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Variations in platelet indices in hypercholesterolemia patients in a tertiary care hospital

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ABSTRACT

Hypercholesterolemia is defined as high levels of cholesterol in the blood. Platelet indices include: Plateletcrit (PCT), Platelet Distribution Width (PDW) and Mean platelet volume (MPV). Hypercholesterolemia is associated with the increased risk of developing cardiovascular diseases like atherosclerosis which in turn results in platelet activation and thrombotic events. This study is aimed to evaluate the variations in platelet indices in adults with hypercholesterolemia which may be significant in indicating cardiovascular diseases. It is a retrospective case-control study which includes 50 patients with a total cholesterol level of more than 170mg/dl as the study group and 50 healthy controls with normal lipid profile parameters. Data were collected from the lipid profile register in the Biochemistry department of Saveetha Medical College for 3 months duration. The fasting blood samples were run in the machine 'vitros 5600 dry chemistry'. The lipid profile values included in this study were Total cholesterol, HDL and TGL. The platelet indices were collected from the automated haematology analyzer 'Sysmex XN 1000' from the Pathology Department, Saveetha Medical College. The data collected were tabulated and analysed using SPSS software. Statistical tool used is the independent T-test. The mean value of the platelet parameters such as MPV, PCT and PDW in the study group was 10.397061, .3000, and 12.452 respectively and that of the control group was 9.907480, .2882, 11.174 respectively. On comparing the platelet parameters such as MPV, PCT and PDW between the study and the control group it was observed that there was a significant variation in MPV and PDW. In the independent sample test, the p-value of MPV, PCT and PDW were 0.21, 0.481 and 0.008, respectively. Thus MPV and PDW shows a significant variation between the study and the control group as it is higher in hypercholesterolemia patients (p-value is <0.05).

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INTRODUCTION

Hypercholesterolemia is defined as high levels of cholesterol in the blood. Elevated levels of non-HDL cholesterol in the blood may be a consequence of diet, obesity, or the presence of other diseases such as type 2 diabetes etc. Hypercholesterolemia is a major risk factor for the development of Coronary Heart Disease (CHD) and stroke. Hypercholesterolemia is very closely associated with atherosclerosis and it plays a role in endothelial dysfunction and involves platelet mediated recruitment of white blood cells to the arteries (Ross, 1999; Huo *et al.*,

2003; Libby *et al.*, 2011). When the arteries are inflamed due to atherosclerosis, the platelets are activated and interact with the endothelial cells and deposit platelet-derived cytokines on the surface of the endothelial cells (Koenen *et al.*, 2009). This, in turn, facilitates the deposition of leucocytes on the surface of these lesions. It is generally known that hypercholesterolemia causes platelet activation and thrombotic events (Connor *et al.*, 1963; Carvalho *et al.*, 1974; Owens *et al.*, 2012).

There is a growing interest in the utility of platelet indices in a variety of clinical conditions most notably cardiovascular disorders (Khandekar, 2006; Assiri *et al.*, 2012; ichi Fujita *et al.*, 2015). Lipids and lipoproteins are known to interact with platelets and affect their structure and function which are believed to be mediated by multiple factors like prostaglandins, thromboxanes, nitric oxide, etc., which may contribute to accelerated atherogenesis associated with Coronary Artery Disease (CAD) and stroke (Siegel-Axel *et al.*, 2008; O'Donnell *et al.*, 2014; Fessler *et al.*, 2013). It is therefore plausible that lipid profile parameters like total cholesterol, LDL-C, HDL-C, and TGL influence the values of platelet indices. These indices include platelet count, Mean Platelet Volume (MPV), Plateletcrit (PCT), Platelet Distribution Width (PDW) and Platelet large cell ratio (P-LCR). The present study includes the platelet indices MPV, PCT and PDW.

Plateletcrit (PCT) is the measure of total platelet mass. The normal range for PCT is 0.22-0.24%. Platelet Distribution Width (PDW) reflects the variation of platelet size distribution. The normal range for PDW is from 9.3-14 fl. Mean Platelet Volume (MPV) is a measure of the average size of platelets. The normal range for MPV is from 7.2-11 fl.

This study was carried out to understand and correlate the platelet indices in adults with hypercholesterolemia, which would be essential for indicating the risk of cardiovascular diseases in the future.

MATERIALS AND METHODS

Type of study

It is a retrospective case-control study conducted between July to October 2019 in the Department of Pathology in collaboration with the Department of Biochemistry of Saveetha Medical College.

Sample size

A total of 50 cases with a Total Cholesterol (TC) level more than 170mg/dl were taken as the study group and a total of 50 cases with normal lipid profile parameters were taken as the control group, as
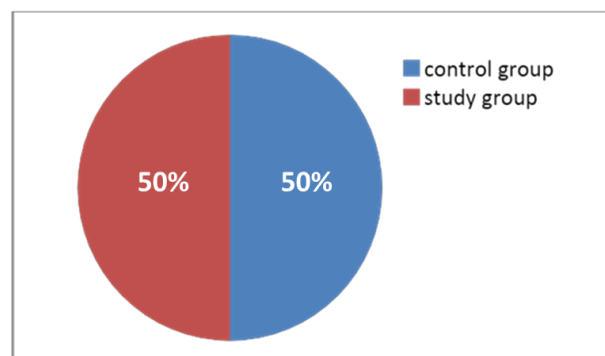

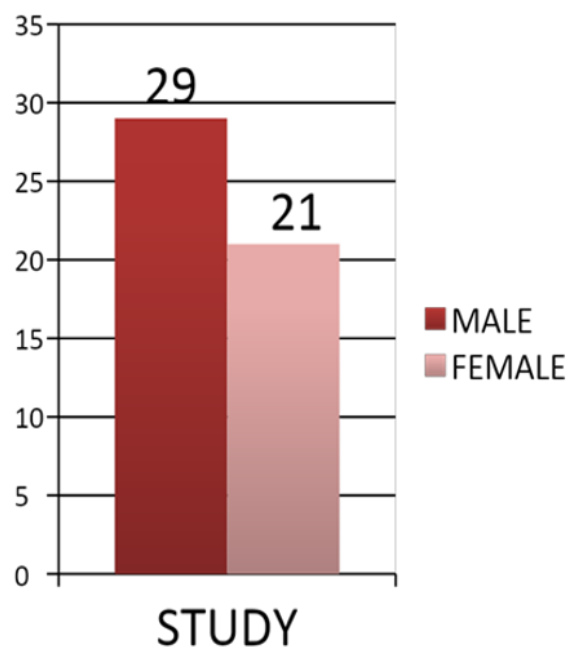**Figure 1: Distribution of the study group and the control group**
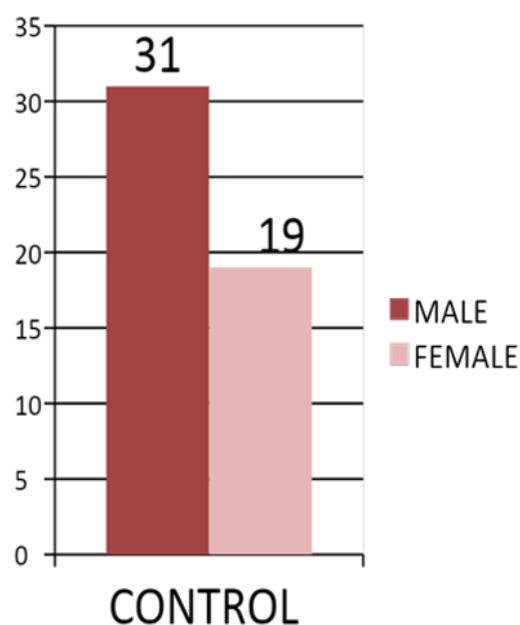

Figure 2: Gender of Study Group

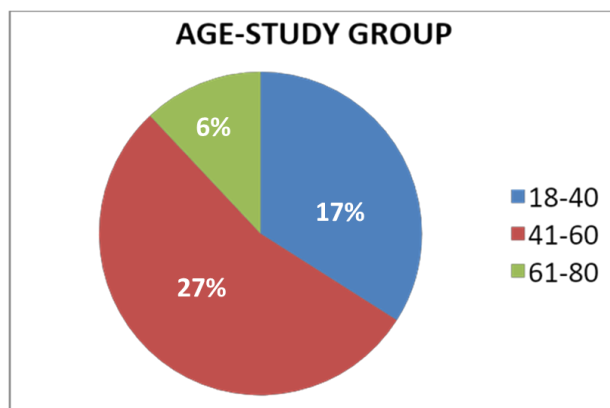**Figure 3: Gender of Control Group**

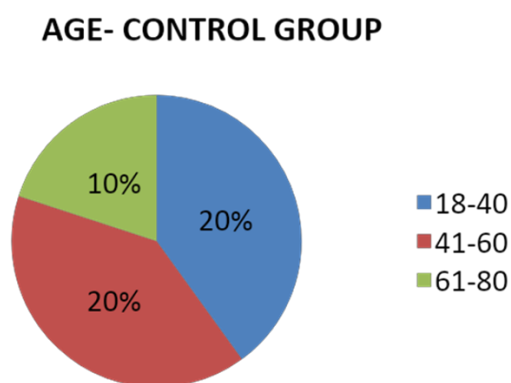**Figure 4: Distribution of Age in Study group**

Figure 5: Distribution of Age in Control group

shown in Figure 1.

Selection criteria

This study included known hypercholesterolemia patients above 18 years of age. (I.e., total cholesterol more than 170mg/dl). Paediatric patients and patients with platelet disorders were excluded.

Data collection procedures

A total of 50 cases with total cholesterol level more than 170mg/dl were traced from the lipid profile register in the Biochemistry department of our medical college for a period of 3 months duration, which was taken as the study group. The fasting blood samples were run in the machine 'vitros 5600 dry chemistry' in the biochemistry laboratory. The lipid profile parameters such as Total Cholesterol, HDL, and LDL were collected from the lipid profile register. Similarly, data's of 50 patients with normal lipid profile parameters were also collected which was taken as the control group.

Total cholesterol

Optimal: <170 mg/dl

Desirable: <200 mg/dl

Borderline high: 200-239 mg/dl

High: $\geq$ 240 mg/dl

The platelet indices of the 50 hypercholesterolemia patients and the 50 normocholesterolemic patients were collected from the automated haematology analyzer 'Sysmex XN 1000' from the Pathology department of our Medical College. The platelet indices include Plateletcrit (PCT), Platelet Distribution Width (PDW) and Mean Platelet Volume (MPV).

Plan of analysis

The data collected were tabulated and analysed using SPSS software. Statistical tests applied on the samples were mean, standard deviation and the independent sample t-test. Significance is assessed at 5% level of significance and 95% confidence interval.

RESULTS AND DISCUSSION

Out of the 50 cases of hypercholesterolemia patients (study group), 29 were male and 21 were female, as shown in Figure 2. Out of the 50 cases of control, 31 were male and 19 were female, as shown in Figure 3.

Both the study and the control groups were divided into 18-40, 41-60, and 61-80 years of age. The majority of the individuals in the study group were between 41-60 years of age (27%), 17% of the individuals were between 18-40 years of age and 6% of individuals were between 61-80 years of age, as shown in Figure 4. Similarly, in the control group, 20% of the individuals were between 18-40 years of age, another 20% of the individuals were between 41-60 years of age and 10% of the individuals were between 61-80 years of age, as shown in Figure 5. The mean age in the study group was 47.07 and that of the control group was 43.52.

The mean value of total cholesterol and HDL in the study group was 222.180 and 42.420, respectively and the mean value of total cholesterol and HDL in the control group was 140.760 and 38.940 respectively; group statistics is shown in Table 1. There was a significant difference in cholesterol levels between the control group and the study group.

The mean value of the platelet parameters such as MPV, PCT and PDW in the study group was 10.397061, .3000, and 12.452 respectively and the mean value of the platelet parameters such as MPV, PCT and PDW in the control group was 9.907480, .2882, 11.174 respectively; group statistics is shown in Table 1. On comparing the platelet parameters such as MPV, PCT and PDW between the study and the control group it was observed that there was a significant variation in MPV and PDW. In the independent sample test, the p-value of MPV, PCT and PDW were 0.21, 0.481 and 0.008 respectively; an

Table 1: Group Statistics

Group Statistics					
	Patient		Mean*	Std. Deviation	Std. Error Mean
Total cholesterol	NORMAL	50	140.760	22.3858	3.1658
	HYPERCHOLESTEROLEMIA	50	222.180	56.0137	7.9215
HDL	NORMAL	50	38.940	11.3864	1.6103
	HYPERCHOLESTEROLEMIA	50	42.420	11.8220	1.6719
MPV	NORMAL	50	9.907480	1.1011201	.1557219
	HYPERCHOLESTEROLEMIA	50	10.397061	.9728992	.1389856
PCT	NORMAL	50	.2882	.07227	.01022
	HYPERCHOLESTEROLEMIA	50	.3000	.09326	.01319
PDW	NORMAL	50	11.174	2.5244	.3570
	HYPERCHOLESTEROLEMIA	50	12.452	2.2043	.3117

HDL-High-Density Lipoprotein; MPV-Mean Platelet Volume; PCT-Plateletcrit; PDW-Platelet Distribution Width.
*Column shows the value of mean in normal and hypercholesterolemia patients.

Table 2: Independent Sample Test

Independent Samples Test				
			t-test for Equality of Means	
			Sig. (2-tailed)	Mean Difference
Total cholesterol	Equal variances assumed		.000	-81.4200
HDL	Equal variances assumed		.137	-3.4800
MPV	Equal variances assumed		.021	-.4895812
PCT	Equal variances assumed		.481	-.01180
PDW	Equal variances assumed		.008	-1.2780

independent sample test is shown in Table **??**. Thus MPV and PDW shows a significant variation between the study group and the control group since the p-value is <0.05.

Coronary artery disease is one of the major causes of morbidity and mortality in the world as well as in the Indian population. Hypercholesterolemia can lead to the development of atherosclerosis which can later manifest as Coronary Heart Disease. Platelets are known to convert the atherosclerotic plaques into thrombus which can lead to the occlusion of the arteries. The platelet indices can help in understanding the properties and function of the platelets. Mean Platelet Volume (MPV) is used to assess the average size of the platelet. Platelet Distribution Width (PDW) reflects the variation of platelet size distribution and, an increase in PDW is considered to be an indicator of increased thrombotic tendency in individuals. Also, large platelets have high metabolic activity and thus have the potential to cause platelet aggregation as compared to smaller platelets.

A significant difference in platelet counts, PCT, MPC, PDW and P-LCR (Hawaldar and Sodani, 2018). However, in our study, there was a significant difference in MPV and PDW between the normocholesterolemic (control) and the hypercholesterolemia (study) patients, whereas there was no significant variation in PCT between the study group and the control group. Platelet indices such as MPV, PDW and P-LCR were significantly higher (p-value <0.05) in the study group than in the control group (Fatima et al., 2017). The platelet indices such as MPV, PDW and P-LCR were significantly higher in the study group than in the control group (Khemka and Kulkarni, 2014). This correlates with our study since our study also shows a significant variation (p-value <0.05) in MPV and PDW between the study group and the control group.

Amongst the platelet indices, only the value of MPV was not associated with any of the lipid parameters (Bora *et al.*, 2016). However, our study showed a significant variation in MPV between the study group and the control group. Our study also correlates with the study of Tseng *et al.* (2016) who observed a significant difference in MPV and PDW between the study and the control group (Tseng *et al.*, 2016). Similarly, on observing the study conducted by Verdoia et al., significant changes in the MPV values were also seen (Verdoia *et al.*, 2015).

The difference in observation between the different studies could be due to the fact that our study is a retrospective study and only the platelet disorders were excluded and not the other clinical diseases the patient could have had, while the others may have included the patients without any associated clinical disease.

It can be suggested that hypercholesterolemia leads to the priming of platelets and increases the platelet activity, which in turn increases the risk of Coronary Artery Disease. Accumulation of cholesterol in the platelets leads to an increase in the activity of the platelets leading to atherosclerosis and other thrombotic events. All the platelet indices were significantly raised in patients with acute Myocardial infarction when compared to those with stable CAD (Khandekar, 2006).

Our study has a few limitations. Since it is a retrospective study, the other clinical disease associated with the patient was not excluded. Also, since the sample size is small, it could have created a bias in the observation. As the study was for a short period of time only the platelet parameters such as MPV, PCT and PDW were included. Further studies including the other platelet parameters will give a better understanding on the association of platelet indices with hypercholesterolemia. Other lipid profile parameters like LDL and TGL can also be utilized to see the correlation with the platelet indices. Additional studies involving a large population and the study conducted for a longer period of time can yield better results and validate the role of platelet indices in the pathogenesis of hypercholesterolemia and associated cardiovascular diseases.

CONCLUSION

Hypercholesterolemia can cause a variety of thromboembolic complications. Our study shows that platelet indices such as MPV and PDW are higher in hypercholesterolemia patients when compared to patients with normal levels of cholesterol. A positive correlation of platelet indices with increasing cholesterol levels may be related to thrombogenic potential of hypercholesterolemia. The platelet indices are generated in the automated haematology analyzer without any additional cost to the pathologist and the patients. Thus, platelet indices can be used as a predictor of thrombotic events in Hypercholesterolemia patients. Further studies conducted on a large scale will serve to prove this hypothesis.

Conflict of Interest

None.

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