Original Article

Comparison of Mean Platelet Volume, Platelet Count, Total Leucocyte and Neutrophil Counts in Normoglycemics, Impaired Fasting Glusose and Diabetics

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Abstract

Introduction: Diabetes mellitus is a global pandemic and a complex disease characterized by chronic hyperglycaemia, metabolic abnormalities, long term macro – microvascular abnormalities involving the blood vessels, eyes, kidneys and nerves. Platelet parameters such as high platelet count and mainly high mean platelet volume (MPV) have been reported in diabetic patients, contributing to the increased risk of vascular disease. Also recent studies have documented the role of platelet – leukocyte aggregates in diabetics contributing to the vascular injury. The objective of our study is to study the simple variables of platelet count, MPV, total WBC count and neutrophil count not only in diabetics, but also in the normoglycemics and impaired fasting groups.

Materials and Methods: Current cross sectional study was conducted at Sapthagri Institute of Medical Sciences and Research Center, Bangalore, India between the period of December 2013 to March 2014. A total of 248 cases were included in the study groups which were categorized as Group I, II, and III based on the fasting plasma sugar levels as normoglycemics, impaired fasting glucose and diabetics respectively. The same samples were run for MPV, platelet counts, Total leukocyte and Neutrophil counts.

Results: A statistically significant correlation was seen between the rising plasma glucose, MPV, Total Leukocyte count and the neutrophil counts. The platelet count however, did not show much statistical significance with rising glucose levels.

Conclusion: MPV, total leucocyte count and the absolute neutrophil counts increased proportionally with increasing plasma glusose levels. The variation was significant in diabetic group. Although the variation between the normoglycemics and impaired fasting group for the same variables was not very significant, the parameters still show increase with rising sugar levels.

Keywords: Diabetes mellitus, Impaired fasting glucose, Mean platelet volume (MPV), Platelets

INTRODUCTION

Diabetes is a global health problem associated with multiple disorders including metabolic, cellular and blood disturbances leading to vascular complications.[1] Platelets play a major role in integrity of normal haematopoiesis, and mean platelet volume (MPV) is an indicator for its function. The large platelets contain more dense granules are more potent than smaller platelets and hence more thrombogenic Many studies have documented the findings of increased platelet count and mean platelet volume in diabetics. Impaired fasting glucose (IFG) is also a frequent glycemic disorder in the general population, as is considered a pre-diabetic state.[2] Studies on mean platelet volume in patients with impaired fasting glucose and normoglycemics is limited in literature. We conducted this study considering the fact that in a country like India, MPV can be used as an important, effortless, simple and cost – effective tool for predicting the possibility of impending acute events. Also recent studies have documented a significant increase in platelet – leukocyte aggregates in diabetics.[1] The aim of the present study was to compare not only the mean platelet volume and

platelet count but also the total white bold cell count and relative neutrophil count in groups of normoglycemics, impaired fasting glucose group and in diabetics and assess the significance, thereby identifying factors which may be intervened to provide better patient care.

MATERIALS AND METHODS

We investigated a total of 248 patients falling under the normoglycemic, impaired fasting glucose and the diabetic category. Patients with abnormal platelet counts, (<100 and >400 × 10^3 per mcro liter), patients who were on anti- platelet medications (ticlopidine, clopidogrel and aspirin) were excuded. The diabetic category was a group of newly diagnosed cases, with patients on anti-diabetic therapy being excluded. Also excluded were males with Hb less than 13 g/dl and females wih Hb less than 11.5 g/l as nutritional anemias can increase the MPV and cause reactive thrombocytosis. Patients with very low fasting blood sugar levels (< 70 mg/l) raised ESR and cholesterol levels were also excluded from the study.

Fasting blood samples were collected in the morning following overnight fast in EDTA & Fluoride vacutainers and samples were run for sugar and complete blood counts within half an hour to avoid sample variations on standing.

Blood glucose was tested using ERBA EM 360 automated biochemistry analyzer. The platelet count, MPV, Total leukocyte count and neutrophil count was done using PENTRA ES 60 Hariba five part analyzer. The patients were divided into three groups based on fasting plasma sugar (FBS) levels. Normoglycemics – 70-100 mg/dl Impaired fasting glucose – 101-126 mg/dl Diabetics - glucose of >127 mg/dl. The diagnostic criterion was that of American Diabetic Association. Platelet count, MPV, Total leukocyte count (TLC) and neutrophil count were compared among all the three groups.

Statistical Analysis

Present study was based on Descriptive and inferential statistical analysis. Results on categorical measurements are given in Number (%) and results on continuous measurements are expressed in Mean ± SD (Min-Max) and Significance is assessed at 5% level of significance. The data took into consideration the assumptions that the Dependent variables are normally distributed, and samples drawn from the population are random, Cases of the samples are independent.

Analysis of variance (ANOVA) has been used to find the significance of study parameters between the three groups. Post-Hoc Tukey test being used to find the pair wise significance. The significance of study parameters on categorical scale between two or more groups was calculated using Chi-square/ Fisher Exact test Pearson correlation between FBS and other variables + Suggestive significance (P value: $0.05 < P < 0.10$)* Moderately significant (P value: $0.01 < P \leq 0.05$)** Strongly significant (P value: $P \leq 0.01$).

Statistical Software

The data analysis was done using the Statistical softwares namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and R environment ver. 2.11.1.

RESULTS

Of the 248 patients, 122 (49.2%) were males and 126 (50.8%) were females. The gender distribution and the mean age in three groups were similar. The mean FBS in the normoglycemic group was 85.94 mg/dl, in the Impaired fasting group was 112.65 mg/dl and in the diabetic group was 201.49 mg/dl. The mean platelet counts in the three groups were 2.14 l/cmm, 2.21 l/cmm and 2.57 l/cmm respectively (Graph 1) The mean MPV in the three groups were 7.9 fl, 8.1 fl and 8.4 fl respectively. (Graph 2) (Table 1). The mean TLC (SI unit × 10^9/L), absolute Neutrophil counts (SI units cells/μL) in the three groups is given in Table 2. The platelet count, MPV, TLC and Neutrophil count in the three groups were compared using the ANOVA Turkey's HSD test (Table 3). The analysis showed that there is significant relationship between rising sugar levels and the variables, more so between the impaired fasting glucose (IFG) and the diabetics, the *P* value being significant for the MPV, TLC and Neutrophil counts.

The analysis showed increase in MPV, TLC and Neutrophil counts with increasing fasting plasma glucose levels, which was statistically significant.

DISCUSSION

Diabetes mellitus (DM) is a major health problem. Increased platelet activity is emphasized to play a role in the development

Table 1: Comparison of mean platelet count and MPV between the three groups

Mean±SD	Group I	Group II	Group III
MPV	7.91±0.82	8.10±0.75	8.42±0.56
Platelet count	2.14+1.18	2.21±2.04	2.57±0.56

MPV – P=0.013* Platelet – P=0.813

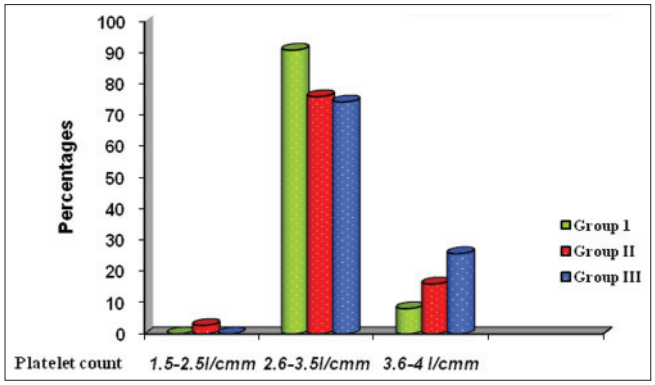
Table 2: Comparison of TLC and neutrophil count between the three groups

Mean±SD	Group I	Group II	Group III
TLC	6.76±1.87	6.82±1.68	7.83±1.69
Neutrophils	1205.65±5.21	1328±5.32	1560±6.29

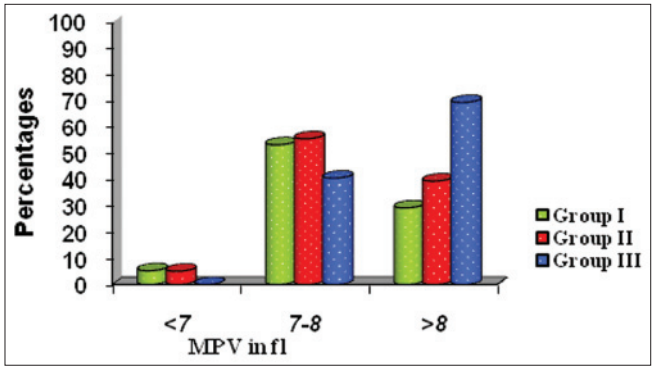
P=0.006** and P=<0.001**

Table 3: Comparison of study variables according to three groups based on sugar levels

Variables	Results			Significance		
	Group 1	Group 2	Group 3	Group 2-I	Group 2-3	Group 1-3
Age in years	40.47±17.47	48.06±15.26	56.65±11.43	0.004**	0.002**	<0.001**
Gender (M:F)	45:54	40:35	37:37	0.303	0.684	0.554
Platelet counts	2.14+1.18	2.21±2.04	2.57±0.56	0.987	0.918	0.873
MPV	7.91±0.82	8.10±0.75	8.42±0.56	0.629	0.002**	0.010*
TLC	6.76±1.87	6.82±1.67	7.83±1.69	0.971	0.001**	0.001**
NEUTRO	1205.65±5.21	1328±5.32	1560±6.29			



Graph 1: Platelet count distribution



Graph 2: MPV levels in three groups studied

of vascular complications of this disorder.[3] Mean platelet volume (MPV) can be used as a simple, economical test in the monitoring of DM, with many studies showing high MPV as a risk factor for the vascular complications of DM like thromboembolism, stroke and myocardial infection.[4-8]

In agreement with many previously conducted studies,[9,10] our study also confirmed a higher MPV and platelet count in diabetics. One possible mechanism of increased MPV in DM is osmotic swelling due to raised blood glucose and its metabolites, due to the short life span of platelets in diabetes and also due to higher platelet turn over and younger platelets.[11,12] The latter fact has been proves as MPV correlates with percentage of reticulated platelets and megakaryocyte ploidy, specially in diabetics. Platelets from patients with DM also have dysregulated signalling pathways that lead to an increased tendency to activate and aggregate in response to a given stimulus.[13]

Our institute being rural in location, patients often land up only when the sugar levels are high or when complications arise, and patients with prediabetic sugar levels are often lost to follow up. Our study with the previously mentioned reasons decided to include the normoglycemics and the impaired sugar level patients in the study to see the stepwise variation in MPV, Platelet count with rising sugar levels. This would facilitate in picking up mainly the vascular complications early, aiding in better patient care. There was a positive correlation in our study between increasing sugar levels and MPV in agreement with the study of Shimodaira et al.[14]

The categorization of the three groups was done according to the American Diabetes Association (ADA). According to ADA, impaired fasting glucose (IFG) is defined as 100-125 mg/dl of fasting plasma glucose, this lowered threshold done in 2003 for better prediction of future diabetes incidence.[15,16] Other organizations like Europen Diabetes Epidemiology group (EDEG) and Japanese Diabetes Society (JDS), still retain the range for IFG as 110-123 mg/dl.[14] In our study we stuck on stringently to the ADA criteria, in order to distinguish prediabetic subjects from normoglycemic subjects more efficiently. The present study found a significant correlation between platelet levels, MPV and increasing blood glucose levels.

The present study also took into consideration the relationship between rising fasting sugar levels along with the total leukocyte and neutrophil counts in the subjects. Evidence from epidemiological studies suggest a positive correlation between a peripheral total White blood cell count (WBC) a non specific marker of inflammation and diabetes risk.[17-20] Recent studies have postulated that hypeglycemia itself has an impact on white blood cell levels. This has further been proved by the lowering of blood glucose levels on treatment with drugs like roziglitazone.[17,21,22] Also increased levels of platelet leukocyte aggregates (PLA) have been described in diabetics, contributing to the microvascular injury.[1] Current study documented a higher TLC and neutrophil count with rising blood glucose levels, thereby supporting the recent hypothesis.

Abnormalities of lipid metabolism, particularly hyertriglyceridemia and low levels of HDL are almost

invariably found in patients with impaired glucose homeostasis, which can potentiate the platelet hyperactivity.[23] It must be finally noted that from the treatment aspect that antiplatelet drugs not only interfere with platelet activation in the setting of pathologic atherothrombosis, but also during physiologic thrombosis, thus questioning their role in the treatment of DM.

CONCLUSIONS

In present study, raised platelet counts and MPV are seen not only in diabetics, but a positive correlation has also been seen in subjects with impaired fasting glucose compare to normoglycemic controls. We also documented a positive correlation between rising blood glucose levels and total leucocyte count (TLC), being highest in the diabetic group. Platelet indices can be used as a simple, quick and effective tool to pick up early vascular complications in patient with impaired sugar levels, aiding in better patient care.

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