

Original Article

Study of the relationship between Platelet Parameters and Hyperlipidemia

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ABSTRACT

Introduction: Hyperlipidemia is emerging as a major risk factor for developing cardiovascular diseases like atherosclerosis and coronary heart disease. Hyperlipidemia in turn results in platelet activation and thrombotic events. Platelets have been shown to have a role in the thrombus consequences of atheromatous damage in hyperlipidemic individuals by initiating and propagating atherosclerotic plaques. Platelet activity can be evaluated with platelet indices, including platelet distribution width and plateletcrit.

Materials and Methods: This was a prospective study carried out over a period of one month in the Department of Pathology, Patan hospital. A total of 223 subjects with hyperlipidemia and 35 controls with normal lipid profiles and PDW were included. Statistical analysis was done using Pearson's correlation test and data was expressed as mean \pm SD for each parameter. A p-value of < 0.05 was considered to be significant.

Results: Maximum number of patients was in 41-60 years of age (42.6%). The male-to-female ratio was 1: 1.1 with 47% males and 53% females. The mean total cholesterol, mean LDL-C and mean HDL-C of the study group were 230.4 ± 26.7 , 150.3 ± 28.4 , and 40.9 ± 15.2 respectively. The mean platelet count and PDW were 288.9 ± 230.5 and 14.1 ± 3.3 respectively. There was a significant correlation between PDW with total cholesterol and LDL-C in a study group with a p-value of $< .001$.

Conclusions: Present study indicates that PDWs are significantly higher in patients with hyperlipidemia. These indices are available without any additional cost to clinicians, pathologists, and patients and can be used to assess the risk associated with hyperlipidemia.

keywords: Hyperlipidemia; Platelet; Platelet distribution width

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INTRODUCTION

Hyperlipidemia is defined as a condition that involves a variety of hereditary and acquired disorders leading to lipoprotein metabolism abnormalities.¹ It is sometimes referred to as dyslipidemia, which covers a wide range of disorders in lipoprotein metabolism. Hyperlipidemia is described by the American Heart Association as an elevated amount of fats in the blood. Studies have shown that elevated levels of LDL-C are associated with the development of atherosclerosis and associated mortality like coronary heart disease and stroke.¹⁻³ Increased levels of low-density lipoprotein cholesterol (LDL-C), have been

identified as an individual risk factor for acute ischemic stroke (AIS). LDL-C, which carries around 70% of the body's total circulating cholesterol, is the primary lipoprotein for transporting cholesterol.⁴⁻⁷ Despite this, hyperlipidemia is a condition that is frequently ignored due to its asymptomatic nature, the lack of awareness of abnormal lipid profiles on screening, and economic problems in developing nations.

Platelets have been shown to have a role in the thrombus consequences of atheromatous damage in hyperlipidemic

individuals by initiating and propagating atherosclerotic plaques, although their primary purpose is to maintain hemostasis by initiating blood coagulation.³ The platelet activation is measured indirectly through several platelet indices such as platelet count (PC) and platelet volume indices (PVI) such as MPV, platelet distribution width (PDW), and platelet-large cell ratio (P-LCR), which are now routinely available in most clinical laboratories at no additional cost. The early stages of atherosclerosis are accelerated by the production of mitogenic substances by platelets in response to arterial endothelial damage, such as platelets-derived growth factor (PDGF) and tumor growth factor (TGF). Platelet activation and thrombotic events are known to be brought on by hypercholesterolemia and hyperlipidemia in general.⁸ The present study was conducted in the Department of pathology to look for a correlation between platelet indices and hyperlipidemia.

MATERIALS AND METHODS

A prospective study was conducted in the Department of Pathology of Patan Hospital from September 2022 to October 2022. All patients of both sexes over the age of 20 who came to our hospital for a routine health checkup were included in the study. As part of their routine health checkup, these patients underwent lipid profile testing after fasting for 12 to 14 hours and a complete blood count. The study included 223 hyperlipidemic patients and 35 controls with and normal PDW. In accordance with the third report of the national cholesterol education program (NCEP) and expert panel on the detection, evaluation, and treatment of high blood cholesterol in adults (adult treatment panel III) from 2002, all patients with cholesterol 200 mg%, triglycerides 150 mg%, LDL 130 mg% and HDL cholesterol 35 mg% were included in the study group. PDW (fl) is a distribution curve of platelets measured at the level of 20% relative height in a platelet-size distribution curve, with a total curve height of 100%

Study subjects:

Inclusion criteria: all patients of both sexes above 20 years of age coming to our institution center for a routine health checkup with a deranged lipid profile.

Exclusion criteria: Patients below 20 years, and patients who received a recent blood transfusion.

The sample was collected from patients after 10 to 14 hours of fasting to ensure lipid profile readings were not affected. Five millilitre of blood was collected from the antecubital vein under aseptic conditions with prior informed consent. Approximately 2 ml of blood was placed in a vacutainer tube in an EDTA vial. Approximately 2 ml of blood was placed in a plain serum vial. The lipid profile testing was done on Vitros4600. CBC was performed on Sysmex XN-550, a 5-part fully automated haematology analyser which also provides platelet indices like mean platelet volume (MPV) and platelet distribution width (PDW) in addition to the standard CBC parameters.

The data was entered in an MS Excel spreadsheet and analysis was performed using Statistical Package for Social Sciences (SPSS) version 26.0. Statistical analysis was done using Pearson’s correlation test and data was expressed as mean ±SD for each

parameter. A p-value of < 0.05 was considered to be significant.

RESULTS

The present study group consisted of 223 hyperlipidemic patients over the age of 20 and 35 matched controls with normal lipid profiles and PDW. Patients aged 20 to 40, 41 to 60, 61 to 80, and older than 80 were separated by gender. The age of patients ranged from 20–96 years with the mean age being 49.5±14.3 years. The youngest patient was 20 years old and the oldest was 96 years old. A maximum number of patients were grouped under 41-60 years of age (42.6%) followed by 33.6% in 20-40 years of age, 22.4% in 61-80 years of age, and 1.3% in ≥81 years of age. The male-to-female ratio was 1:1.1 with 46.8% males and 53.1% females. (Table 1)

Table 1: Distribution of cases according to age and gender

Age (years)	Male	Female	Percentage
20-40	46	29	75 (33.6%)
41-60	45	50	95(42.6%)
61-80	16	34	50 (22.4%)
≥81	0	3	3 (1.3%)
Mean ± SD 49.5 ± 14.3			

The mean total cholesterol, mean LDL-C and mean HDL-C of the study group were 230.4±26.7, 150.3±28.4, and 40.9±15.2 respectively. There was a significant correlation between cholesterol and LDL-C levels of the study group with a p-value of <.001.

In the study group, the mean platelet count and mean platelet distribution width (PDW) were 288.9±230.5 and 14.1±3.3 respectively. In the case study group, there were three cases of thrombocytopenia, with the lowest being 101 x103 /uL, and four cases of thrombocythemia, with the highest being 3451 x103 /uL; all of the cases had blood cholesterol levels that were borderline high. There is no significant association between cases of hyperlipidemia and platelet counts (table 2). The control group had seven cases of thrombocytopenia with the lowest being 67 x103 /uL.

Table 2. Correlation between various parameters of lipid profile and platelet count in the study group (n=223).

Parameters	Pearson correlation to Platelets	P value
LDL	0.01	0.76
TG	0.58	0.35
T. Cholesterol	0.78	0.20

***Correlation is significant at 0.01 level (2-tailed).*

There were a total of 52 normal cases of PDW in the study group, all with deranged lipid profiles. The PDW value was significantly higher in the high-LDL-C and high total cholesterol of the study group with a p-value of < .001 than in the normal LDL-C and normal total cholesterol group (table 3). Elevated LDL-C and total cholesterol levels were common in the 50-70 age group. However, there is no statistically significant connection. A total of 21 cases in the study group were in their early twenties with borderline high blood cholesterol levels.

Table 3. Comparison of PDW and lipid profile in case group (n=253)

	LDL-C	Cholesterol	PDW	Age	TG	HDL-C
LDL-C	1	-	-	-	-	-
Cholesterol	.993**	1	-	-	-	-
PDW	.982**	.983**	1	-	-	-
TG	-0.050	-0.042	-0.053	-0.044	1	-
HDL-C	-0.108	-0.099	-0.099	-0.097	-0.078	1

**Correlation is significant at 0.01 level (2-tailed)

DISCUSSION

Dyslipidemia, a latent blood disorder that is often asymptomatic, can lead to many complications, the most common being coronary heart disease (CHD). Platelets are known to convert chronic atherosclerotic plaques into a thrombus causing occlusion of the arteries.⁹ Platelet count is a parameter that reflects the functioning, production, and aging of the platelets.¹⁰ On the other hand, PDW is an indicator of platelet size distribution, and an elevated PDW is considered an indicator of increased susceptibility to thrombosis in individuals.¹¹

This study was an attempt to evaluate the relationship between platelet parameters with hyperlipidemia. In the present study, male to female ratio of 1:1.1 was found which correlates with the study of Tsenget al¹². and discordance to Hawaldar R. et al and Khemka R et al. Female preponderance in the present study could be due to most of the females visiting the hospital in their 5th decade of life, increased sedentary life, smoking, and various hormonal imbalances. The maximum number of patient in the present study were in the 41-60 years age group which correlate with the study of Hawaldar R. et al. and Janani K et al.^{13, 14} Age was not found to be statistically significant in both the groups. However, hyperlipidemia in younger children may be due to familial hypercholesterolemia and the popularity of fast food consumption among the young age groups.

In this study, a significant positive correlation between serum cholesterol and LDL-C was found in the study group, which was in concordance with Luo et al. and Cindy I k lam et al.^{15, 16} However, triglyceride readings were not found to be significantly raised in the same study group. This means that total cholesterol can be used as the initial screening to identify individuals who may need lipoprotein analysis. Serum total cholesterol is useful as an initial screening test to detect individuals with raised LDL.¹⁵

The results of the present study showed that platelet counts did not correlate with the case and control groups since thrombocytopenia and thrombocytosis were observed in both case and control groups. A similar observation was found in Assiriet al.¹⁷ and Lippi et al.¹⁸ While other studies although, smaller in sample size, reported the platelet count to be lower.

Platelet distribution width, which is variability in platelet size, is associated with increased platelet production and activity.¹⁹ Present study revealed PDW was significantly higher in hyperlipidemic patients than in controls (P<0.00001). This finding is consistent with Grotto et al.²⁰ and Tseng et al.¹² The study Ravindran et al.²¹ also showed a statistically significant increase in PDW in patients with hyperlipidemia associated with coronary artery disease. In fact, they indicated the presence of more than one deleterious factor that could affect platelet parameters. Vatankulu et al investigated the relationship between PDW and the extent of CAD and chronic total occlusion¹⁹ Vagdatli et al and De Luca et al reported that PDW is a more specific platelet activation marker and provides more information than MPV.^{22, 23} A similar study done by Khemka et al²⁴ found no significant difference between the hyperlipidemic patient and their PDW. One study in the literature investigated the relationship between PDW and carotid intima-media thickness, and that study did not reveal a correlation between carotid intima-media thickness and PDW.²³ In a study by Khandekar et al²⁵ it was observed that all platelet indices are significantly raised in patients with acute myocardial infarction (MI) as compared to those with stable coronary artery disease (CAD). Ege et al²⁶ found that PDW levels were higher in saphenous vein grafts. In contrast, De Luca et al²⁷ found in a large prospective study that PDW was not associated with the extent of coronary artery disease and subclinical atherosclerosis of the carotid artery.

The difference in observations between the different studies may be due to the fact that we included patients with no associated clinical disease, while others have included patients with coronary artery comorbidity, diabetes, and hypertension with hyperlipidemia that may have affected platelet indices.

Limitation of the study: Present study has several limitations. This study was a single-center cross-sectional study. The sample size is small, which could lead to possible bias in the observations. As the study was for a short period of time, all of the comorbidities and environmental factors that might have affected platelet count and functions were not taken into account. Further studies including the other platelet parameters such as mean platelet volume, and plateletcrit will give a better understanding of the association of platelet indices with hypercholesterolemia. Additional studies with a large population with associated comorbidity and a longer study period could reflect better results and confirm the role of platelet markers in the pathogenesis of hypercholesterolemia and associated cardiovascular diseases.

CONCLUSIONS

The current study shows that PDWs are significantly higher in patients with hyperlipidemia. We concluded that platelet volume parameters, PDW, are readily available, relatively inexpensive, and are useful markers that can be used in patients in conjunction with other screening tools to screen patients presenting at a health center to determine the assessed risk of hyperlipidemia.

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