

Original Research Article

A study of lipid profile in controlled vs uncontrolled type 2 DM with special reference to HBA1C levels


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Abstract

Introduction: Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Micro-vascular complications of diabetes include diabetic neuropathy, diabetic nephropathy and diabetic retinopathy. HbA1c is an index of mean blood glucose in fasting and postprandial state and is a well established, and widely used as a clinical measure of chronic glycemia, in the follow-up monitoring of diabetes. Few studies showed significant relationship between total cholesterol (TC), LDL, triglycerides (TGs) and HbA1c, while others reported no considerable relationship. In this study, lipid profile was compared in controlled and uncontrolled type 2 diabetic patients.

Materials and methods: This cross-sectional study was conducted at Malla Reddy Institute of Medical Sciences, Ranga Reddy in the Department of General Medicine on sixty Type 2 diabetic patients from June 2021 to September 2021. Out of which, 30 patients were on controlled state (HbA1c <7.5%) and 30 (HbA1C 7.5%) patients were on uncontrolled state. Informed consent was obtained from all the patients. History of cerebrovascular disease, who were already on lipid lowering

drugs, with other chronic metabolic disorders or systemic illness; Chronic alcohol consumption; Renal Failure; History of smoking, intake of illicit drugs, intake of herbal drugs, cardiotoxic drug consumption, pregnant state were excluded. All the parameters were assessed in both the groups and were compared. All values were expressed as mean \pm standard deviation of the mean. P value < 0.05 was considered as significant.

Results: Mean age among Controlled DM and Uncontrolled DM groups were 47.90 ± 13.85 and 52.20 ± 11.61 years with p value of 0.19 which was statistically not significant. FBS, PPBS, HbA1c & VLDL were more in males than female patients. Total cholesterol, triglycerides, LDL & HDL were more in females than male patients. But statistical significance was found only between gender and PPBS. Among controlled DM patients, Negative correlation was found between HbA1c with Serum Triglycerides, Total Cholesterol & LDL Cholesterol; Positive correlation was found between HbA1c with HDL Cholesterol & VLDL Cholesterol. Among uncontrolled DM patients, Negative correlation was found between HbA1c with HDL Cholesterol; Positive correlation was found between HbA1c with Serum Triglycerides, Total Cholesterol, LDL Cholesterol & VLDL Cholesterol.

Conclusion: The glycemic control of the patient has got a strong impact on the serum lipid level and dyslipidemia is frequently encountered in those who have got poor glycemic control.

Key words

Lipid, Diabetes Mellitus, Controlled, Uncontrolled, HbA1c.

Introduction

Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Several distinct types of DM are caused by a complex interaction of genetics and environmental factors. Depending on the etiology of the DM, factors contributing to hyperglycemia include reduced insulin secretion, decreased glucose utilization, and increased glucose production. The metabolic dysregulation associated with DM causes secondary pathophysiologic changes in multiple organ systems that impose a tremendous burden on the individual with diabetes and on the health care system [1].

Micro-vascular complications of diabetes include diabetic neuropathy, diabetic nephropathy and diabetic retinopathy. The complications of DM categorized under macrovascular complications include cardiovascular disease, cerebrovascular disease and diseases related to peripheral vessels. Along with these complications, weight gain related with diabetes lead to further worsening of the disease. Other complications include acute metabolic complications, diabetic ketoacidosis [1].

HbA1c is an index of mean blood glucose in fasting and postprandial state and is a well established, and widely used as a clinical measure of chronic glycemia, in the follow-up monitoring of diabetes. Several studies indicate that HbA1c may show a glycemic threshold with microvascular complications, suggesting it may additionally be useful as a diagnostic test for diabetes [2].

Few studies showed significant relationship between total cholesterol (TC), LDL, triglycerides (TGs) and HbA1c [3], while others reported no considerable relationship [4]. Similarly, while one study reported a significant negative relationship between HbA1c and LDL-C [5], others reported the opposite results [6]. Importantly, a recent study revealed a positive relationship between HbA1c and high TGs, concluding that poorly controlled diabetes measured by HbA1c could be a sign of dyslipidemia (Hypertriglyceridemia) and that it may predict CVD risk factors in T2DM [7]. In this study, lipid profile was compared in controlled and uncontrolled type 2 diabetic patients.

Materials and methods

This cross-sectional study was conducted at Malla Reddy Institute of Medical Sciences, Ranga Reddy in the Department of General Medicine on sixty type 2 diabetic patients from June 2021 to September 2021. Out of which, 30 patients were on controlled state and 30 patients were on uncontrolled state. Informed consent was obtained from all the patients. The study protocol was approved by Ethical committee for research studies of MRIMS. Diabetic patients were classified into 2 groups with 30 subjects in each group as per their glycemic index. Group 1 was controlled diabetic patients ($HbA1c \leq 7.5\%$) and Group 2 was uncontrolled diabetic patients ($HbA1c > 7.5\%$).

History of cerebrovascular disease, who were already on lipid lowering drugs, with other chronic metabolic disorders or systemic illness; Chronic alcohol consumption; Renal Failure; History of smoking, intake of illicit drugs, intake of herbal drugs, cardiotoxic drug consumption, pregnant state were excluded.

After obtaining the informed consent, venous blood samples were collected from all 60 patients after at least 8 hours of fasting. The serum was later used for analyzing fasting blood sugar, HbA1c, lipid profile- serum total cholesterol, triglycerides, HDL cholesterol, LDL-cholesterol, VLDL-cholesterol and post prandial blood sugar (PPBS) after two hours of having breakfast.

All the parameters were assessed in both the groups and were compared. All values were expressed as mean \pm standard deviation of the mean. P value < 0.05 was considered as significant.

Results

Mean age among Controlled DM and Uncontrolled DM groups were 47.90 ± 13.85 and 52.20 ± 11.61 years with p value of 0.19 which was statistically not significant.

FBS, PPBS, HbA1c & VLDL were more in males than in female patients. Total cholesterol, triglycerides, LDL & HDL were more in females than in male patients. But statistical significance was found only between gender and PPBS (**Table – 1**).

Among patients with Controlled DM, males were 46.7% and females were 53.3% and among patients with uncontrolled DM, males were 70% and females were 30% with no statistical significance. Results were depicted as per **Table – 2 to 5**.

Discussion

Diabetes mellitus is a common secondary cause of hyperlipidaemia, particularly, if glycemic control is poor which is an important risk factor for atherosclerosis and coronary heart disease [13]. There is two to four times increased risk of coronary artery disease among diabetics compared to non diabetic patients [14 15]. The increased risk of vascular disease in diabetics is in part due to the lipid abnormalities [16]. Many studies have shown altered lipid profile in diabetes mellitus and dyslipidemia predisposes to cardiovascular complications especially coronary heart disease among diabetic patients [17-20]. Hence, we did this study to know the lipid levels among diabetics and compared the lipid levels among controlled and uncontrolled diabetic subjects.

In this study, mean age among Controlled DM and Uncontrolled DM groups were 47.90 ± 13.85 and 52.20 ± 11.61 years with p value of 0.19 which was statistically not significant. In Abdulwahid NA, et al. [26], mean age among Controlled DM and Uncontrolled DM groups were 49.2 ± 12.7 and 50.1 ± 12.6 years.

In this study, FBS, PPBS, HbA1c & VLDL were more in males than in female patients. Total cholesterol, triglycerides, LDL & HDL were more in females than in male patients. But statistical significance was found only between gender and PPBS.

Table - 1: Gender wise distribution of different parameters.

	Gender	Mean	Std. Deviation	T Test	P Value
Age	Male	50.69	11.26	0.45	0.65
	Female	49.16	15.01		
Fasting blood Glucose (mg/dl)	Male	170.77	93.17	1.66	0.10
	Female	134.00	70.39		
Postprandial blood glucose (mg/dl)	Male	247.23	131.04	2.12	0.03
	Female	185.16	75.70		
HbA1c	Male	8.20%	2.81%	1.61	0.11
	Female	7.14%	2.04%		
Serum Triglycerides (mg/dl)	Male	146.29	60.51	-0.46	0.64
	Female	155.20	87.74		
Total Cholesterol (mg/dl)	Male	140.43	59.12	-1.65	0.10
	Female	165.56	56.00		
LDL Cholesterol (mg/dl)	Male	86.97	40.51	-1.49	0.14
	Female	102.52	38.73		
HDL Cholesterol (mg/dl)	Male	36.657	9.75	-0.16	0.87
	Female	37.076	9.95		
VLDL (mg/dl)	Male	39.71	25.10	1.07	0.28
	Female	33.24	19.57		

Table - 2: FBS, PPBS & HbA1c levels in both the groups.

	Group	Mean	SD	SE Mean	T Test	P Value
Fasting blood Glucose (mg/dl)	Controlled DM	110.20	21.29	3.88	-4.78	0.001
	Uncontrolled DM	200.70	101.34	18.50		
Postprandial blood glucose (mg/dl)	Controlled DM	157.60	39.74	7.25	-5.15	0.001
	Uncontrolled DM	285.13	129.69	23.67		
HbA1c	Controlled DM	5.94%	0.34%	0.06%	-7.87	0.001
	Uncontrolled DM	9.58%	2.51%	0.45%		

Table - 3: Lipid profile levels in both the groups.

	Group	Mean	SD	SE Mean	T Test	P Value
Serum Triglycerides (mg/dl)	Controlled DM	117.27	38.61	7.05	-3.89	0.001
	Uncontrolled DM	182.73	83.64	15.27		
Total Cholesterol (mg/dl)	Controlled DM	133.27	46.03	8.40	-2.24	0.01
	Uncontrolled DM	168.53	65.17	11.90		
LDL Cholesterol (mg/dl)	Controlled DM	91.87	33.56	6.12	-0.30	0.76
	Uncontrolled DM	95.03	46.43	8.47		
HDL Cholesterol (mg/dl)	Controlled DM	39.26	8.00	1.46	1.97	0.05
	Uncontrolled DM	34.40	10.83	1.97		
VLDL (mg/dl)	Controlled DM	32.07	18.38	3.35	-1.69	0.09
	Uncontrolled DM	41.97	26.24	4.79		

In Gangadhar M, et al. [8], FBS, PPBS, HbA1c, total cholesterol, triglycerides and LDL were more in females than in male patients but the

mean values were not significant statistically. Only FBS and total cholesterol were statistically significant ($p < 0.05$). In Singh P, et al. [25], FBS,

PPBS and HbA1c values were more in female patients when compared to the male patients. But the difference in the mean values was not statistically significant. All the circulating lipid values were more in females when compared to males. But the difference in the mean values was not statistically significant. Wexler, et al. reported that the lipid parameters were significantly higher in females as compared to

males and were statistically significant [9]. In Eltigani, et al., there was a statistically significant association between triglycerides and HDL cholesterol with glucose levels which was more in females than in males [10]. Agarwal M, et al. showed that the lipid abnormalities were more among diabetic males than in diabetic females which is contrary to our study [11].

Table - 4: Correlation between HbA1c and lipid profile among controlled DM patients.

		Mean	SD	Correlation	P Value
1	HbA1c	5.94%	0.34%	-0.04	0.82
	Serum Triglycerides (mg/dl)	117.27	38.61		
2	HbA1c	5.94%	0.34%	-0.41	0.02
	Total Cholesterol (mg/dl)	133.27	46.03		
3	HbA1c	5.94%	0.34%	-0.13	0.46
	LDL Cholesterol (mg/dl)	91.87	33.56		
4	HbA1c	5.94%	0.34%	0.06	0.74
	HDL Cholesterol (mg/dl)	39.26	8.00		
5	HbA1c	5.94%	0.34%	0.18	0.33
	VLDL (mg/dl)	32.07	18.38		

Table - 5: Correlation between HbA1c and lipid profile among uncontrolled DM patients.

		Mean	SD	Correlation	P Value
1	HbA1c	9.58%	2.51%	0.24	0.19
	Serum Triglycerides (mg/dl)	182.73	83.64		
2	HbA1c	9.58%	2.51%	0.25	0.17
	Total Cholesterol (mg/dl)	168.53	65.17		
3	HbA1c	9.58%	2.51%	0.17	0.34
	LDL Cholesterol (mg/dl)	95.03	46.43		
4	HbA1c	9.58%	2.51%	-0.20	0.27
	HDL Cholesterol (mg/dl)	34.40	10.83		
5	HbA1c	9.58%	2.51%	0.34	0.06
	VLDL (mg/dl)	41.97	26.24		

In this study, among patients with Controlled DM, males were 46.7% and females were 53.3% and among patients with uncontrolled DM, males were 70% and females were 30% with no statistical significance. In Abdulwahid NA, et al. [26], Out of the total 229 patients; 120 were controlled patients 63 (52.5%) were males and 57 (47.5%) were females. As for the remaining 109 uncontrolled DM patients; 63 (57.8%) of them were males, and 46 (42.2%) were females.

In this study, fasting blood glucose was high in uncontrolled DM patients (200.70 ± 101.34 mg/dl) than controlled DM patients (110.20 ± 21.29 mg/dl) with p value of 0.001 which was statistically significant. Post-prandial blood glucose was high in uncontrolled DM patients (285.13 ± 129.69 mg/dl) than controlled DM patients (157.60 ± 39.74 mg/dl) with p value of 0.001 which was statistically significant. HbA1c was high in uncontrolled DM patients ($9.58 \pm 2.51\%$) than controlled DM patients ($5.94 \pm$

0.34%) with p value of 0.001 which was statistically significant.

In this study, serum Triglycerides were high in uncontrolled DM patients (182.73 ± 83.64 mg/dl) than controlled DM patients (117.27 ± 38.64 mg/dl) with p value of 0.001 which was statistically significant. Total Cholesterol was high in uncontrolled DM patients (168.53 ± 65.17 mg/dl) than controlled DM patients (133.27 ± 46.03 mg/dl) with p value of 0.01 which was statistically significant. LDL Cholesterol was high in uncontrolled DM patients (95.03 ± 46.43 mg/dl) than controlled DM patients (91.87 ± 33.56 mg/dl) with p value of 0.76 which was statistically not significant. HDL Cholesterol was low in uncontrolled DM patients (34.40 ± 10.83 mg/dl) than controlled DM patients (39.26 ± 8.00 mg/dl) with p value of 0.05 which was statistically significant. VLDL was high in uncontrolled DM patients (41.97 ± 26.24 mg/dl) than controlled DM patients (32.07 ± 18.38 mg/dl) with p value of 0.09 which was statistically not significant.

In Sarkar S, et al. [4], results of serum lipid profile showed that mean values for TC, TG, HDL, LDL and VLDL in study group were 227.76 ± 30.72 , 152.23 ± 40.94 , 40.5 ± 6.43 , 153.30 ± 27.70 and 33.00 ± 9.94 mg/dL. In Gangadhar M, et al. [8], serum Triglycerides were high in uncontrolled DM patients (243.12 ± 8.11 mg/dl) than controlled DM patients (174.38 ± 3.41 mg/dl). Total Cholesterol was high in uncontrolled DM patients (226.68 ± 4.48 mg/dl) than controlled DM patients (198.18 ± 3.75 mg/dl). LDL Cholesterol was high in uncontrolled DM patients (132.54 ± 2.64 mg/dl) than controlled DM patients (93.7 ± 1.69 mg/dl). HDL Cholesterol was low in uncontrolled DM patients (39.4 ± 1.30 mg/dl) than controlled DM patients (42.76 ± 0.98 mg/dl). VLDL was high in uncontrolled DM patients (51.8 ± 1.30 mg/dl) than controlled DM patients (39.06 ± 0.91 mg/dl). All lipid parameters were deranged between controlled and uncontrolled groups and were statistically significant.

In Amer W, et al., all the lipid fractions were deranged in uncontrolled type 2 DM patients which is comparable with present study [12].

In Singh P et al. [25], blood glucose levels and lipid profile parameters (except HDL) were found to be increased significantly in uncontrolled diabetics and moderately controlled diabetics when compared to controlled diabetics. In Abdulwahid NA, et al. [26], controlled DM group, total cholesterol, LDL-C, HDL-C, and triglycerides showed insignificant changes and for the uncontrolled DM group, showed significant changes.

In Setiya S, et al. [29], mean FBS was 198.32 ± 54.21 , mean PPBS was 243.50 ± 69.62 and mean HbA1c was 7.65 ± 0.92 . The mean total cholesterol was 183.21 ± 12.64 , mean total triglyceride was 196.32 ± 13.17 , Mean HDL was 37.12 ± 3.65 , mean LDL was 106.82 ± 9.63 and VLDL was 106.82 ± 9.63 . In Hussain S, et al. [30], mean total cholesterol was 155.76 ± 13.41 , mean total triglyceride was 180.52 ± 17.21 , mean LDL was 99.09 ± 12.72 , Mean HDL was 36.94 ± 4.28 and mean HbA1c was 9.76 ± 1.46 .

In this study, among controlled DM patients, Negative correlation was found between HbA1c with Serum Triglycerides, Total Cholesterol & LDL Cholesterol; Positive correlation was found between HbA1c with HDL Cholesterol & VLDL Cholesterol. Among uncontrolled DM patients, Negative correlation was found between HbA1c with HDL Cholesterol; Positive correlation was found between HbA1c with Serum Triglycerides, Total Cholesterol, LDL Cholesterol & VLDL Cholesterol.

In Alzahrani SH, et al. [21], show a statistically non-significant negative link between HbA1c and HDL-C. In Sarkar S, et al. [4], HbA1c has significant negative correlation with HDL ($p < 0.008$). FBG showed positive correlation with TG ($p < 0.13$) and VLDL ($p < 0.33$). Positive correlations were observed between serum levels of TC, TG, LDL, VLDL with HbA1c. FBS has significant positive correlation with HbA1c

($p < 0.002$) and FBS has negative correlation with TC, HDL and LDL. In Setiya S, et al. [29], HbA1c positively and significantly correlated with total cholesterol ($r=0.212$), LDL ($r=0.253$), HbA1c negatively and significantly correlated with HDL ($r= - 0.121$), and did not show any show correlation with VLDL ($r=0.046$) and total triglycerides ($r=0.19$). In Hussain S, et al. [30], HbA1c negatively and significantly correlated with HDL ($r= - 0.13$). HbA1c positively and significantly correlated with total cholesterol ($r=0.20$) and LDL ($r=0.24$), did not show any show correlation with VLDL ($r=0.03$) and total triglycerides ($r=0.02$). According to Parveen, et al. [31], found a positive correlation between HbA1c and high triglycerides suggested that HbA1c can be used as a potent marker for dyslipidemia and mitigate the macro- and micro-vascular complications [32]. In Majumder M, et al. [33], no significant correlation was observed between HbA1c and lipid profile.

Negative relationship between HbA1c and HDL-C was seen in other studies [3, 4, 5, 22, 23] Few other studies have described a positive relationship between HbA1c and HDL-C [6, 24].

Type 2 diabetes mellitus is associated with more risk of Coronary heart disease (CHD) and dyslipidemia. In newly diagnosed and established Type 2 diabetes mellitus patients' correlation was found between HbA1c levels and carotid intima-media thickness.

Diabetic patients with elevated HbA1c and altered lipid profile considered as a very high risk group for severe complications. Improving glycemic control can reduce the risk of various complications in diabetic subjects [27]. According to the Diabetes Complications and Control Trial (DCCT) HbA1c is the gold standard of glycemic control and the level of HbA1c value $\leq 7.0\%$ was said to be appropriate for reducing the risk of cardiovascular complications [28].

Conclusion

The glycemic control of the patient has got a strong impact on the serum lipid level and dyslipidemia is frequently encountered in those who have got poor glycemic control. Patients should be educated about regular monitoring of lipid profiles and if found to be abnormal, should control blood sugar and lipids very effectively.

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