. J. Lab Med.*2007;29:77-91.
6. Lee WS, Kim TY. Mean platelet volume and platelet distribution width are useful in the differential diagnosis of aplastic anemia and idiopathic thrombocytopenic purpura. *Clin. Chem. Lab. Med.* 2010;48:1675-1676.
7. Cure MC, Cure E, Kirbas A, Cicek AC, Yuces. The effects of Gilbert's syndrome on the Mean platelet volume and other hematological parameters. *Blood Coagulation, Fibrinolysis*; 2013;24:484-488.
8. Amar R. Shah, Sanjay N, Chaudhari, Menka H Shah. Role of platelet parameters in diagnosing various clinical condition. *National. J. of Med. Research.*2013;vol 13:162-164.
9. Chiarello P, Magnolia M, Rubino M, Liguori SA. Thrombocytosis in children. *Minerva Pediatr.* 2011;Dec;63(6):501-513.
10. Robbins G, Barnard DL. Thrombocytosis and micro thrombocytosis: A clinical evaluation of 372 cases. *Acta. Haemat.* 1983;70:175-182.
11. Sun Y.C, John J.Y and Jin -Tae. S. Mean platelet volume /platelet count ratio in anemia. *Platelets.* 2013;May;24(3):244-245.
12. Gurhan K, Irfan 4, Zahit B, Taskin S and Aydin T: Platelet parameters in women with iron deficiency anemia. *Journal of the National Medical Association.* 2006: March. Vol. 98, no.3. 398-402.

13. Suleyman Y, Medine CC, Erkan C, Sefak Tarkan Y. Evaluation of mean platelet volume before and after iron deficiency anemia treatment. *International Medical Journal Sifa University*. 2015: January–April; Vol. 2. 7-10.
14. Lamparelle RD, Baynes RD, Atkinson P. 2013. Platelet parameters art. Platelet counts and mean platelet volume in normal and pregnant subjects. *S. Afr Med J*. 1988;73:36–39.
15. Lozano M, Narvaez J, Faundez A. Platelet count and mean platelet volume in the Spanish population (abstract) *Med. Chin*. 1998;110:774-777.
16. Kurekci AE., Atay AA, Sarichi SU. Effect of iron therapy on the whole blood platelet aggregation in infants with iron deficiency anemia. *Thromb. Res*. 2000;97:281-285.
17. Stenberg PE, Hill RJ. Platelets and megakaryocytes. In: Lee Gr, Foerster J, Lukens J. *Wintrobe's clinical hematology*. Baltimor, Williams Wilkins 2013,13<sup>th</sup> ed.:615-660.
18. Beguin Y. Erythropoietin and platelet production. *Haematologica*.1999;84:541-547.
19. Loom, Beguin Y. The effect of recombinant human erythropoietin on platelet counts is strongly modulated by adequacy of iron supply. *Blood*. 1999;93:3286-3293.