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Blood Pressure, Lipid Profile and Glycemic Control among Type-2 Diabetic Mellitus Patients: A Cross-Sectional Study

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Abstract

Introduction: Diabetes mellitus (DM) is a global health condition that affects an increasing number of individuals each year. Type 2 diabetes is a complex condition that causes insulin resistance in the liver and muscle, as well as decreased pancreatic β cell function, resulting in a relative insulin deficit. Diabetes mellitus (DM) is a worldwide health concern, with an increasing number of persons affected each year. Type 2 diabetes mellitus is a complex condition that causes insulin resistance in the liver and muscle, as well as decreased pancreatic β cell function, leading to a relative insulin deficit.

Aims & objectives: To Estimate the Blood pressure, lipid profile and glycemic control among People diagnosed with type-2 diabetic Mellitus.

Material & methods: Patients with T2DM who visited an outpatient department (Medicine Department) at the Index Medical College & Research Center in Indore were included in a cross-sectional study. Informed written consent was obtained from all the patients after explaining the study objectives. The study population comprised of 160 subjects, including 80 T2DM patients and 80 healthy individuals. FBS, HbA1c, lipid profile, was estimated and BP was measured. It was found that SBP and DBP were increased in patients having poor glycemic index.

Conclusion: The findings of this study revealed a strong negative association with HDL and VLDL and a significant positive correlation with total cholesterol, triglycerides, and LDL. It appears that the degree of hypertension, especially among individuals with poor glycemic control, is strongly related to lipid profile rather than glycemic control.

Keywords: Diabetes mellitus, glycated haemoglobin, systolic blood pressure, diastolic blood pressure, dyslipidemia, hyperglycemia

1. Introduction

Diabetes mellitus (DM) is a global health issue, with a rising number of people affected each year [1]. Type 2 diabetes mellitus is a complicated illness characterized by insulin resistance in the liver and muscle, as well as reduced pancreatic β cell activity, resulting in a relative insulin deficit [2].

Type 2 diabetes mellitus (T2DM) is a rapidly growing public health problem with far-reaching consequences for human health, living standards, the economy, and healthcare systems. According to the International Diabetes Federation (IDF), 425 million individuals globally have diabetes mellitus (DM), and by 2045, there will be 629 million DM patients, with 352 million people at risk of developing type 2 diabetes [3].

Diabetes is expected to rise from 8.8% in 2015 to 10.4% in 2040, making it a major health issue worldwide. The number of diabetics is increasing due to population expansion and the high incidence of physical inactivity and obesity [4].

T2DM patients are predisposed to diabetic dyslipidemia, which increases their chance of developing macrovascular (stroke, peripheral vascular disease, and coronary artery disease [CAD]) and microvascular illnesses (nephropathy, neuropathy, and retinopathy) [5].

Typical findings include an increase in total and very low-density lipoprotein (LDL) cholesterol, triglyceride (TG) concentration, exacerbated postprandial lipemia, reduced high-density lipoprotein (HDL) cholesterol, and a predominance of small, dense LDL-cholesterol particles. Insulin resistance is frequently observed throughout this phase. Raising TGs has been linked to a higher risk of CHD in individuals without diabetes as well as those with the disease. Dyslipidemia is associated with both metabolic syndrome and lifestyle variables, including food and daily activities. The capacity of tiny LDL particles to permeate arterial walls, which increases their susceptibility to oxidation and is indirectly associated with coronary artery disease, may cause their pro-atherogenic characteristics [6].

Insulin resistance or insufficiency has been linked to a higher frequency of lipid abnormalities in diabetes mellitus, which impacts important enzymes and pathways involved in lipid metabolism.

Therefore, there is a strong correlation between hyperglycemia, dyslipidemia, and coronary artery disease in type 2 diabetes. It has been suggested that persistent, uncontrolled hyperglycemia is the cause of the greater prevalence of cardiovascular disease in type 2 diabetes [7].

Diabetics have their glycemic management regularly monitored by measuring their levels of glycated hemoglobin (HbA1c). Reaching a level below 7% is the aim. Several factors, including sugar consumption, exercise, and medication adherence, might influence HbA1c levels. According to certain research, HbA1c may be used as a biomarker to potentially predict dyslipidemia and cardiovascular disease (CVD). As the gold standard for glycemic control, the amount of circulating HbA1c must be regulated to prevent complications from type 2 diabetes. In addition to serving as an indicator of glycemic control, HbA1c readings are the primary predictor of death and complications connected to diabetes [8].

Hence, this study was undertaken to observe the correlation of HbA1c with lipid profile in type 2 diabetes mellitus Patients.

2. Materials and Methods

Study Design and Location

Patients with T2DM who visited an outpatient department (Medicine Department) at the Index Medical College & Research Center in Indore were included in a cross-sectional study that was carried out between April 2019 and August 2020. The hospital's ethics committee accepted the study protocol. The study protocol was approved by the ethics committee of the hospital. Informed written consent was obtained from all the patients after explaining the study objectives.

Patients and methods

Venous blood samples were collected. The serum was used for analyzing fasting blood sugar (FBS), total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), triglycerides (TGs), and low-density lipoprotein cholesterol (LDL-C) using an auto analyzer. HbA1c was estimated using an ARCHITECT c4000 analyzer.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Patients of age ≥18 years, both males and females.
- Patients diagnosed with type 2 Diabetes Mellitus.

Exclusion Criteria:

- Patients with type-1 DM.
- Hypothyroidism.
- Patients already on lipid- lowering drugs.
- Pregnant females with GDM.
- Hypertensive patients using beta blockers or thiazide diuretics.
- Other disease conditions where lipid profile is altered due to pathophysiologic conditions or drugs.

Statistic Analysis

All patients were categorized into two groups according to their HbA1c levels. The data were evaluated via the SPSS statistical package version 16.0. Pearson's correlation test was performed to examine various correlations. Independent sample Student's t test (two-tailed) was used to compare the means of different parameters. All p-values less than 0.05 were considered statistically significant. The value of HbA1c was given as a percentage of the total hemoglobin and values of all other parameters were given in mg/dl. All values are expressed as mean ± standard deviation (SD) or standard error of the mean.

3. Result

The study population comprised of 160 subjects, including 80 T2DM patients and 80 healthy individuals. The basic sociodemographic details of the study subjects are represented in Table 1. The majority of the participating T2DM patients were males (66 %) and in healthy controls were male too (58.75%). The average age of males in the healthy control group is 35.96 yrs and females is 36.99 yrs while in T2DM group, the average age of males in is 60.61 yrs and females is 60.01 yrs. There are comparisons of glycemic index as well as lipid profile parameters between healthy individuals and type 2 diabetes mellitus patients are shown in Table No.1 ($p \leq 0.001$). Parameters of blood pressure between healthy control and type 2 diabetes mellitus are shown in Table No. 2 ($p \leq 0.001$). T2DM Patients in the group HbA1c ≥7% had significantly higher values of FBS, HbA1c, TG, levels compared to control group in HbA1c <7%. (Table No. 1)

The mean systolic BP levels are 120.73 ± 2.58 mmHg and mean diastolic BP levels are 76.65 ± 3.04 mmHg in the healthy control group, that is lower as compared to T2DM. (Table No. 2)

The Pearson correlation analysis results demonstrated that HbA1c was correlated with both SBP and DBP. (Table 3).

TABLE 1: COMPARISON OF DIABETIC PARAMETERS LEVELS IN CONTROL AND DIABETES GROUP

S.N	Parameters	Control Mean ± SD	Patients Mean ± SD
1.	HbA1C (%)	5.44 ±0.43	8.93 ± 1.88**
2.	Fasting Blood Glucose (mg/dl)	89.61 ± 8.59	198.31 ± 77.63**
3.	Post Prandial Glucose	125.7 ±10.71	264.98 ± 95.97**
4.	T CHOL (mg/dl)	176.3 ± 31.26	217.45 ± 49.55**
5.	TG (mg/dl)	134.3 ± 25.46	194.01 ±119.39**
6.	HDL (mg/dl)	40.75 ± 6.45	45.23 ± 23.64**
7.	VLDL (mg/dl)	25.7 ±5.49	53.27 ± 52.85**
8.	LDL (mg/dl)	109.6 ± 29.7	119.22 ± 44.10**

$p \leq 0.05$ Significant, **$p \leq 0.001$ Highly Significant, # $p > 0.05$

TABLE 2: COMPARISON OF BLOOD PRESSURE PARAMETERS LEVEL IN CONTROL AND DIABETES GROUP

S.N.	Parameters	Control Mean ±SD	Patients Mean ±SD
1.	SBP (mmHg)	120.73 ± 2.58	130.57 ± 5.67**
2.	DBP (mmHg)	76.65 ± 3.04	83.75 ± 2.85**

Note: ** indicate moderately significant, Significance was measured at the level of $p<0.05$.

TABLE 3: CORRELATION BETWEEN HbA1c AND OTHER VARIABLES IN THE DIABETES GROUP

Variables	r value	P value
SBP (mmHg)	0.2262	0.00001**
DBP (mmHg)	0.1013	0.00001**
FBS (mg/dl)	0.4846	0.00001**
PPBS (mg/dl)	0.4907	0.00001**
TC (mg/dl)	0.0779	0.00001**

Note: **indicate moderately significant, Significance was measured at the level of $p<0.05$.

4. Discussion

Diabetes is a collection of metabolic diseases typified by a persistently high blood sugar level brought on by insufficient insulin activity. The most common cause of both macrovascular and microvascular problems is diabetes mellitus [9]. In addition to hyperglycemia and hypertension, dyslipidemia has been identified as a risk factor for diabetes in prior studies [10]. Numerous prior studies have reported that the abnormal lipid profile seen in type 2 diabetes is linked to insulin resistance. Insulin resistance causes increased release of free fatty acids from fatty tissues, impaired muscle uptake of free fatty acids, and increased fatty acid release to the liver, which has been closely linked to hypertension and diabetic dyslipedemia [11].

The aim of our study was to find an association between systolic blood pressure (SBS) and diastolic blood pressure (DBP), lipid profile, and HbA1c in healthy control and type 2 diabetic subjects. Ethical clearance was granted by the scientific and ethical committee of the institution. The study was conducted in Index Medical College, Hospital & Research Center (IMCHRC), Indore; patients were selected from medicine OPD. Patients provided consent prior to sample collection. The present study included total 160 subjects, a control group of 80 healthy controls, and a study group of 80 T2DM diagnosed patients.

In our study, out of 80 patients in each group, there were 33 females and 47 males in the healthy group and 27 females with 53 males in type 2 Diabetes mellitus group. In the present study, we estimated SBP as well as DBP of both control and type 2 diabetes mellitus patients. We found significantly increased BP level in the diabetes group as compared to the control healthy group ($p\leq0.001$). In the present study, mean values of HbA1c were 5.44% and 8.93% in healthy individuals and type-2 diabetes mellitus, respectively. They were found to be significantly increased in the study group as compared to control subjects (Table 1) ($p\leq0.001$). This is in accordance with Ifeyinwa Dorothy Nnakenyi [12], who also found elevated levels of HbA1c in type 2 diabetic patients compared to healthy subjects.

In this cross-sectional study among the T2DM patients compared to healthy controls, we observed people diagnosed with Type 2 Diabetes Mellitus were found to have increased BP (SBS & DBP). Many studies revealed the importance of BP control in diabetic patients to minimize diabetes related complications. (Table 2)

This study analyzed the correlation between BP and other variables such as HbA1c, FBS, TC, TG, HDL, & LDL. Our results demonstrated that either SBP (p=0.001) or DBP (p=0.001) correlated with HbA1c. Bower *et al*. (Maryland) reported a strong association between hypertension, diabetes, and insulin resistance [13]. Our study also compared BP among the good glycemic control and poor glycemic control group. In a study, Britton *et al*. (Boston) reported higher HbA1c values were associated with increased risks of hypertension [14].

In this study, we found a correlation between increased risks of hypertension and people diagnosed with type 2 diabetes mellitus. It was also found that there was a positive correlation between HbA1c and SBP as well as DBP in Type 2 diabetes mellitus patients. Our findings were concurrent with Huanhuan Hu [15].

In the present study, we also a found positive correlation between glycated haemoglobin (HbA1c) and fasting blood sugar (FBS), post-prandial (PP), and total cholesterol (TC) in T2DM Diagnosed patients. (Table 3) Our finding was concurrent with Abdulaziz Yahya Sharahili [16].

Abdulaziz Yahya Sharahili found a significant positive correlation between HbA1c and each of triglycerides and cholesterol, and those findings also highlight the important relationship between glycemic control and dyslipidemia.

5. Conclusion

The results of this investigation demonstrated a substantial negative correlation with HDL and VLDL and a significant positive correlation with total cholesterol, triglycerides, and LDL. We concluded that dyslipidemia and poor glycemic control are common in a large percentage of diabetic patients. The findings of this investigation are consistent with the hypothesis

that, in addition to glycaemic management, HbA1c can be a valuable marker for predicting dyslipidemia in patients with T2DM. Thus, we can lower the death rate of these individuals by regularly monitoring it. It seems that the degree of hypertension, particularly in those with poor glycemic control, is significantly connected with lipid profile rather than glycemic control. Strict management of HbA1c, lipid profile, and blood pressure is necessary to prevent or postpone diabetes-related problems.

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