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A Study of Platelet Parameters in Patients of Type 2 Diabetes Mellitus

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ABSTRACT

Type 2 Diabetes Mellitus is a heterogenous group of disorders characterized by variable degree of insulin resistance, impaired insulin secretion and excessive hepatic glucose production. Diabetic thrombocytopathy is a condition that affects the platelet function in diabetic individuals. The aim of this research is to study the platelet parameters in type 2 diabetics.

Method: In this cross sectional study we studied fasting blood sugar level, post prandial blood sugar, HbA1c and platelet parameters in relation with HbA1c and blood sugar levels in 115 patients of type 2 diabetes mellitus.

Results: Present study shows that there is statistically significant correlation between BSL (Fasting) ,BSL (Post prandial) and HbA1c; BSL (Post Prandial) and Plateletcrit and no statistically significant correlation between the other platelet parameters and HbA1c, fasting blood sugar level and post prandial blood sugar level in type 2 diabetics

KEYWORDS: Type 2 Diabetes Mellitus, Platelet parameters, HbA1c, BSL(Fasting), BSL (Post prandial).

ARTICLE DETAILS

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INTRODUCTION:

Type 2 Diabetes Mellitus is a heterogenous group of disorders characterized by variable degree of insulin resistance, impaired insulin secretion and excessive hepatic glucose production. It occurs when the body becomes resistant to insulin resulting in eventual insulin deficiency. **Prevalence and Mortality-**About 422 million people worldwide have diabetes, and 1.6 million deaths are attributed to diabetes each year. Prevalence of type 2 Diabetes mellitus in India is 9.3% and incidence is 90.7% [1].Long standing cases of type 2 diabetes develop macrovascular complications like cardiovascular diseases including ischemic heart diseases, coronary artery diseases, peripheral vascular diseases [2] and microvascular complications like Diabetic neuropathy, Diabetic nephropathy, Diabetic retinopathy and Diabetic microangiopathy. These complications occur due to altered platelet parameters in type 2 Diabetes mellitus and these are common causes of morbidity and mortality in type 2 diabetes mellitus patients.

Diabetic thrombocytopathy refers to the abnormality of platelet function in diabetic individuals[3].The biochemical abnormalities responsible for it are reduced membrane fluidity, increased arachidonic acid metabolism, increased thromboxane A-2 synthesis, decreased prostacyclin production, decreased Nitric Oxide production, increased expression of activation dependent adhesion molecules. (eg. GPIIb -IIIa, P-selectin) [4]

Following platelet parameters are studied in type 2 diabetes mellitus patients which are considered in this cross-sectional study-

- Mean platelet volume (average size of platelets in the blood)
- Platelet count
- Platelet distribution width (Platelet anisocytosis)
- Plateletcrit (percentage of blood volume occupied by platelets)
- Platelet large cell ratio.[4][5][6]7]

A Study of Platelet Parameters in Patients of Type 2 Diabetes Mellitus

Aim:

To study platelet parameters in type 2 diabetics.

Objectives:

1.To study fasting blood sugar level, post prandial blood sugar level and HbA1c in type 2 diabetics.

2.To study Platelet parameters in type 2 diabetics

3. To study platelet parameters in relation with HbA1c and blood sugar levels in patients of type 2 diabetes mellitus.

MATERIAL AND METHODS

Total 115 type 2 diabetes mellitus patients were included in this cross sectional study. The study was conducted at Bharati Vidyapeeth Medical College and hospital, Sangli over a duration of 1 year. The demographic information and clinical details of the patients were recorded including fasting blood sugar level, post prandial blood sugar level, HbA1C and platelet parameters.

Equipments used: Venous blood sample was collected in EDTA and fluoride vacutainers for estimation of platelet parameters, fasting blood sugar level, post prandial blood sugar level. Platelet parameters of blood samples were obtained using SYSMAX automated Complete Blood Count analyzer. Blood sugar levels were obtained using ARCHITECT PLUS AUTOMATED ANALYZER. HbA1c sample was analyzed on MERIL DIAGNOSTIC'S PRO VISO SPECIFIC PROTEIN ANALYZER.

INCLUSION CRITERIA

1.Patients attending Medicine O.P,D and admitted in Bharati Hospital, Sangli who have type 2 Diabetes mellitus.

2. Patients above >18 years of age.

3. Patients who gave consent.

Exclusion criteria:

1.Patients with bleeding tendencies.

2.Patients with Anemia

3. Patients who have received blood transfusion in the last 14 days

4. Pregnancy

5. Patients with diagnosed malignant disorders/thrombocytopenia/thrombocytosis

6. Diabetics on antiplatelet drugs like aspirin, clopidogrel or on insulin.

7. Patients with bacterial, viral and protozoal infections

Calculated Sample size- 115

Sampling technique- Convenience sampling method.

Study tools: Proforma And Laboratory Investigations.

Risk Involved: NIL

DETAILED RESEARCH PLAN

Venous blood sample was collected in EDTA and fluoride vacutainers for estimation of platelet parameters, fasting blood sugar level, post prandial blood sugar level. Platelet parameters of blood samples were obtained using sysmax automated Complete Blood Count analyzer. Blood sugar levels were obtained using architect plus automated analyzer. HbA1c sample was analyzed on meril diagnostic's pro viso specific protein analyzer. The normal reference range for this set up is from 5.3%-7.5 %. The international reference range is from 3.8-5.8%. The HbA1c values considered in this research were thus, recalculated according to appropriate conversion techniques. This was done based upon the internationally standardized Average Blood Sugar levels.[8]

Study population comprises of-

n=115, Type 2 Diabetic patients

Based on HbA1C levels diabetics were classified in groups as HbA1c ≥8.25%, HBA1c 7.6%-8.25%, HbA1c <7.6% [6][8]

OBSERVATIONS

Study subjects classified based on HbA1c into 3 groups [3][9] , n=115

OBSERVATIONS AND RESULTS

Group 1: HbA1c more than equal to 8.25 %

Group 2: HbA1c between 7.6 and 8.25%

Group 3: HbA1c less than 7.6%

Table I: Age distribution

In the present study in Group 1, 54.48 years mean age was observed, in group 2, 58.43 years mean age was observed where in group 3, 56.15 years mean age was observed. Statistically no significant difference was observed between the age and HbA1c levels.

Descriptives

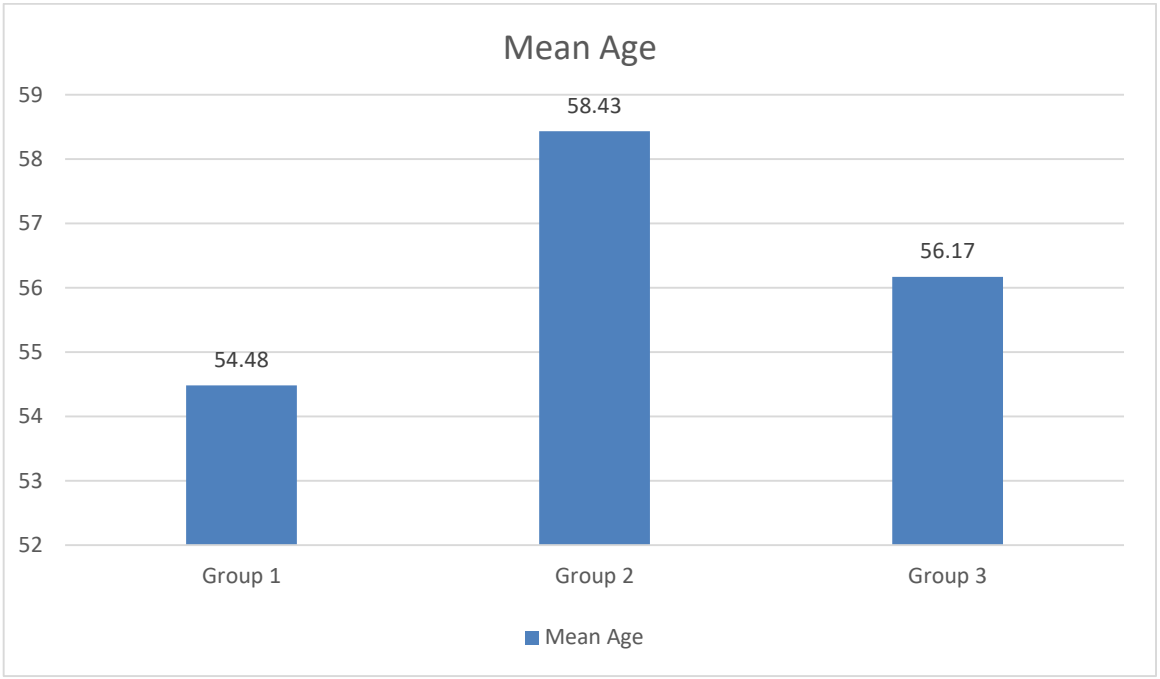
Age

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
HbA1c more than equal to 8.25 %	55	54.67	13.71	1.85	50.97	58.38	29.00	80.00
HbA1c between 7.6 and 8.25%	14	58.43	13.51	3.61	50.63	66.23	41.00	81.00
HbA1c less than 7.6%	46	56.15	14.84	2.19	51.74	60.56	20.00	85.00
Total	115	55.72	14.08	1.31	53.12	58.32	20.00	85.00

ANOVA

Age

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	171.62	2	85.81	.428	.653
Within Groups	22437.47	112	200.33		
Total	22609.10	114			



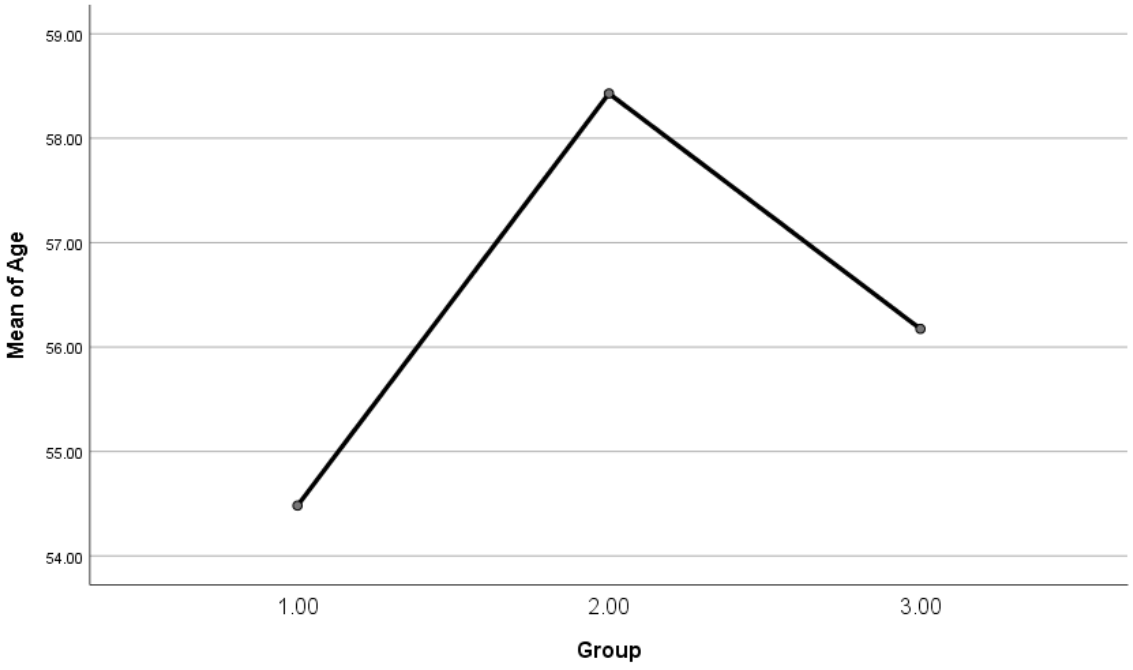


Table II: Gender distribution

Gender	Group 1		Group 2		Group 3	
	No of cases	Percentage (%)	No of cases	Percentage (%)	No of cases	Percentage (%)
Male	33	61.11	11	78.57	26	56.52
Female	22	38.89	3	21.43	20	43.48
Total	54	100	14	100	46	100

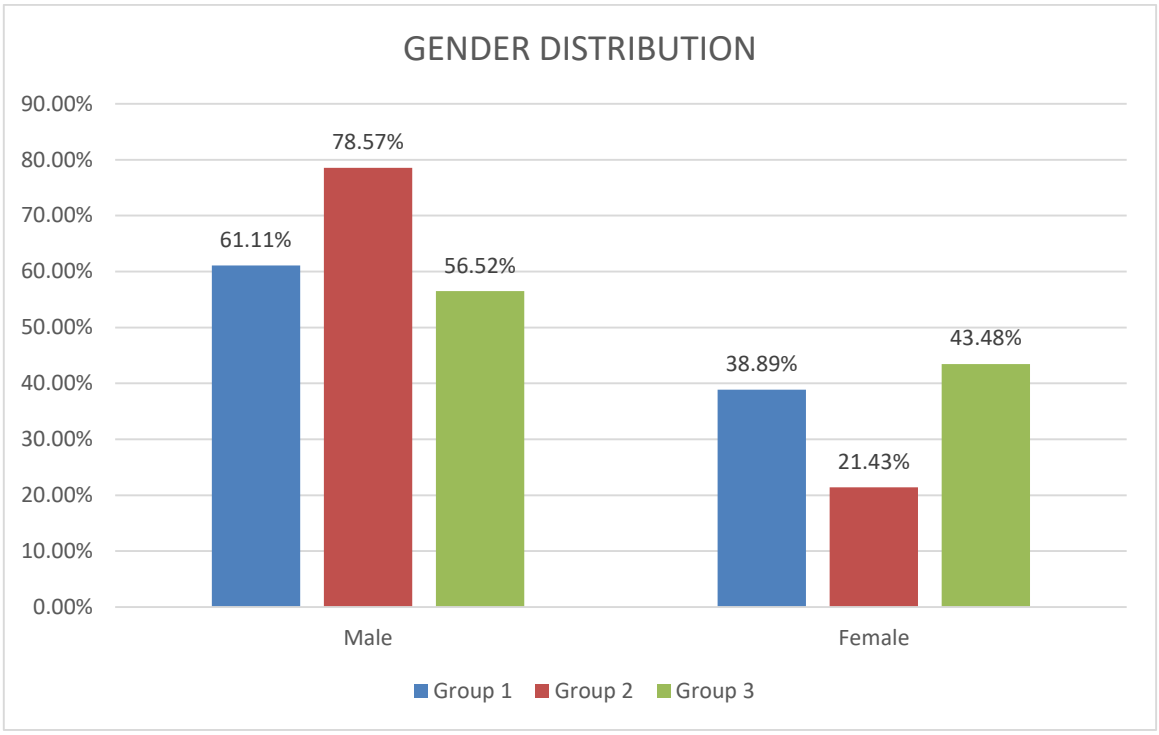


Table III: BSL Fasting

Descriptives

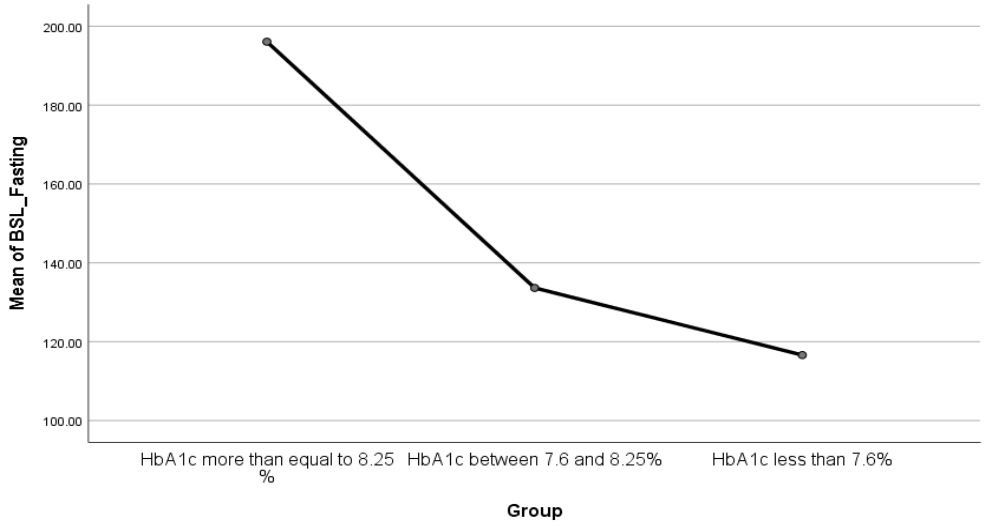
BSL_Fasting

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
HbA1c more than equal to 8.25 %	55	196.07	77.47	10.45	175.13	217.02	70.00	401.00
HbA1c between 7.6 and 8.25%	14	133.64	32.31	8.64	114.99	152.30	84.00	191.00
HbA1c less than 7.6%	46	116.61	39.78	5.87	104.80	128.42	66.00	260.00
Total	115	156.69	71.05	6.63	143.56	169.81	66.00	401.00

ANOVA

BSL_Fasting

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	166640.85	2	83320.43	22.82	.000
Within Groups	408885.88	112	3650.77		
Total	575526.73	114			



In Group 1: 196.07 mean BSL Fasting was observed, in Group 2 133.64 mean BSL fasting was observed where in group 3 116.61 mean BS: fasting was observed. Statistically significant difference was observed in BSL fasting and groups. (p=<0.0001***)

Table IV: BSL PP

Descriptives

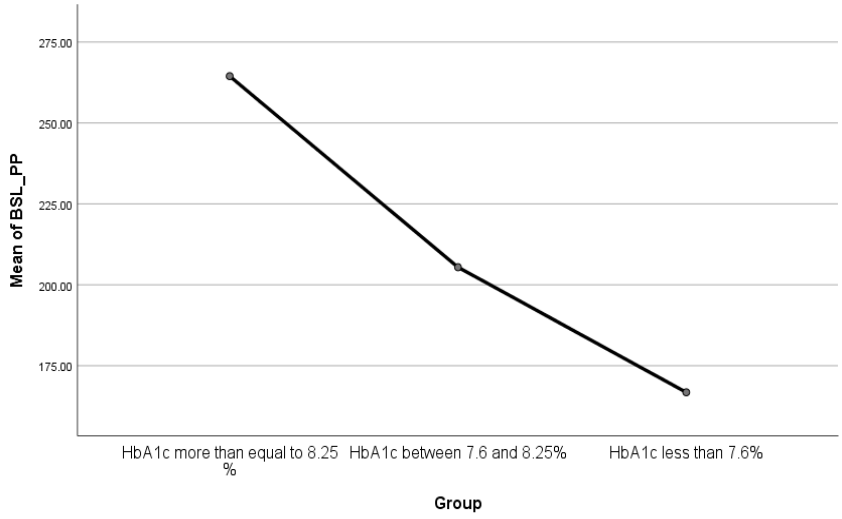
BSL_PP

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
HbA1c more than equal to 8.25 %	55	264.45	98.31	13.26	237.88	291.03	75.00	554.00
HbA1c between 7.6 and 8.25%	14	205.43	62.88	16.81	169.12	241.74	115.00	319.00
HbA1c less than 7.6%	46	166.78	58.90	8.68	149.29	184.27	87.00	383.00
Total	115	218.20	92.29	8.61	201.15	235.25	75.00	554.00

ANOVA

BSL_PP

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	241567.51	2	120783.75	18.55	.000
Within Groups	729366.89	112	6512.20		
Total	970934.40	114			



In Group 1, 264.45 mean BSL PP was observed, in Group 2 205.43 mean BSL PP was observed where in group 3 166.78 mean BSL PP was observed. Statistically significant difference was observed in BSL PP between three groups. (p=<0.0001***)

Table V: Platelet

Descriptives

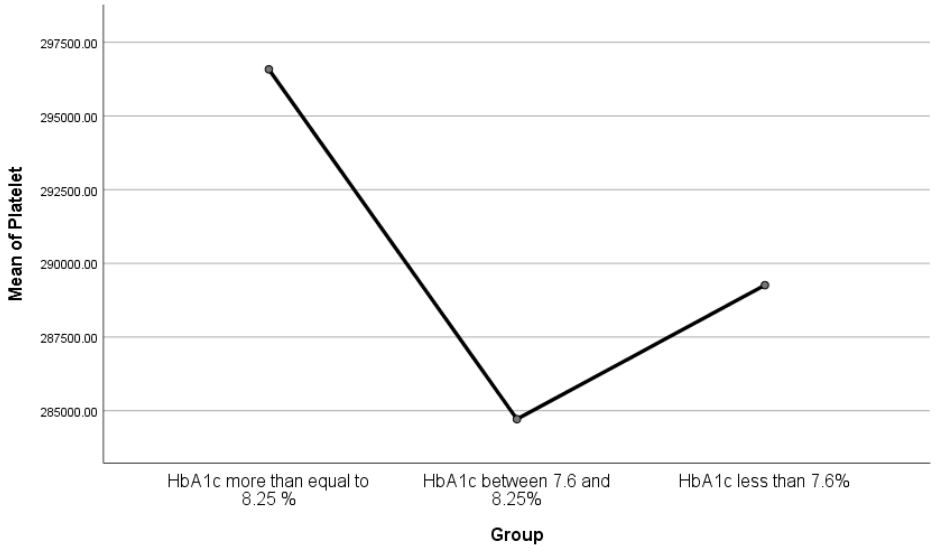
Platelet

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
HbA1c more than equal to 8.25 %	55	296581.82	106439.46	14352.29	267807.20	325356.44	94000.00	601000.00
HbA1c between 7.6 and 8.25%	14	284714.29	64695.06	17290.48	247360.47	322068.10	134000.00	406000.00
HbA1c less than 7.6%	46	289260.87	102815.79	15159.36	258728.35	319793.39	110000.00	726000.00
Total	115	292208.70	100181.11	9341.94	273702.39	310715.00	94000.00	726000.00

ANOVA

Platelet

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2237882778.09	2	1118941389.05	.11	.896
Within Groups	1141895108526.26	112	10195492040.41		
Total	1144132991304.35	114			



In Group 1, 296581.82 mean Platelet was observed, in Group 2 284714.29 mean Platelet was observed where in group 3 289260.87 mean Platelet was observed. Statistically no significant difference was observed in Platelet between three groups. (p=0.904)

Table VI: Plateletcrit

Descriptives

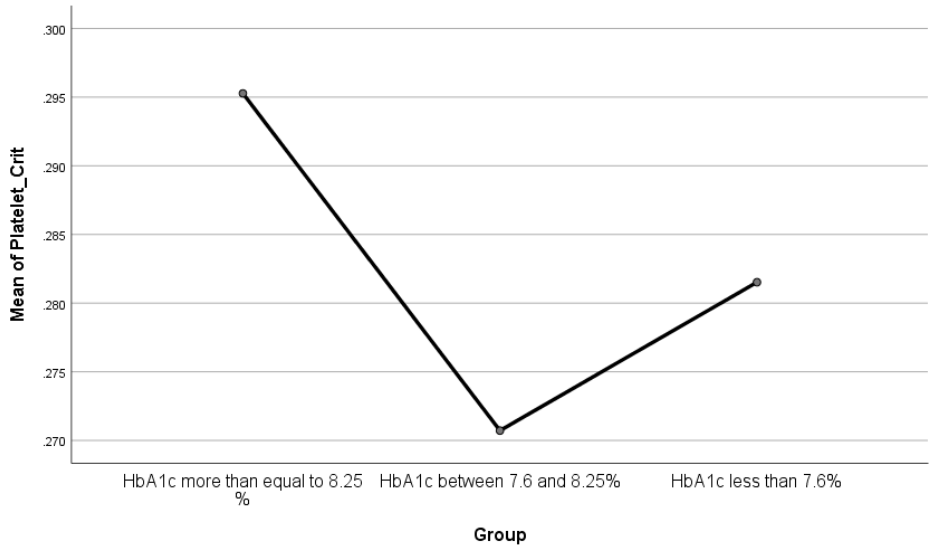
Plateletcrit

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
HbA1c more than equal to 8.25 %	55	0.30	0.11	0.01	0.27	0.32	0.11	0.59
HbA1c between 7.6 and 8.25%	14	0.27	0.06	0.02	0.24	0.31	0.16	0.37
HbA1c less than 7.6%	46	0.28	0.09	0.01	0.25	0.31	0.11	0.68
Total	115	0.29	0.10	0.01	0.27	0.30	0.11	0.68

ANOVA

Plateletcrit

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.01	2	.004	.48	.623
Within Groups	1.04	112	.009		
Total	1.05	114			



In Group 1, 0.30 mean Plateletcrit was observed, in Group 2, 0.27 mean Platelet was observed where in group 3 0.28 mean Platelet was observed. Statistically no significant difference was observed in Platelet CRIT between three groups. (p=0.904)

Table VII: MPV

Descriptives

MPV

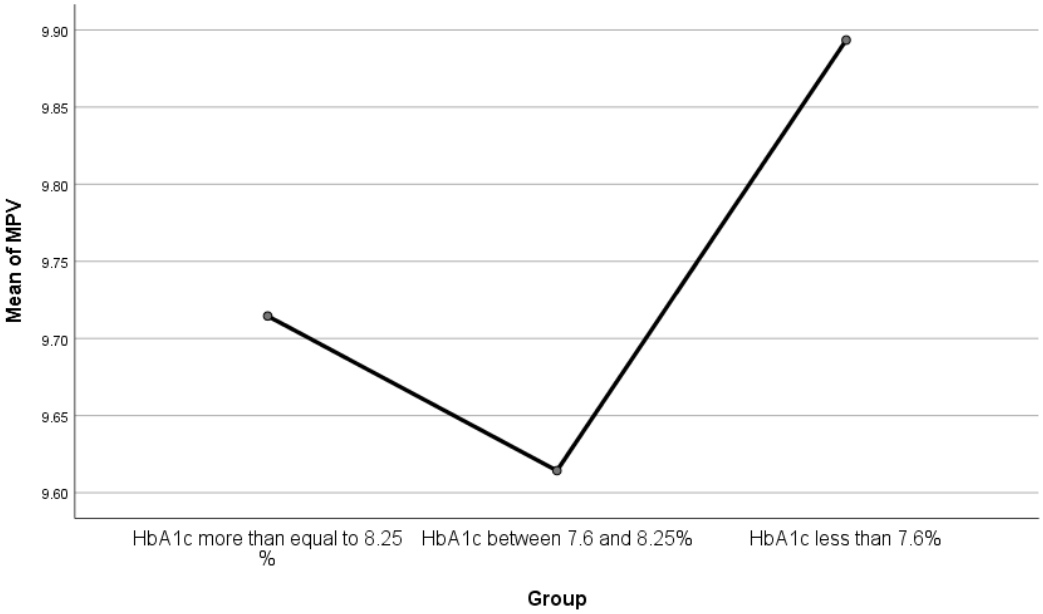
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
HbA1c more than equal to 8.25 %	55	9.71	0.72	0.10	9.52	9.91	8.60	12.10
HbA1c between 7.6 and 8.25%	14	9.61	1.05	0.28	9.01	10.22	8.30	12.10

HbA1c less than 7.6%	46	9.89	0.90	0.13	9.63	10.16	8.10	12.50
Total	115	9.77	0.83	0.08	9.62	9.93	8.10	12.50

ANOVA

MPV

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.21	2	.604	.87	.424
Within Groups	78.17	112	.698		
Total	79.38	114			



In Group 1, 9.71 mean MPV was observed, in Group 2, 9.61 mean MPV was observed where in group 3, 9.89 mean MPV was observed. Statistically no significant difference was observed in MPV between three groups. (p=0.442)

Table VIII: PDW

Descriptives

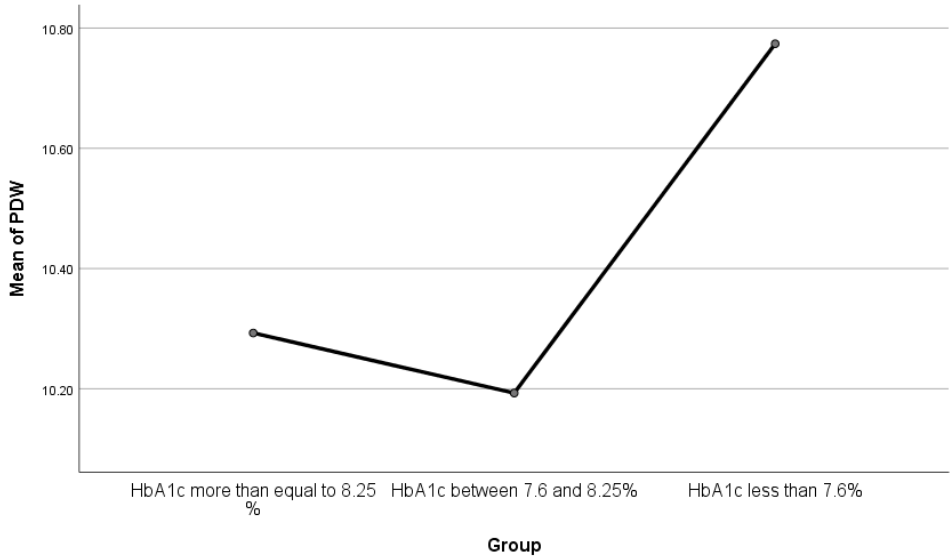
PDW

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
HbA1c more than equal to 8.25 %	55	10.29	1.38	0.19	9.92	10.67	8.00	13.90
HbA1c between 7.6 and 8.25%	14	10.19	1.79	0.48	9.16	11.23	7.70	14.50
bA1c less than 7.6%	46	10.77	2.06	0.30	10.16	11.39	7.00	15.70
Total	115	10.47	1.73	0.16	10.15	10.79	7.00	15.70

ANOVA

PDW

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.05	2	3.53	1.18	.312
Within Groups	335.70	112	2.99		
Total	342.75	114			



In Group 1, 10.29 mean PDW was observed, in Group 2, 10.19 mean PDW was observed where in group 3, 10.77 mean PDW was observed. Statistically no significant difference was observed in PDW between three groups. (p=0.442)

Table IX: PLCR

Descriptives

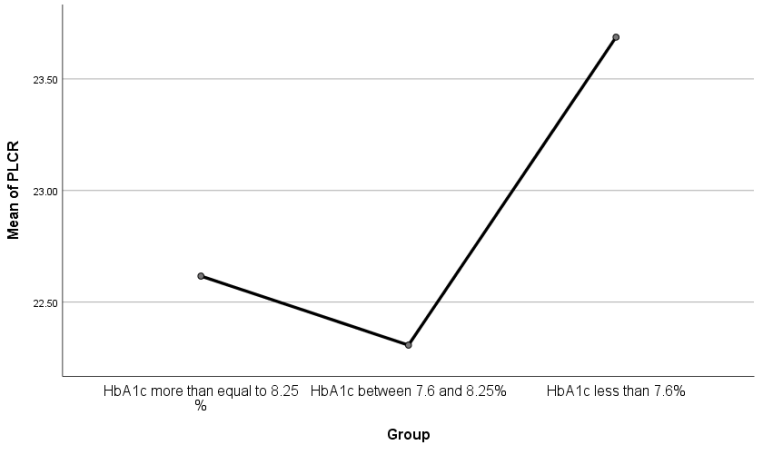
PLCR

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
HbA1c more than equal to 8.25 %	55	22.62	5.89	0.79	21.02	24.21	7.90	40.00
HbA1c between 7.6 and 8.25%	14	22.31	7.09	1.90	18.21	26.40	11.10	39.60
HbA1c less than 7.6%	46	23.69	7.66	1.13	21.41	25.96	9.00	45.90
Total	115	23.01	6.76	0.63	21.76	24.25	7.90	45.90

ANOVA

PLCR

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	36.52	2	18.26	.40	.674
Within Groups	5166.03	112	46.13		
Total	5202.55	114			



In Group 1, 22.62 mean PLCR was observed, in Group 2, 22.31 mean PLCR was observed where in group 3, 23.69 mean PLCR was observed. Statistically no significant difference was observed in PDW between three groups. (p=0.675).

Table X: Correlation between BSL Fasting and platelet

Descriptive Statistics

	Mean	Std. Deviation	N
BSL_Fasting	156.69	71.05	115
Platelet	292208.70	100181.11	115

Correlations

		BSL_Fasting	Platelet
BSL_Fasting	Pearson Correlation	1	-.068
	Sig. (2-tailed)		.472
	N	115	115
Platelet	Pearson Correlation	-.068	1
	Sig. (2-tailed)	.472	
	N	115	115

Statistically no significant correlation was observed between BSL Fasting and platelet count. (p=0.47)

Table XI: Correlation between BSL PP and platelet count

Descriptive Statistics

	Mean	Std. Deviation	N
Platelet count	292208.70	100181.11	115
BSL_PP	218.20	92.29	115

Correlations

		Platelet	BSL_PP
Platelet count	Pearson Correlation	1	.076
	Sig. (2-tailed)		.420
	N	115	115
BSL_PP	Pearson Correlation	.076	1
	Sig. (2-tailed)	.420	
	N	115	115

Statistically no significant correlation was observed between BSL PP and platelet. (p=0.42)

Table XII: Correlation between BSL PP and HbA1C

Descriptive Statistics

	Mean	Std. Deviation	N
BSL_PP	218.20	92.29	115
HBA1C	8.55	2.11	115

Correlations

		BSL_PP	HBA1C
BSL_PP	Pearson Correlation	1	.562**
	Sig. (2-tailed)		.000
	N	115	115
HBA1C	Pearson Correlation	.562**	1
	Sig. (2-tailed)	.000	
	N	115	115

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

Statistically significant correlation was observed between BSL PP and HbA1c. (p=<0.0001***)

Table XIII: Correlation between BSL fasting and HbA1C

Descriptive Statistics

	Mean	Std. Deviation	N
HBA1C	8.55	2.11	115
BSL_Fasting	156.69	71.05	115

Correlations

		HBA1C	BSL_Fasting
HBA1C	Pearson Correlation	1	.610**
	Sig. (2-tailed)		.000
	N	115	115
BSL_Fasting	Pearson Correlation	.610**	1
	Sig. (2-tailed)	.000	
	N	115	115

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

Statistically significant correlation was observed between BSL Fasting and HbA1c. (p=<0.0001***)

Table XIV: Correlation between BSL Fasting and Platelet Crit

Descriptive Statistics

	Mean	Std. Deviation	N
BSL_Fasting	156.69	71.05	115
Platelet_Crit	0.29	0.10	115

Correlations

		BSL_Fasting	Platelet_Crit
BSL_Fasting	Pearson Correlation	1	.063
	Sig. (2-tailed)		.502
	N	115	115

Platelet_Crit	Pearson Correlation	.063	1
	Sig. (2-tailed)	.502	
	N	115	115

Statistically no significant correlation was observed between BSL fasting and platelet crit. (p=0.50)

Table XV: Correlation between BSL PP and Platelet Crit

Descriptive Statistics

	Mean	Std. Deviation	N
Platelet_Crit	0.29	0.10	115
BSL_PP	218.20	92.29	115

Correlations

		Platelet_Crit	BSL_PP
Platelet_Crit	Pearson Correlation	1	.200*
	Sig. (2-tailed)		.032
	N	115	115
BSL_PP	Pearson Correlation	.200*	1
	Sig. (2-tailed)	.032	
	N	115	115

*. Correlation is significant at the 0.05 level (2-tailed).

Statistically significant correlation was observed between BSL PP and platelet crit. (p=0.03

Table XVI: Correlation between BSL Fasting and MPV

Descriptive Statistics

	Mean	Std. Deviation	N
BSL_Fasting	156.69	71.05	115
MPV	9.77	0.83	115

Correlations

		BSL_Fasting	MPV
BSL_Fasting	Pearson Correlation	1	.015
	Sig. (2-tailed)		.870
	N	115	115
MPV	Pearson Correlation	.015	1
	Sig. (2-tailed)	.870	
	N	115	115

Statistically no significant correlation was observed between BSL fasting and MPV. (p=0.87)

Table XVIII: Correlation between BSL Fasting and PDW

Descriptive Statistics

	Mean	Std. Deviation	N
BSL_Fasting	156.69	71.05	115
PDW	10.47	1.73	115

Correlations

		BSL_Fasting	PDW
BSL_Fastin	Pearson Correlation	1	.009
	Sig. (2-tailed)		.925
	N	115	115
PDW	Pearson Correlation	.009	1
	Sig. (2-tailed)	.925	
	N	115	115

Statistically no significant correlation was observed between BSL fasting and PDW. (p=0.92)

Table XIX: Correlation between BSL Fasting and PLCR

Descriptive Statistics

	Mean	Std. Deviation	N
BSL_Fasting	156.69	71.05	115
PLCR	23.01	6.76	115

Correlations

		BSL_Fasting	PLCR
BSL_Fasting	Pearson Correlation	1	.030
	Sig. (2-tailed)		.753
	N	115	115
PLCR	Pearson Correlation	.030	1
	Sig. (2-tailed)	.753	
	N	115	115

Statistically no significant correlation was observed between BSL fasting and PLCR. (p=0.75)

Table XX: Correlation between BSL PP and MPV

Descriptive Statistics

	Mean	Std. Deviation	N
BSL_PP	218.20	92.29	115
MPV	9.77	0.83	115

Correlations

		BSL_PP	MPV
BSL_PP	Pearson Correlation	1	-.081
	Sig. (2-tailed)		.389
	N	115	115
MPV	Pearson Correlation	-.081	1
	Sig. (2-tailed)	.389	
	N	115	115

Statistically no significant correlation was observed between BSL PP and MPV. (p=0.38)

Table XXI: Correlation between BSL PP and PDW

Descriptive Statistics

	Mean	Std. Deviation	N
BSL_PP	218.20	92.29	115
PDW	10.47	1.73	115

Correlations

		BSL_PP	PDW
BSL_PP	Pearson Correlation	1	-.115
	Sig. (2-tailed)		.223
	N	115	115
PDW	Pearson Correlation	-.115	1
	Sig. (2-tailed)	.223	
	N	115	115

Statistically no significant correlation was observed between BSL PP and PDW. (p=0.22)

Table XXII: Correlation between BSL PP and PLCR

Descriptive Statistics

	Mean	Std. Deviation	N
BSL_PP	218.20	92.29	115
PLCR	23.01	6.76	115

Correlations

		BSL_PP	PLCR
BSL_PP	Pearson Correlation	1	-.061
	Sig. (2-tailed)		.518
	N	115	115
PLCR	Pearson Correlation	-.061	1
	Sig. (2-tailed)	.518	
	N	115	115

Statistically no significant correlation was observed between BSL PP and PLCR. (p=0.51)

DISCUSSION

Type 2 Diabetes Mellitus is a very common Metabolic disorder and it results in approximately 1.6 million deaths every year. Cardiovascular diseases are the most common cause of death in Type 2 Diabetes patients. Diabetic thrombocytopathy is thought to be a major contributor for development of cardiovascular diseases. The mechanisms proposed to cause diabetic thrombocytopathy are mentioned above. There has been research conducted to study the correlation of Diabetes Mellitus and development of diabetic thrombocytopathy as measured by studying measures of glycemic control and various platelet parameters. Studies conducted by Colwell J.A., Nesto R.W [2], Kodiatte TA, Manikyam UK, Rao SB, Jagadish TM, Reddy M, Lingaiah HK, Lakshmaiah[5], Jaman S, Sawgat R, et al. (2017) [6] Singh S, Gautam S, Osti BP[7] showed that there was a statistically significant correlation between glycemic control and specific platelet parameters studied. Our study found out that there is a statistically significant correlation between BSL (Post Prandial) and Plateletcrit and no significant correlation was observed between the other parameters included in this study. In this study we divided the patients based on HbA1c values calculated from BSL values according to the international conversion formulae [8]. But we found no significant correlation between platelet parameters and the various groups classified on the basis of HbA1c. It has to be mentioned that there are a few limitations to our study such as a relatively small sample size.Further research is required to study the correlation of glycemic control with diabetic thrombocytopathy.

CONCLUSION

Present study shows that there is statistically significant correlation between BSL (Fasting) and HbA1c groups, BSL (Post prandial) and HbA1c groups, and BSL (Post Prandial) and Plateletcrit.

There is no statistically significant correlation between Platelet count and HbA1c groups, Plateletcrit and HbA1c groups, Mean Platelet volume and HbA1c groups, Platelet

Distribution width and HbA1c groups and Platelet Large Cell Ratio and HbA1c groups.

There is statistically no significant relationship between BSL (Fasting) and Platelet count, Plateletcrit, Mean Platelet volume, Platelet Distribution width, Platelet Large Cell Ratio

CONFLICT OF INTEREST STATEMENT

Authors Dr. Ruta Chaudhari (1st author) ,Dr. Jayshree Awalekar (2nd Author) and

Dr. Akshay Joglekar (3rd Author) declare that they have no conflict of interest.

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