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Clinical profile of Patients of Diabetes Mellitus with special reference to Dyslipidemia

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is a significant disease in both developing and developed countries, which carries a substantial risk of morbidity from cardiac disease. The hypothesis suggests that the lipid particle composition in diabetic dyslipidemia is more likely to cause atherosclerosis compared to other forms of dyslipidemia. The objective of our study was to establish the correlation between T2DM and lipid profile abnormalities, as well as identify the factors that contribute to an elevated risk of dyslipidemia in patients with T2DM.

Methods: We conducted an epidemiological cross-sectional study in DM Clinic in comprehensive health insurance clinic. We included patients with T2DM, patient age from 18 to 60 years old, and apparently uncomplicated.

Results: We recruited a total of 47 patients diagnosed with Type 2 Diabetes Mellitus (T2DM), with an average age of 49.5 ± 9.12 years. Out of the total, 21 individuals (44.7%) were male, while 26 individuals (55.3%) were female. Approximately 55% of the patients examined exhibited dyslipidemia. Upon evaluating each component of the lipid profile, it was found that 53.2% of the patients examined had elevated triglyceride levels, 46.9% had high cholesterol, 45.9% had abnormal LDL-cholesterol levels, and 25.5% had low HDL levels. DM patients with dyslipidemia exhibited significantly elevated levels of fasting blood glucose and glycosylated hemoglobin.

Conclusions: This study revealed a significant occurrence of dyslipidemia in individuals with diabetes mellitus. This study emphasizes the significance of effectively managing diabetes mellitus (DM) to prevent and treat dyslipidemia. It reveals that dyslipidemia is more common in diabetic patients whose diabetes is not well controlled. Additionally, it

suggests that reducing body mass index (BMI) and not having hypertension can help shield against the risk of dyslipidemia.
Keywords: *Lipid Profile; Type 2 diabetes mellitus; Dyslipidemia*

Introduction

Cardiovascular diseases (CVDs) are the primary cause of mortality and impairment in numerous developed and developing nations worldwide, including Palestine [1,2]. It is impacting both men and women to a similar degree [3]. Studies have demonstrated that the presence of certain risk factors, including elevated levels of blood triglycerides, LDL, VLDL, glycated hemoglobin (HbA1c), microalbuminuria, hypertension, low concentration of HDL, and increased body mass index (BMI), are linked to coronary artery disease (CAD) [4]. (refer to Figure 1)

Individuals diagnosed with diabetes mellitus (DM) have a significantly increased risk, ranging from two to four times higher, of developing coronary artery disease (CAD) [1]. To prevent acute complications and minimize the risk of long-term complications, it is necessary to provide ongoing medical care and patient self-management education [5]. According to the report from the international diabetes federation, diabetes mellitus (DM) affects over 415 million people worldwide, with a prevalence rate of 9% in adults. Approximately 90% of all diabetes cases have been attributed to type 2 diabetes. Moreover, this report forecasts a surge in this figure to 642 million by the year 2040 [6].

Individuals diagnosed with type 2 diabetes mellitus have a higher likelihood of experiencing accelerated development of atherosclerosis, a condition characterized by the buildup of plaque in the arteries, which can lead to an increased risk of premature death [7]. Dyslipidemias are undoubtedly a significant factor in the development of accelerated atherosclerosis. The presence of other risk factors for coronary artery disease (CAD), such as diabetes, can significantly increase the risk of CAD even in cases of mild dyslipidemia [8]. There was a connection between abnormal endothelial function and elevated levels of low-density lipoprotein cholesterol (LDL-C) in patients with type 2 diabetes mellitus (T2DM) [9]. Diabetic patients have a higher prevalence of subclinical carotid artery disease, characterized by an increase in carotid intima media thickness and the presence of plaque, compared to healthy individuals [10]. The presence of elevated total cholesterol (TC) and LDL-C levels has been found to be linked to an increase in carotid intima media thickness in individuals with type 2 diabetes mellitus (T2DM) [10]. Furthermore, a study revealed a correlation between the thickness of the innermost layer of the carotid artery in adulthood and LDL cholesterol levels, systolic blood pressure, body mass index (BMI), and smoking during childhood, regardless of the presence of diabetes [11]. Diabetes and dyslipidemia are recognized as significant risk factors for coronary artery disease (CAD) [12].

The American Diabetes Association (ADA) states that the ideal lipid levels for adults and children with type 2 diabetes mellitus (T2DM) are LDL-C levels below 100 mg/dL, high-

density lipoprotein cholesterol (HDL-C) levels above 35 g/dL, and triglyceride (TG) levels below 150 mg/dL [13,14]. Several studies have demonstrated a correlation between inadequate glycemic control and elevated total cholesterol levels in patients with type 2 diabetes mellitus [12]. Out of the group, 35% had elevated total cholesterol levels (>200 mg/dL), 27% had elevated LDL cholesterol levels (>130 mg/dL), and 12% had elevated triglyceride levels (>200 mg/dL) [15]. Research has revealed that Dyslipidemia is frequently not identified and inadequately managed in high-risk populations, such as individuals with type 2 diabetes mellitus [13].

The prevalence of type II diabetes among Palestinian individuals aged 20 to 79 years was found to be 10.6% in 2017 [6]. The projected percentage is anticipated to reach 20.8% and 60.18% by the years 2020 and 2040, respectively. Out of a population of 1000, 169 individuals have confirmed cases of type II diabetes. It is projected that by 2040, the number of individuals with type II diabetes will increase to approximately 489 within the same population [16]. Recent findings indicate that diabetes and its associated complications account for 5.7% of the overall mortality rate in Palestine. Remarkably, diabetes ranks as the sixth most prevalent cause of death in the country [17].

In response to the rising prevalence of diabetes and dyslipidemias in Palestine, and the absence of research on these topics in the region, we undertook this study to ascertain the occurrence of various dyslipidemia types among individuals with type 2 Diabetes Mellitus. Additionally, our objective was to identify the blood markers of serum lipid profile that are linked to inadequately managed type 2 diabetes mellitus.

METHODS- We conducted an epidemiological cross- sectional study in general medicine OPD of tertiary care hospital . We included patients with T2DM, patient age from 18 to 60 years old, and apparently uncomplicated. Exclusion criteria were; patients having hepatic, renal or metabolic disorders or other comorbidities, and patients who refused to participate in this study. For each eligible patient, we reported the following data: written informed consent, detailed history including medical, surgical history, history of drug intake and family history, history of endocrine disease, history of previous operations. General examination includes Blood pressure, pulse examination, temperature and respiratory rate, upper, lower limbs and head and neck examination with, comment on lymph node. Local examination of different systems for; Cardiac examination, chest examination, thorough Abdominal examination, thorough neurological examination.

Medication adherence was assessed using Morisky medication adherence scale (MMAS-8). The MMAS-8 is eight items produced to measure medication adherence. It is composed of seven (Yes-No) questions. The eighth question uses a 5-point of Likert scale [5]. The translation was carried out according to standard forward and backward method. In the forward translation process the scale was translated into Arabic by language experts.

5 ml of venous blood were taken from each patient and then divided into fluoride oxalate, ethylene diamine acetate and test tubes. All biochemical methods were made using automated chemistry analyzer according to the standardized protocols. Fasting blood

glucose level was measured by glucose oxidase-peroxidase method HDL was assessed by phosphotungstate precipitation method. TC and TG were measured by cholesterol oxidase-peroxidase and glycerol phosphate kinase methods, respectively. LDL was calculated using Friedwald formula. Non-HDL was measured by subtracting HDL from TC. ApoB was estimated using the following equation; ApoB=0.65×TC-0.5 9×HDL-C+0.01×TG when, TG<270 mg/dl and ApoB =25.6+0.58×TC-0.38×HDL-C-0.6×TG when TG>270mg/dl. HbA1c was measured by ion-exchange resin method.

RESULTS

The current study comprised of 47 patients diagnosed with Type 2 Diabetes Mellitus (T2DM), with an average age of 49.5 ± 9.12 years. Out of the total, 21 individuals (44.7%) were male, while 26 individuals (55.3%) were female. The majority of the patients included in the study were female and non-smokers. The baseline characteristics were documented in Table 1.

Approximately 55% of the patients included in the study exhibited dyslipidemia. Upon evaluating each component of the lipid profile, it was found that 53.2% of the patients examined had elevated triglyceride levels, 46.9% had high cholesterol, 45.9% had abnormal LDL-cholesterol levels, and 25.5% had low HDL levels, as indicated in Table 2. Table 3 demonstrates a statistically significant disparity in fasting blood glucose and glycosylated hemoglobin levels between the groups under study. Specifically, diabetic patients with dyslipidemia exhibited significantly higher levels of these markers.

The correlation analysis yielded the following results: There is a statistically significant positive correlation between HBA1c and disease duration, total cholesterol, triglycerides, LDL cholesterol levels. Conversely, there is a significant negative correlation between HBA1c and HDL cholesterol level. Moreover, there is a statistically insignificant positive correlation between the duration of the disease and both total cholesterol and LDL cholesterol levels. Conversely, there is a statistically insignificant negative correlation between the duration of the disease and HDL cholesterol level. There is a statistically insignificant positive correlation between the duration of the disease and the level of triglycerides. The majority of patients with dyslipidemia reported a low level of adherence to their medication. Approximately 91.5% of patients exhibited reduced adherence to their anti-diabetic medication. A statistically significant difference exists between the studied groups in terms of medication adherence. All patients with dyslipidemia reported low medication adherence, with a p-value of 0.001.

Logistic regression analyses revealed that body weight and increasing HBA1c are significant predictors of dyslipidemia in diabetic patients. Specifically, each unit increase in body weight is associated with a 1.106-fold increase in the risk of dyslipidemia, while each unit increase in HBA1c is associated with a 1.721-fold increase in the risk of dyslipidemia. The risk of developing the disease is increased by 1 fold for each increase in fasting blood glucose, and by 1.112 folds for each increase in disease duration, although the latter

increase is not statistically significant. Poor compliance with medication consistently indicates the development of dyslipidemia. In contrast, a decrease in BMI and the absence of hypertension provide a protective effect against that risk, with a reduction of approximately 0.1 and 0.7 respectively (OR 0.893 and 0.487 respectively), as indicated in Table 4.

Table 1. Distribution of the studied patients according to demographic characteristics and special habits

	Mean ± SD	**Range**
Age	49.5 ± 9.12	24 - 60
Weight (kg)	89.34 ± 14.36	55 - 118
Height (m)	1.7 ± 0.11	1.5 – 1.92
BMI (kg/m^2)	32.42 ± 7.07	16.34 – 47.61
Disease duration	6.95 ± 3.89	1 - 25
HBA1c (%)	8.46 ± 2.71	4.51 – 15.9
Fasting blood glucose (mg/dL)	183.91 ± 63.71	100 - 442
Total cholesterol (mg/dL)	195.34 ± 50.92	105 – 288
Triglycerides (mg/dL)	158.96 ± 66.18	5 – 299
HDL (mg/dL)	45.56 ± 7.84	30 - 65
LDL (mg/dL)	122.27 ± 43.66	32 - 197
	N	%
Gender:		
Male	21	44.7
Female	26	55.3
Education:		
None	3	7.4
Primary	5	10.6
Secondary	24	51.1
Tertiary	15	30.9
Smoking:		
No	29	61.7
Yes	18	38.3

BMI, body mass index, HDL, high density lipoprotein; LDL, low density lipoprotein, HbA1c,
glycated hemoglobin A1c

Table 2. Distribution of the studied patients according to dyslipidemia

	N	%	Reference values
Dyslipidemia:			
Absent Present	21 26	44.7 55.3	
Cholesterol level: Normal			
Borderline to high	25	53.2	< 200 mg/d
High	10	21.3	200 to 239 mg/dl
	12	25.5	>240 mg/dl
Triglycerides level:			
Normal Borderline to high	22	46.8	<150 mg/dL
High to very high	14	29.8	150-199 mg/dL
	11	23.4	>200 mg/dL
LDL cholesterol: Normal			
Borderline to high High to	26	54.3	<129 mg/dL
very high	9	20.2	130-159 mg/dL
	12	25.5	>160 mg/dL
HDL cholesterol:			
Normal	35	74.5	40-50 mg/dL for men and 50-59 mg/dl for women
Low	12	25.5	<40 mg/dL for men and <50 mg/dL for women.

HDL, high density lipoprotein; LDL, low density lipoprotein

Table 3. Relation between dyslipidemia in the studied patients and other data.

Absent		**Present**	**t**	**p**
	Mean ± SD	**Mean ± SD**		
Age	50.31±8.53	48.85±9.59	0.772	0.442
Weight	84.31± 13.06	93.4 ± 14.19	-3.2	0.002*
Height	1.7 ± 0.1	1.7 ± 0.12	-0.318	0.751
BMI	29.65±5.97	32.84±7.61	-2.281	0.025*
Disease duration	5.84±3.94	7.85±3.63	3.568	<0.001**

Fasting blood glucose	157.76±50.54	204.54±65.84	-3.758	<0.001**
HBA1c	6.92 ± 1.78	9.69 ± 2.71	-5.951	<0.001**
	N (%)	**N (%)**	**X2**	**p**
Gender:				
Male	12 (54.8)	11 (44.2)	0.01	0.922
Female	10 (45.2)	14 (55.8)		
Education level:				
Illiterate	1 (7.1)	2 (7.7)		
Primary	2 (9.5)	3 11.5)	0.429	0.934
Secondary	11 (54.8)	13 (48.1)		
Tertiary	6 (28.6)	9 (32.7)		
Smoking:				
No	13 (64.3)	16 (59.6)	0.214	0.643
Yes	7 (35.7)	11 (40.4)		
*p<0.05 is statistically significant, **p≤0.001 is statistically highly significant BMI, body mass index, HbA1c, glycated hemoglobin A1c				

Table 4. logistic regressions for variables independently predict presence of dyslipidemia in the studied diabetic patients

β	**OR**	**95% CI**		**p**
		Lower	**Upper**	
Weight	0.101	1.106	1.021	1.199	0.013*
BMI	-0.114	0.893	0.770	1.035	0.133
Duration	0.106	1.112	0.954	1.295	0.175
Hypertension (No)	-0.720	0.487	0.487	1.506	0.211
FBG	0.001	1.001	0.988	1.014	0.863
HBA1C	0.543	1.721	1.152	2.572	0.008*
*p<0.05 is statistically significant, **p≤0.001 is statistically highly significant BMI, body mass index, HbA1c, glycated hemoglobin A1c, FBG, Fasting blood glucose, OR odds ratio, CI confidence interval,				

DISCUSSION

Both dyslipidemia and DM have been demonstrated to be predictive factors for associated comorbidities such as hypertension and cardiovascular diseases. Fats contribute to the development of DM. DM is often accompanied by dyslipidemia. Patients with DM have been reported to exhibit abnormalities in fat metabolism, which increases their risk of cardiovascular arteriosclerosis [18].

This study was conducted on patients diagnosed with type 2 diabetes mellitus (T2DM). The

objective of this study was to establish the correlation between type 2 diabetes mellitus (T2DM) and lipid profile abnormalities, as well as to mitigate the complications associated with lipid dyslipidemia in patients with T2DM in the Tur Sinai District. The study was conducted at the DM Clinic, a comprehensive health insurance clinic located in the Tur Sinai District. It included a total of 94 subjects who had been diagnosed with Type 2 Diabetes Mellitus for a duration of more than 6 months. Participants were requested to fill out questionnaires that included demographic details, such as their previous and/or current medical background, and were instructed to come back after abstaining from food for a minimum of 8 hours in order to provide a blood sample. The current study observed a higher proportion of females (55.3%) compared to males (44.7%) with T2DM. The majority of patients had completed secondary education, while only 7.4% had no formal education (as shown in table 3). The elevated proportion of females in this study can be attributed to the demographic characteristics of the patient population attending the hospital during morning clinic hours, as well as the challenging living conditions in Sinai.

The study found that 61.7% of patients were not smokers. This was encouraging because smoking is linked to a higher likelihood of developing diabetes mellitus and dyslipidemia. Furthermore, smoking is a significant contributing factor to the development of heart diseases. The impact of this substance on vascular diseases does not exacerbate the regulation of blood pressure, glucose metabolism, and lipid metabolism. Diabetes mellitus (DM) leads to the development of microangiopathy and diabetic microangiopathy [19] in affected patients. Furthermore, the impact of smoking on metabolic diseases remains ambiguous. However, quitting smoking enhances glucose and metabolism, while reducing the likelihood of impaired glucose tolerance and diabetic microangiopathy. Immediate smoking cessation is imperative for all individuals with metabolic disorders in order to effectively manage their conditions and mitigate the risk of developing arteriosclerosis [19]. Nevertheless, our study found a low prevalence of smokers. However, we did not observe any statistically significant difference between the patients with and without dyslipidemia in terms of smoking habits.

Additionally, this study revealed that the majority of diabetic patients exhibited elevated levels of LDL cholesterol and TAG (Table 7). Nevertheless, there was a substantial decrease in the average concentration of HDL levels. The predominant lipid parameter disorder observed in our study was hypertriacylglycerolemia, with a prevalence of 53.2%. This discovery aligns with previous research that documented comparable percentages in Hyderabad (60%) and Sudan (48.8%) [20,21].

Our study revealed that 44.2% of individuals diagnosed with dyslipidemia were male, while 55.3% were female. Additionally, DM patients exhibited elevated levels of TAG,

LDL, and reduced levels of HDL cholesterol. This outcome bears resemblance to the Asian Pacific Cohort Studies Collaboration [22]. Previous studies have indicated that LDL cholesterol levels in patients with type 2 diabetes mellitus (T2DM) may be higher than the levels observed in our study [23].

Subsequent analysis revealed that there was no substantial disparity in serum total cholesterol (TC) and low-density lipoprotein (LDL) cholesterol levels between patients with diabetes mellitus (DM) and the control group [24]. However, previous studies conducted in Haiderabid, Nepail, Sudan, and Ghania have reported higher rates of dyslipidemia in patients with type 2 diabetes mellitus. Specifically, the rates were 70% in Haiderabid, 22% in Nepail, 94% in Sudan, and 26.5% in Ghania. The variation can be attributed to disparities in lifestyle, genetics, and the management of diabetes mellitus [25].

Effective management of blood sugar levels is a critical determinant of the complications experienced by individuals with diabetes. Identifying the factors linked to effective regulation of blood glucose aids healthcare providers in mitigating the likelihood of diabetic complications. The current study found that a majority of patients with dyslipidemia had a low level of adherence to their medication. Approximately 91.5% of patients exhibited reduced adherence to their anti-diabetic medication. Furthermore, the average HbA1c level was (8.46 ± 2.71), which demonstrates a strong correlation with the elevated proportion of individuals who do not comply with their prescribed anti-diabetic medication. The causes of inadequate glycemic control are multifactorial. In a previous study on type 2 diabetes mellitus, it was discovered that over 70% of patients had inadequate control of their diabetes, as indicated by a HbA1c level greater than 8% [21].

Our study revealed unregulated blood glucose levels. Hence, it is imperative to provide T2DM patients with comprehensive knowledge regarding the importance of consistent monitoring of their blood glucose levels and optimal glycemic management. In this study, we also attempted to establish a correlation between lipid profiles and different clinical and anthropometric variables. Statistical analysis reveals a significant disparity in body weight, BMI, and disease duration between the groups under study. These factors were notably higher among diabetic patients with dyslipidemia. This study was subject to certain limitations. Potential selection bias may be present due to the utilization of a consecutive sampling technique to select study participants. Furthermore, the study employed a cross-sectional design, which means that the observed parameters may not have a genuine association.

CONCLUSIONS

This study emphasized the elevated occurrence of dyslipidemia in individuals with diabetes mellitus. The current study emphasizes the significance of rigorous management of diabetes mellitus (DM) in the prevention and treatment of dyslipidemia. It reveals that dyslipidemia is more common in diabetic patients with poor control of their condition. Furthermore, reducing body mass index (BMI) and not having hypertension can serve as protective factors against the development of dyslipidemia.

The findings indicate a significant occurrence of dyslipidemia, which likely contributes significantly to the occurrence of cardiovascular diseases and cerebrovascular accidents in individuals with diabetes. There may be selection bias present due to the use of consecutive sampling technique to select study participants. Furthermore, the study employed a cross-sectional design, which means that the observed parameters may not have a genuine association.

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