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HbA1c as a marker for glycemic control and dyslipidemia in diabetes mellitus patients in a tertiary care hospital

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Abstract
Aim: To establish HbA1c as a marker for glycemic control and dyslipidemia in diabetics in a tertiary care hospital.
Material and Method: A single centered study of eighteen-month duration conducted in the general medicine department in a tertiary care teaching hospital of north India. A systematic protocol followed for obtaining permission from IEC by submitting a detailed Performa of study which include data collection form, patient information and consent form and evaluated biomedical literature or articles. The study was approved by the research ethical committee.
Result: A substantial association was also found between HbA1c and lipid profile markers. Study was conducted on 170 patient. Raised triglycerides, total cholesterol and LDL levels were seen in 69.4%, 29.4% and 19.4% cases of type 2 diabetics while low HDL was observed in 50% cases.
Conclusion: A high prevalence of dyslipidemia was observed among cases of diabetes. We also observed a significant correlation between HbA1c and lipid profile parameters. Thus better glycemic control reflected by HbA1c would also reflect better lipidemic state and vice versa.

Keywords: HbA1c, glycemic control, dyslipidemia

1. Introduction
Diabetes Mellitus is a global epidemic and an important cause of morbidity and mortality. As per Indian diabetic federation (IDF) estimate, 366 million people worldwide had DM in 2011, by 2030 it will increase to 552 millions [1].
The diabetic ketoacidosis which was major fatal complication of diabetes has virtually come down with advent of insulin. However, vascular complications have remained the same and they have replaced diabetic ketoacidosis as the most frequent cause of death in diabetes.
Diabetic patients with accompanied dyslipidemia are soft targets for cardiovascular deaths. The prevalence of dyslipidemia in DM is 95%. In India, prevalence of dyslipidemia is 85.5% in male type 2 DM and 97.8% in female type 2 DM. It is characterized by increased triglycerides and decreased HDL-C levels.DM itself does not increase level of LDL-C, but small dense particles of LDL found in type 2 DM are more atherogenic because they are more glycosylated and susceptible to oxidation. An early intervention to normalize circulating lipids in diabetics has shown to reduce cardiovascular complications and mortality. Hba1c is widely used as an indicator of glycemic status. Recently, elevated Hba1c has been regarded as an independent risk factor for coronary heart disease (CHD) and stroke in subjects with or without diabetes [2]. Estimated risk of cerebrovascular disease has shown increased by 18% for each 1% increase in absolute hba1c value in diabetics [3].
Dyslipidemia is disease of higher socioeconomic class because of sedentary life style but lower socioeconomic class people having type 2 DM are also prone for dyslipidemia. Few studies have previously tried to find correlation between hba1c and lipid profile. Some of the parameters of lipid profile have significant correlation [4]. On the other hand some studies do not report significant correlation [12]. These inspired us to take forward this study which was aimed to find out association between glycemic control (Hba1c), age, gender and serum lipid profile in type2 DM patients of lower socioeconomic class [6].

Material and Methods

A single centered study of eighteen-month duration conducted in the general medicine department in a tertiary care teaching hospital of north India. A systematic protocol followed for obtaining permission from IEC by submitting a detailed Performa of study which include data collection form, patient information and consent form and evaluated biomedical literature or articles. The study was approved by the research ethical committee.

Consent: Informed consent was obtained from all patients participating in the study.

Selection Criteria of Patients

Inclusion Criteria

1. Patients with Diabetes mellitus.
2. Patients of age 18 and above.
3. Patients who are willing to participate in the study.

Exclusion Criteria

1. Patients who are not willing to participate.
2. Patients on anti lipidemic therapy or steroids.
3. Patients with history of hypercholesterolemia.
4. Patients with comorbidities.

Results

Table 1: Distribution of study groups as per age group

Age Group	N	%
21-40 years	39	22.9%
41-60 years	81	47.6%
> 60 years	50	29.4%
Total	170	100.0%
Mean age - 53.4 +/- 8.7 years		

Mean age of the diabetic cases was 53.4 years with 29.4% of them were over 60 years of age.

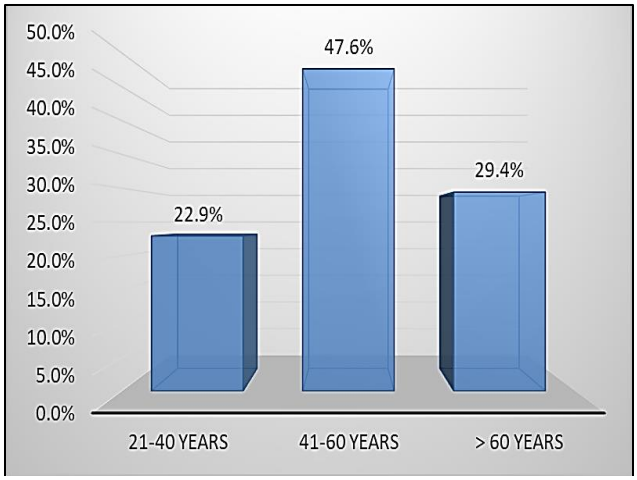

Fig 1: Age Group (years)

Table 2: Distribution of study groups as per gender

Gender	N	%
Female	81	47.6%
Male	89	52.4%
Total	170	100.0%

Slight male preponderance was seen among cases of diabetes with 52.4% males to 47.6% females.

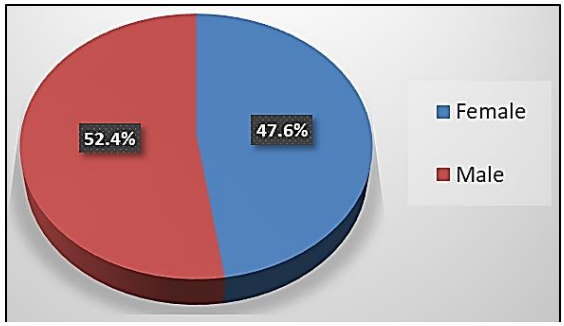

Fig 2: Gender

Table 3: Distribution of study groups as perglycemic control

HbA1c Levels	N	%
< 5.7%	15	8.8%
5.7 - 6.4%	38	22.4%
> 6.4%	117	68.8%
Total	170	100.0%

Mean glycated haemoglobin levels among diabetics was 8.4% with good and moderate control seen in 8.8% and 22.4% cases. Poor glycemic control was observed in 68.8% diabetic cases.

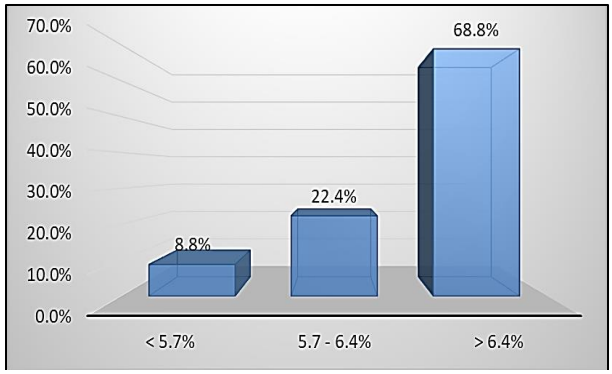

Fig 3: Glycemic control (HbA1c)

Table 4: Distribution of study groups as per presence of dyslipidemia

Dyslipidemia	N	%
No	28	16.5%
Yes	142	83.5%
Total	170	100.0%

Overall prevalence of dyslipidemia among diabetics was observed as 83.5%.

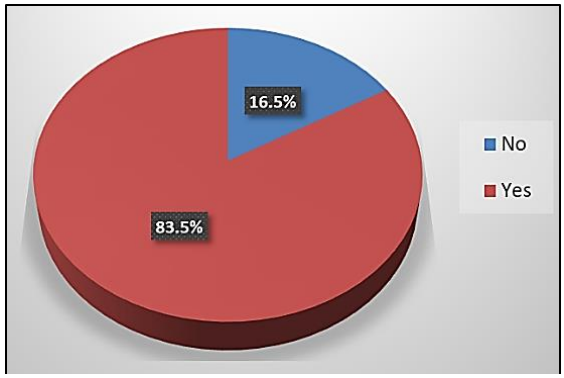

Fig 4: Dyslipidemia

Table 5: Distribution of study groups as per prevalence of altered lipid parameters

Lipid Parameters	N	%
Raised Triglycerides	118	69.4%
Raised Total Cholesterol	50	29.4%
Raised LDL	33	19.4%
Low HDL	85	50.0%

Raised triglycerides, total cholesterol and LDL levels were seen in 69.4%, 29.4% and 19.4% cases of type 2 diabetics while low HDL was observed in 50% cases.

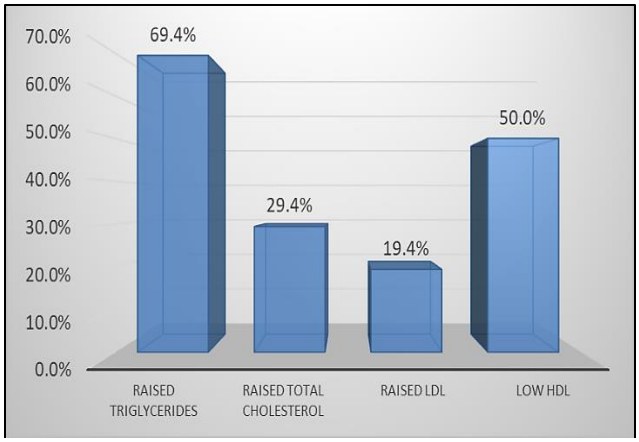

Fig 5: Lipid parameters

Table 6: Association of glycemic control with dyslipidemia

Glycemic Control (HbA1c)	Dyslipidemia		Total
	No	Yes	
Good (<6.5%)	16	37	53
	30.2%	69.8%	100.0%
Poor (>/= 6.5%)	12	105	117
	10.3%	89.7%	100.0%
Total	28	142	170
	16.5%	83.5%	100.0%
p- value <0.01			

Poor glycemic control was significantly associated with prevalence of dyslipidemia. Prevalence was 89.7% in subjects with poor glycemic control as compared to 69.8% in subjects with good control ($p < 0.01$).

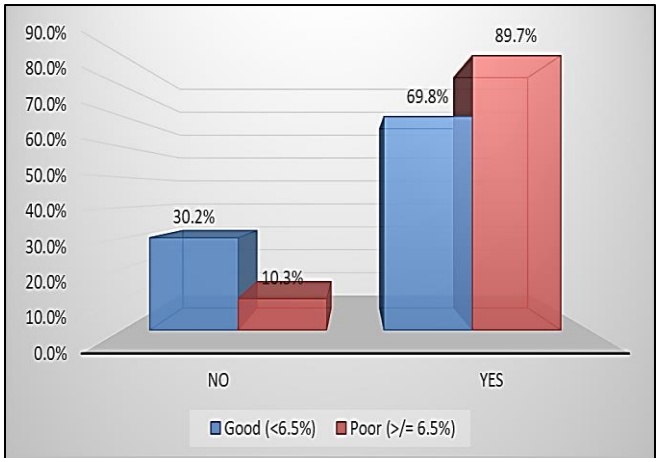

Fig 6: Dyslipidemia vs glycemic control

Table 7: Association of glycemic control with triglyceride levels

Glycemic Control (HbA1c)	Triglycerides		Total
	Normal/Borderline	High	
Good (<6.5%)	32	21	53
	60.4%	39.6%	100.0%
Poor (>/= 6.5%)	20	97	117
	17.1%	82.9%	100.0%
Total	52	118	170
	30.6%	69.4%	100.0%
p- value <0.01			

Poor glycemic control was significantly associated with raised triglycerides. Prevalence was 82.9% in subjects with poor glycemic control as compared to 39.6% in subjects with good control ($p < 0.01$).

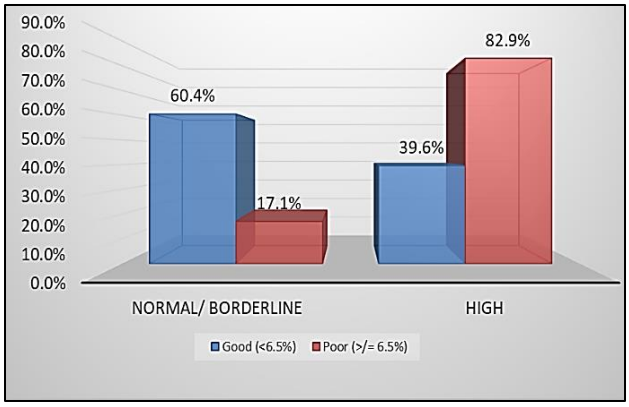

Fig 7: Triglycerides vs glycemic control

Table 8: Association of glycemic control with total cholesterol

Glycemic Control (HbA1c)	Total Cholesterol		Total
	Normal/Borderline	High	
Good (<6.5%)	47	6	53
	88.7%	11.3%	100.0%
Poor (>/= 6.5%)	73	44	117
	62.4%	37.6%	100.0%
Total	120	50	170
	70.6%	29.4%	100.0%
p- value <0.01			

Poor glycemic control was significantly associated with raised total cholesterol. Prevalence was 37.6% in subjects with poor glycemic control as compared to 11.3% in subjects with good control ($p < 0.01$).

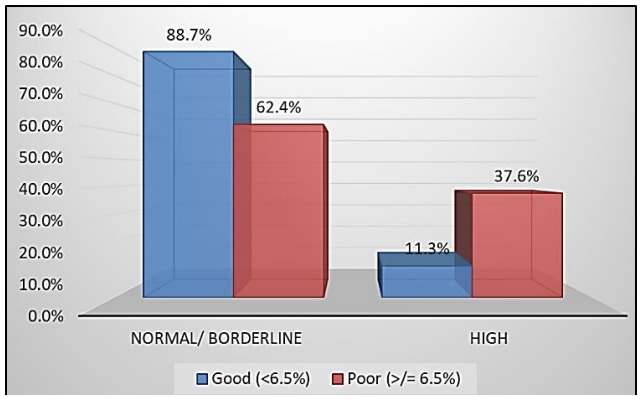

Fig 8: Total cholesterol vs glycemic control

Table 9: Association of Glycemic Control With Ldl Levels

Glycemic Control (HbA1c)	LDL		Total
	Normal/Borderline	High	
Good (<6.5%)	51	2	53
	96.2%	3.8%	100.0%
Poor (>/= 6.5%)	86	31	117
	73.5%	26.5%	100.0%
Total	137	33	170
	80.6%	19.4%	100.0%
p- value <0.01			

Poor glycemic control was significantly associated with raised LDL levels. Prevalence was 26.5% in subjects with poor glycemic control as compared to 3.8% in subjects with good control ($p < 0.01$).

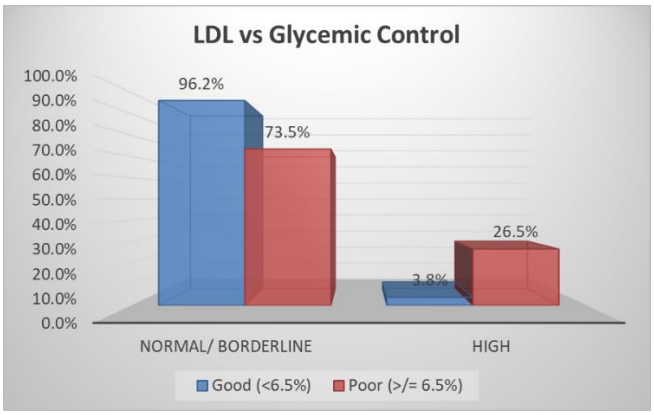

Fig 9: LDL vs Glycemic Control

Table 10: Association of Glycemic Control With Hdl Levels

Glycemic Control (HbA1c)	HDL		Total
	Normal/Borderline	Low	
Good (<6.5%)	36	17	53
	67.9%	32.1%	100.0%
Poor (>/= 6.5%)	49	68	117
	41.9%	58.1%	100.0%
Total	85	85	170
	50.0%	50.0%	100.0%
p- value <0.01			

Poor glycemic control was significantly associated with low HDL levels. Prevalence was 58.1% in subjects with poor glycemic control as compared to 32.1% in subjects with good control ($p < 0.01$).

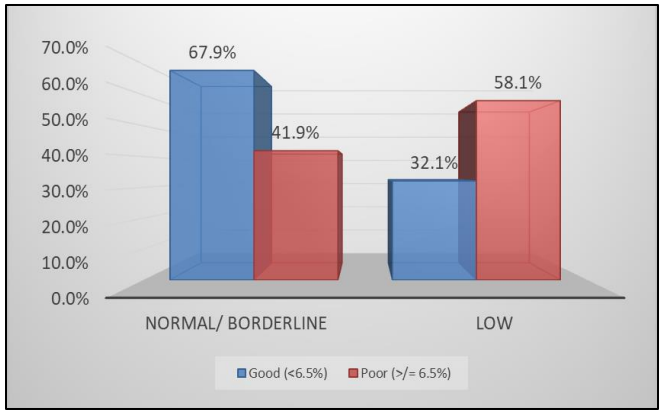

Fig 10: HDL vs Glycemic Control

Table 11: Regression analysis to find the association of HbA1c with dyslipidemia

Logistic Regression: Dyslipidemia (Y/N)								
Variables	B	S.E.	Wald	Df	p- value	Odds Ratio	95% CI	
							Lower	Upper
HbA1c	0.32	0.083	14.957	1	<0.01	1.377	1.171	1.62
Constant	-1.62	0.552	8.619	1	0.003	0.198		

On regression analysis, raised glycated haemoglobin levels were observed as a significant predictor of development of dyslipidemia among type 2 diabetic cases (Odds Ratio – 1.37; 95% CI – 1.17 – 1.62; $p < 0.01$).

Discussion

The goal of this hospital-based case control study was to look at the lipid profile of type 2 diabetics and see if there was a link between HbA1c and lipid fractions. Using a successive sample approach, 170 type 2 diabetes mellitus patients admitted to our hospital were included in the study. All cases were given a thorough clinical examination after taking a detailed history. After that, all of the patients were tested for dyslipidemia (lipid profile) and glycemic control (glycated hemoglobin).

Glycemic Control & Dyslipidemia

Dyslipidemia was found to be substantially linked to poor glycemic control. In participants with poor glycemic control, the prevalence was 89.7%, compared to 69.8% in subjects with adequate control (p0.01). Raised TG (82.9 percent vs 39.6%), TC (37.6% vs 11.3 percent), LDL (26.5 percent vs 3.8 percent), and low HDL (58.1 percent vs 32.1 percent) were all linked to poor glycemic control.On Pearson correlation analysis, there was a significant link between triglycerides, total cholesterol, and LDL levels with glycated haemoglobin and fasting blood sugar levels, but there was an inverse correlation with HDL (p0.01). Raised glycated haemoglobin levels were found to be a significant predictor of the development of dyslipidemia in type 2 diabetic patients in regression analysis (Odds Ratio – 1.37; 95 percent CI – 1.17 – 1.62; p0.01).

Singh G et al. [7] found a substantial positive connection between HbA1c and total cholesterol (r=0.29), triglycerides (r=0.26), high density lipoprotein cholesterol (HDL-C) (r=0.19), and low density lipoprotein cholesterol (LDL-C) (r=0.5).

HbA1c has a positive significant link with cholesterol, LDL, and a negative significant correlation with HDL, according to Bhakta G et al. [8]. When comparing patients with HbA1c >7.0 percent to those with HbA1c 7.0 percent, the value of cholesterol, LDL, was significantly greater.

HbA1c was found to have a strong association with total cholesterol (TC), triglyceride (TG), low density lipoprotein cholesterol (LDL), Non-High Density Lipoprotein cholesterol (non-HDL), LDL/HDL ratio, and TC/HDL ratio by Thambiah SC et al. [9]. TC, TG, non HDL, and the TC/HDL ratio were substantially greater in patients with HbA1c 6.5 percent than in patients with HbA1c 6.5 percent.

HbA1c was positively connected with all lipid profile measures except HDL-C, which was inversely correlated, according to Ahmad M et al. [10]. According to the findings,

there is a link between glycemic control (HbA1c) and the severity of dyslipidemia in type 2 diabetes patients.

Poor glycemic control was linked to dyslipidemia in diabetic individuals, according to Sirivole MR et al. [11]. The levels of glycosylated haemoglobin (HbA1c) and lipid profile were found to be significantly linked in this study.

we found a relatively high prevalence of dyslipidemia among diabetic patients. A substantial association was also found between HbA1c and lipid profile markers. As a result, improved glycemic management, as measured by HbA1c, would also represent improved lipidemic status, and vice versa. The current study's findings imply that glycemic control is critical in managing dyslipidemia and the risk of cardiovascular disease in type 2 diabetics. As a result, obtaining the goal HbA1c will help to improve lipid levels, reduce diabetic complications in type 2 diabetic patients, and lower the risk of developing atherosclerosis.

Conclusion

In conclusion, a high prevalence of dyslipidemia was observed among cases of diabetes. We also observed a significant correlation between HbA1c and lipid profile parameters. Thus better glycemic control reflected by HbA1c would also reflect better lipidemic state and vice versa. Hence, achieving the target HbA1c will contribute in improving the lipid state, and may lessen the diabetic complications in type 2 diabetic patients and also reduce the risk of development of atherosclerosis.

The results of the present study suggest the importance of glycemic control to manage dyslipidaemia and risk for cardiovascular diseases in type 2 diabetics. Glycated hemoglobin can thus be used as an indicator of glycemic control as well as a predictor of dyslipidaemia in T2DM patients.

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