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Role of platelet volume indices in diagnostic approach of thrombocytopenia

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Abstract
Background: Platelet indices helps in the diagnosis of myriad cases of thrombocytopenia, the current study was conducted to underline their importance in the diagnosis of thrombocytopenia.
Materials and Methods: A prospective cross sectional hospital based study was conducted in the CSSH, Meerut on blood samples received from both OPD and IPD patients from October 2019 to August 2021. A total of 200 cases of thrombocytopenia were studied. Detailed relevant clinical data was recorded including history, physical examination and available investigations including serological results. EDTA sample was run on five part hematology analyzers to collect various Platelet parameters.
Results: Among all cases dengue was the main cases of thrombocytopenia**.** Majority of cases were of destructive thrombocytopenia and showed increased MPV and PDW as compared to hypoproductive thrombocytopenia.
Conclusion: The evaluation of thrombocytopenic individuals is necessary in order to determine the cause and its implications for treatment. The interpretation of platelet indices can aid in the initial management of thrombocytopenic patients and avoid unnecessary invasive tests.

Keywords: Platelet, platelet indices, thrombocytopenia, destructive thrombocytopenia, hypo proliferative thrombocytopenia

Introduction

Platelets, also known as thrombocytes, are derived from megakaryocytes that play an important role in hemostasis. Addison was the first to characteristics platelets in 1841 [1]. Platelets circulate throughout the body in a resting condition [2].

Platelets are small membrane-bound anucleate cells with a diameter of 2 m and a volume of 8 fl. The thickness of the surface membrane is roughly 20 nm [3]. They contain mitochondria, lysosomes, alpha granules, and dense granules (which serve as energy reservoirs). The release of these granules in response to platelet activation is critical for maintaining proper homeostasis and thrombosis [4].

Adult platelet counts range from 150 – 450x10^3/ µL. Platelets have an average lifespan of 8 to 10 days. Both primary and secondary hemostasis rely on platelets. They are necessary for maintaining the integrity of the vascular endothelium and preventing haemorrhage by forming platelet plugs and allowing the coagulation system to participate in the development of a solid, stable fibrin clot [5].

There are two types of platelet disorders: quantitative and qualitative. Defective platelet functioning cause qualitative abnormalities (thrombasthenia). Quantitative disorders are caused by either a low platelet count (thrombocytopenia) or a high platelet count (thrombocytosis) [6].

The presence of a subnormal amount of platelets (<150x10^3/ µL) in circulating blood is referred to as thrombocytopenia. It could be due to a lack of platelet production or the degradation of platelets in the periphery. Hypoproliferative thrombocytopenias (aplastic anaemia, acute leukaemia and chronic lymphocytic leukaemia) are one type of thrombocytopenia, while destructive thrombocytopenias (Idiopathic thrombocytopenia, malaria, kala-azar, and dengue fever) are another. Bleeding is more likely in patients with severe thrombocytopenia [7].

The extensive use of automatic devices for blood cell analysis in clinical laboratories has allowed this phenomena to be recognised.

The only way to be confident about the presence of platelet clusters is to examine blood films under a microscope [8].

The gold standard for determining the cause of thrombocytopenia has been the bone marrow aspiration study across time. However, the process is invasive, time-consuming, and might result in bleeding.

The interpretation of platelet indices can aid in the initial care of thrombocytopenic patients and prevent invasive procedures such as bone marrow testing. Given the convenience and non-invasive nature of platelet indices calculation versus bone marrow aspiration/biopsy, a comprehensive investigation on this topic is critical. Although there are few studies in the literature on the significance of various platelet indices, the current study was conducted to underline their importance in the diagnosis of thrombocytopenia.

Materials and Methods

A prospective cross sectional hospital based study was conducted in the Department of Pathology at Subharti medical college and associated Chhatarpati Shivaji Subharti Hospital (CSSH), Meerut on blood samples received from both OPD and IPD patients from October 2019 to August 2021. A total of 200 cases were studied.

Detailed relevant clinical data was recorded including history, physical examination and available investigations including serological results (such as for dengue, malaria). EDTA sample was run on five part hematology analyzers and various platelet parameters of thrombocytopenic patients were collected.

Platelet parameters that were studied includes: a) Platelet count b) Plateletcrit (PCT) c) Platelet distribution width (PDW) d) Mean platelet volume (MPV).

Grading of thrombocytopenia was done as per common Toxicity Criteria (developed by National cancer institute) to describe severity of thrombocytopenia. On the basis of platelet count, the cases was divided into the four grades: Grade 1: 75-150 × 10^3/µL, Grade 2: 50-< 75 × 10^3/µL, Grade 3: 25-< 50 × 10^3 /µL, Grade 4: < 25 x 10^3 / µL. Every case of thrombocytopenia was reassessed by peripheral smear examination. Data was entered in Microsoft Office Excel and analysis was done. Patients of both sexes with age more than 18 years and platelet count <1,50,000/µl were included whereas patient on antiplatelet drugs and other medications causing thrombocytopenia and microclots in blood were excluded in this study.

Results

The total no. of 200 cases were studied. The age range of patients was 18 years to 85 years and were divided in six groups-group 1 (18-30 years), group 2 (31-40 year), group 3 (41-50 years), group 4 (51-60 years), group 5 (61-70 years) and group 6 (>70 years)). Majority (31.0%) of patients belong to group 1, Male predominance was seen, the male to female ratio being 1.4:1.

The cases were grouped according to the severity of thrombocytopenia. Maximum number of cases were of grade-1 thrombocytopenia (47.0%), followed by grade-2 thrombocytopenia (24.0%), grade-3 thrombocytopenia (15.0%) and grade-4 thrombocytopenia (14.0%).

The etiological distribution revealed, most of the thrombocytopenia cases were of Dengue (25.0%) followed by Sepsis (17.5%); Chronic liver disease (16.5%); PUO (8.5%) and Malaria (7.5%); Road traffic accident (6.0%); Acute leukemia (5.5%). (Table 1).

Table 1: Distribution of Cases of Thrombocytopenia according to Etiology

Clinical diagnosis	No. of patients (n=200)	Percentage (%)
Dengue	50	25.0%
Sepsis	35	17.5%
Chronic liver disease	33	16.5%
PUO	17	8.5%
Malaria	15	7.5%
Road traffic accident	12	6.0%
Acute leukemia	11	5.5%
Aplastic anemia	8	4.0%
Macrocytic anemia	7	3.5%
Pregnancy	5	2.5%
Chronic renal disease	4	2.0%
Microcytic anemia	2	1.0%
Hepatitis C	1	0.5%

Majority of cases showed increased Mean platelet volume (MPV) and Platelet distribution width (PDW). (Table 2) & (Table 3)

Table 2: Association between mean platelet volume and clinical diagnosis

Clinical diagnosis	Frequency (n=200)	Mean Platelet Volume (MPV)		
		Decreased	Normal	Increased
Dengue	50 (25.0%)	0 (0.0%)	24 (48.0%)	26 (52.0%)
Sepsis	35 (17.5%)	0 (0.0%)	18 (51.4%)	17 (48.6%)
Chronic liver disease	33 (16.5%)	0 (0.0%)	12 (36.4%)	21 (63.6%)
PUO	17 (8.5%)	0 (0.0%)	9 (52.9%)	8 (47.1%)
Malaria	15 (7.5%)	1 (6.7%)	11 (73.3%)	3 (20.0%)
Road traffic accident	12 (6.0%)	0 (0.0%)	4 (33.3%)	8 (66.7%)
Acute leukemia	11 (5.5%)	3(27.3%)	5 (45.5%)	3 (27.3%)
Aplastic anemia	8 (4.0%)	0 (0.0%)	6 (75.0%)	2 (25.0%)
Macrocytic anemia	7 (3.5%)	0 (0.0%)	3 (42.9%)	4 (57.1%)

Pregnancy	5 (2.5%)	0 (0.0%)	2 (40.0%)	3 (60.0%)
Chronic renal disease	4 (2.0%)	0 (0.0%)	3 (75.0%)	1 (25.0%)
Microcytic anemia	2 (1.0%)	0 (0.0%)	2 (100.0%)	0 (0.0%)
Hepatitis C	1 (0.5%)	0 (0.0%)	1 (100.0%)	0 (0.0%)
Total	200 (100.0%)	4(2.0%)	100 (50.0%)	96 (48.0%)

Table 3: Association between platelet distribution width and clinical diagnosis

Clincal Diagnosis	Total (n=200)	Platelet Distribution Width (PDW) Group		
		Decreased	Normal	Increased
Dengue	50 (25.0%)	0 (0.0%)	4 (8.0%)	46 (92.0%)
Sepsis	35 (17.5%)	0 (0.0%)	5 (14.3%)	30 (85.7%)
Chronic liver disease	33 (16.5%)	0 (0.0%)	4 (12.1%)	29 (87.9%)
PUO	17 (8.5%)	0 (0.0%)	2 (11.8%)	15 (88.2%)
Malaria	15 (7.5%)	0 (0.0%)	7 (46.7%)	8 (53.3%)
Road traffic accident	12 (6.0%)	0 (0.0%)	1 (8.3%)	11 (91.7%)
Acute leukemia	11 (5.5%)	0 (0.0%)	5 (45.5%)	6 (54.5%)
Aplastic anemia	8 (4.0%)	1 (12.5%)	1 (12.5%)	6 (75.0%)
Macrocytic anemia	7 (3.5%)	0 (0.0%)	1 (14.3%)	6 (85.7%)
Pregnancy	5 (2.5%)	0 (0.0%)	2 (40.0%)	3 (60.0%)
Chronic renal disease	4 (2.0%)	0 (0.0%)	0 (0.0%)	4 (100.0%)
Microcytic anemia	2 (1.0%)	0 (0.0%)	2 (100.0%)	0 (0.0%)
Hepatitis C	1 (0.5%)	0 (0.0%)	0 (0.0%)	1 (100.0%)
Total	200 (100.0%)	1 (0.5%)	34 (17.0%)	165 (82.5%)

Chi square test; $p<0.00$

Discussion

Platelets are involved in normal haemostasis, thrombosis, and a variety of bleeding disorders [9]. As a consequence, decrease in platelet quantity (thrombocytopenia) result in significant morbidity.

In this study, Male preponderance was observed similar to other studies (M:F- 1.4: 1). Mittal V *et al.* [10] did a study on patients aged 1 to 80 years old and found that 65 percent of the patients were male and 35 percent were female. Francis *et al.* [11] found 61.2% male and 38.8% female patients, with a male to female ratio of 1.57:1.

Grade 1 thrombocytopenia is most frequent (47%) followed by grade 2 (24%), grade 3 (15.0%) and grade 4 (14%). In a similar study done by Mittal V *et al.* [10] classified thrombocytopenia into three categories: mild thrombocytopenia (platelet count 100 to 150 x 10^9/ L), moderate thrombocytopenia (platelet count > 50 x 10^9 / L and 100 x 10^9 / L), and severe thrombocytopenia (platelet count less than 50 x 10^9 / L). Mild thrombocytopenia was the most common type, followed by moderate and severe thrombocytopenia.

Majority of cases of hyper-destructive thrombocytopenia like dengue, chronic liver disease showed increased MPV while hypo-productive thrombocytopenia showed mainly normal MPV. PDW was increased in all cases of hyper-destructive thrombocytopenia and cases of aplastic anaemia, macrocytic anaemia (hypo-productive thrombocytopenia) also showed increased PDW. Numbenjapon T *et al.* [12] found that MPV was significantly higher in hyper-destruction group compared to hypo-productive thrombocytopenia. Kamala M Y *et al.* [13] also found that MPV and PDW were higher in hyper-destructive thrombocytopenia and can be used as an initial hint for predicting the type of thrombocytopenia. All cases showed PCT less than the normal range. Reduced PCT was also seen in a study conducted by Gao Y *et al.* [14].

Conclusion

The evaluation of thrombocytopenic individuals is necessary in order to determine the cause and its implications for treatment. The interpretation of platelet indices can aid in the initial management of thrombocytopenic patients and avoid unnecessary invasive tests required to establish etiology of thrombocytopenia. These platelet indices are easily accessible thanks to automated haematology analyzers, and they can help to eliminate the need for more expensive and intrusive testing to diagnose thrombocytopenia.

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