Platelet Indices as Quality Markers for Remission in Patients With Leukemia

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Abstract

Background: The purpose of this study was to investigate whether platelet indices (mean platelet volume (MPV) and platelet distribution width (PDW)) could serve as surrogate marker for follow-up in patients with leukemia.

Methods: Blood samples were obtained from 48 patients with leukemia at diagnosis before chemotherapy and at the time of remission (mean age: 17.92 years; 24 males and 24 females). We measured the blood platelet indices using an automated counter.

Results: MPV was higher at the time of remission, but it was not statistically significant. However, PDW was significantly larger (P < 0.05) at the time of remission. There was no significant difference in the MPV or PDW in patients with acute lymphoblastic leukemia versus acute myeloblastic, males versus females, in patients on chemotherapy versus no chemotherapy at the time of remission, or patient at remission versus healthy control.

Conclusions: We found no significant difference in the MPV between the two groups. PDW proposed as indicators of certain pathologic conditions and it seems possible to use PDW as surrogate markers foe follow up in patients with leukemia. However, platelet indices (MPV and PDW) cannot be used as indicator to discriminate between the subtypes of leukemia. The potential role of platelet indices in leukemia remains to be investigated by a multi institutional level to verify the possible clinical significance of this finding.

Keywords: Platelets; Indices; Leukemia

Introduction

The quantitation of blood cell counts (red cells, white cells, and platelets) is an old and a well-recognized tool. Nowadays, new indices related to platelet count have been estimated by automated blood cell analyzers. The most important parameters are plateletcrit (PCT), mean platelet volume (MPV), and platelet distribution width (PDW) [1]. Platelet activation leads to changes in platelet shape with increase in platelet swelling leading to an increase in MPV [2, 3]. There have been some reports about these platelet indices and platelet disorders [4-8]. High MPV and PDW were reported in patients with idiopathic thrombocytopenic purpura [9-11]. However, PDW is a more reliable marker for discriminating hyperdestructive thrombocytopenia from hypoproductive thrombocytopenia [12]. Moreover, it has been shown that MPV is a reliable measure of residual platelet function in stored platelet concentrate, an increased MPV representing deterioration of the product [13, 14]. High MPV and low PDW were reported in patients with leukemia [15]. To understand the heterogeneity of platelets, we investigate whether platelet indices (MPV and PDW) could serve as surrogate tools for follow up patients with different kinds of leukemia.

Materials and Methods

A hospital-based study was carried out on 48 patients, who were admitted to King Abdallah University hospital with leukemia over a 5-year period from 2006 to 2011. We included patients with a confirmed diagnosis of leukemia and follow them up until remission according to the complete blood count and the bone marrow aspirate and biopsy. All patients or their parents in the minor cases provided written informed consent form to the study, which was approved by Ethics Committee at Jordan University of Science and Technology. Venous blood samples were taken from the patients at diagnosis before chemotherapy and at the time of remission into 7.5% edetic acid (EDTA) for the measurement of the platelet indices. The sample was run within 60 minutes of

Table 1. The Baseline Characteristics of the Patients and Platelet Indices

	Patients at Diagnosis	Patients at Remission	Healthy Control
Number	48	48	50
Age in Years			
Mean	17.92	19.92	16
Median	10	12	11
Range	2 - 55	4 - 57	3 - 30
Sex			
Male	24	24	26
Female	24	24	24
Mean Platelets Number (x 10^9)/L*	74.8	226.8	284
Mean MPV (fl)	8.96	9.283	8.535
Mean PDW*	10.524	12.263	12.432

*P value < 0.05. Reference for MPV (7.5 - 11.5fl), Platelets (150 - 400 x 10^9)/L, and PDW (9.4 - 11.5). MPV indicates mean platelet volume (fl); PDW, platelet distribution width.

collection using the ABX MICROS 60 automated Hematology Analyzer to calculate the platelet count, MPV, PCT, and PDW. Differences in the means were analyzed using paired t test. A P value < 0.05 was considered statistically significant. Statistical package for social sciences (SPSS, version 15) software was used to analyze the data.

Results

We studied 48 patients with leukemia (24 (50%) male and 24 (50%) female). Ages for the patients at diagnosis ranged from 2 to 55 years with a median of 10 years. At the time of diagnoses, 30 patients had acute lymphoblastic leukemia (ALL) and 18 had acute myeloid leukemia (AML). The baseline characteristics of the patients and platelet indices are shown in Table 1. The MPV was larger at remission (mean ± SD: 9.283 ± 1.564 fl) than at diagnosis (mean ± SD: 8.96 ± 1.525 fl), but it was statistically not significant (P = 0.18). The PDW was smaller at diagnosis (mean ± SD: 10.524 ± 1.428) than at remission (mean ± SD: 12.263 ± 1.738) (P < 0.05) (Table 1). However, there was no statistically significant difference in MPV and PDW between patients with ALL versus patients with AML. There was no statistically

significant difference in MPV and PDW between male patients versus female patients. There was no statistically significant difference in MPV and PDW between patients on chemotherapy versus patients off chemotherapy during remission status. There was no statistically significant difference in MPV and PDW between patients on early remission versus patients on late remission. There was no statistically significant difference in MPV and PDW between patients on remission versus healthy controls.

Discussion

There is now much interest in developing methods and instruments for an accurate platelet count and the determination of platelet parameters in various pathologies [16, 17]. Recent advances in automated blood cell analyzers have made it possible to measure blood cell parameters automatically. MPV is calculated from a log transformation of the platelet volume distribution curve, yielding a geometric mean for this parameter [18-20]. Under normal circumstances, there is an inverse relationship between platelet size and number [18]. When platelets decrease in number, bone marrow megakaryocytes are stimulated by thrombopoietin, and their

nucleus becomes hyperlobulated, with much higher DNA content. These stimulated megakaryocytes produce larger platelets. Thus, platelets with a higher MPV are expected to be seen in destructive thrombocytopenia when megakaryocytic stimulation is present. Conversely, platelets with a lower MPV are expected in thrombocytopenic states associated with marrow hypoplasia or aplasia. There are a substantial number of diseases reported to be correlated with MPV values [4-6, 8, 18, 21, 22]. The exact mechanisms in support of increasing MPV, as a surrogate for increasing platelet activation, are not fully known. The increased MPV may relate to one or more of a combination of increased platelet swelling with activation, increased life-span of larger platelets, and the increased production of larger and more active platelet precursors (platelet "left shift") from the bone marrow or splenic storage pool [3, 19, 23, 24]. Our data showed no statistically significant differences in MPV values between the two groups; this is probably because MPV depends on the number of new platelets that is similar in the two groups. Similarly, there was no statistically significant difference in MPV values among the subtypes of leukemia.

The role and utility of additional platelet markers, such as the PDW, is being increasingly recognized [25, 26]. PDW is the SD of the log-transformed data of platelet. It has been reported that PDW increases over storage time because of the formation of abnormally small and large platelets, and that the PDW is useful as a predictor of the viability of transfused platelets [27-29]. It has been reported that PDW is a more reliable marker for discriminating hyperdestructive thrombocytopenia from hypoproductive thrombocytopenia than MPV [12]. Our data showed a statistically significant difference in PDW values between the two groups; this is probably because platelets in the leukemia group are dysplastic. In conclusion, our data showed PDW is significantly lower in patients with leukemia at diagnosis than in remission status, but no correlation was shown between PDW values and subtypes of leukemia. Platelet indices can be easily identified during routine hematologic analysis. Thus, platelet indices are an important, simple, effortless, and cost-effective tool that should be used and explored extensively, especially in the developing countries, for follow up for patients with leukemia. Furthermore our study shows that platelets of leukemic patients in remission present normal PDW and MPV parameters. A multiinstitutional level, larger, and longer-term follow-up study will be required to verify the possible clinical significance of these findings.

Authorship Contributions

1-Suleimman A Al-Sweedan was contributed in designed and perform research, data collection, analysis, editing and writing; 2-Ismail I. Matalka was contributed in data collection, analysis, editing and writing.

Conflict of Interest Disclosures

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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