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A cross-sectional study to determine the lipid profile derangement in newly diagnosed type-2 diabetic patients

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Abstract
Aim: To study the lipid profile abnormalities in newly diagnosed type 2 diabetics.
Methodology: A cross-sectional study was carried out to determine the triglyceride levels in newly diagnosed type 2 diabetic patients. A total of 200 newly diagnosed type 2 diabetics were enrolled in our study. Relevant patient data was collected from the inpatient and outpatient Department of General Medicine, Mamatha Medical College, Telangana, Khammam, India. Fasting lipid profile levels were measured in these patients. The Study was carried out during a period of 1 year. Inclusion criteria: All patients of age > 25 years who have been diagnosed as having type 2 diabetes mellitus within the last 3 months using the ADA (American Diabetes Association) criteria. All individuals signed informed written consent for their participation. Blood samples were taken of all the patients to analyze lipid profile and Blood glucose levels.
Results: Out of 200 enrolled patients, the maximum number of patients belonged to the age group of 41-50 years (50%) and the least number belonged to the age group 20-30 years (1.5%). The gender distribution of the participants showed that 98 (49%) were males, and 102 (51%) were females. According to ATP III classification, 88 (44%) participants had normal serum triglycerides levels which is level of serum triglycerides. Among the 112 participants with abnormal triglycerides, 32.5% had borderline high levels (150-199mg/dl), 19% had high levels (200-499 mg/dl) and 4.5% participants had very high triglycerides (≥500 mg/dl). According to the NCEP ATP III criteria, HDL levels ≤40 is considered low for males and ≤50 is considered low for females. Based on this criterion, in our study, 48.5% participants had low HDL and 51.5% participants had normal HDL. 60 (30%) participants had an optimal level of LDL, 79 (39.5%) had near optimal levels of LDL, 40 (20%) had borderline high levels of LDL, 16 (8%) had high levels of LDL, and 5 (2.5%) participants had very high levels of LDL. 137 (68.5%) participants had desirable total Cholesterol levels of < 200mg/dl, 60 (30%) had borderline high levels of 200- 239mg/dl and 3 (1.5%) had high total cholesterol levels of ≥240mg/dl.
Conclusion: This study found that lipid profile is associated with T2DM. Hence in view of the associated cardiovascular mortality and morbidity, optimum care of these patients include not only adequate glycemic control but effective measure to control the dyslipidemia as well. The appropriate treatment for glycemic control should go concomitantly with lipid lowering drugs and lifestyle modifications.

Keywords: Diabetes, dyslipidemia, cholesterol, triglycerides

Introduction
Type 2 diabetes mellitus (T2DM) is the most common metabolic disorder and is considered a major global health threat all over the world [1]. Lipid abnormalities in patients with diabetes, often termed "diabetic dyslipidemia", are typically characterized by high total cholesterol (T-Chol), high triglycerides (Tg), low high density lipoprotein cholesterol (HDL-C) and increased levels of small dense LDL particles. Low density lipoprotein cholesterol (LDL-C) levels may be moderately increased or normal. Lipid abnormalities are common in people with T2DM and prediabetes [2, 3] but the pattern of the different lipids may vary between ethnic groups, economic levels, and access to health care [4, 5].
According to the report by the International Diabetes Federation in 2015, about one out of 11 adults had diabetes mellitus in the year 2017 and its prevalence is likely to increase to 642 million by 2040. T2DM was estimated to account for about 6.8% of global mortality in adults aged 20–79 years in 2010. Dyslipidemia and hypertension are major modifiable risk factors for T2DM and related CAD, which account for more than 87% of disability in low- and middle-income countries [6, 7].
The mechanism of T2DM is largely understood. It is generally accepted that in normal circumstances, there is a feedback loop between insulin action and insulin secretion.

When this feedback is disrupted, the sensitivity to insulin is impaired and insulin secretion is affected, resulting in abnormal blood levels of glucose [4]. Insulin resistance (IR) and β-cell dysfunction are the main hallmarks of T2DM [8]. A growing body of data has shown that an abnormal lipid profile has a close relationship with IR. IR also serves as the major component of other metabolic disorders, in addition to T2DM. For instance, IR has been indicated to be associated with a high level of very-low-density lipoprotein (VLDL), high concentrations of serum triglycerides (TG), and low serum high-density lipoprotein (HDL). Therefore, the lipid profile is emphasized in almost all follow-up programs of T2DM and serves as a serious risk factor [9, 10].
A recently published meta-analysis reported that abnormal levels of the above-mentioned lipid parameters reflect, to some extent, the risk of T2DM [11]. Furthermore, studies in people with T2DM have found an increased association between CAD and high Tg and low HDL-C combined, compared to the two lipid parameters assessed separately [12, 13]. Understanding the association between serum lipid patterns and different stages of glucose intolerance is of considerable clinical and public health importance and such data can potentially form the basis for future prevention programs for diabetes and related complications.

Materials and Methods

A cross-sectional study was carried out to determine the triglyceride levels in newly diagnosed type 2 diabetic patients. A total of 200 newly diagnosed type 2 diabetics were enrolled in our study. Relevant patient data was collected from the inpatient and outpatient Department of General Medicine, Mamatha Medical College, Telangana, Khammam, India. Fasting lipid profile levels were measured in these patients. The Study was carried out during a period of 1 year.

Inclusion criteria

All patients of age > 25 years who have been diagnosed as having type 2 diabetes mellitus within the last 3 months using the ADA (American Diabetes Association) criteria.

Exclusion criteria

Patients on steroids, having type 1 diabetics, on antipsychotic medications, known cases of active hypothyroidism, known cases of Cushing's syndrome were excluded from the study.

Methodology

All individuals signed informed written consent for their participation. Blood samples were taken of all the patients to analyze lipid profile and Blood glucose levels.

Results

Out of 200 enrolled patients, the maximum number of patients belonged to the age group of 41-50 years (50%) and the least number belonged to the age group 20-30 years (1.5%). The gender distribution of the participants showed that 98 (49%) were males, and 102 (51%) were females.

Table 1: Demographic details

Variables		Number	%
Age	20-30	3	1.5
	31-40	41	20.5
	41-50	100	50
	51-60	56	28
Gender	Male	98	49
	Female	102	51

According to ATP III classification, 88 (44%) participants had normal serum triglycerides levels which are level of serum triglycerides. Among the 112 participants with abnormal triglycerides, 32.5% had borderline high levels (150-199mg/dl), 19% had high levels (200-499 mg/dl) and 4.5% participants had very high triglycerides (≥500 mg/dl).

Table 2: Lipid profile of all the patients

Variables	Range	Number	%
Serum triglycerides levels (mg/dl)	Normal (<150mg/dl)	88	44
	Borderline high (150-199 mg/dl)	65	32.5
	High (200- 499mg/dl)	38	19
	Very High (>500mg/dl)	9	4.5
Serum HDL levels	Low (<40 for males and <50 for females)	97	48.5
	Normal	103	51.5
Serum LDL levels	Optimal (<100 mg/dl)	60	30
	Near optimal (100-129 mg/dl)	79	39.5
	Borderline high (130-159 mg/dl)	40	20
	High (160-189 mg/dl)	16	8
	Very high (>189 mg/dl)	5	2.5
Total cholesterol	Normal (<200 mg/dl)	137	68.5
	Borderline high (200-239 mg/dl)	60	30
	High (>239 mg/dl)	3	1.5

According to the NCEP ATP III criteria, HDL levels ≤40 is considered low for males and ≤50 is considered low for females. Based on this criterion, in our study, 48.5% participants had low HDL and 51.5% participants had normal HDL.
According to the NCEP ATP III criteria, 60 (30%) participants had an optimal level of LDL, 79 (39.5%) had near optimal levels of LDL, 40 (20%) had borderline high levels of LDL, 16 (8%) had high levels of LDL, and 5 (2.5%) participants had very high levels of LDL.

Among the 200 participants, 137 (68.5%) participants had desirable total Cholesterol levels of < 200mg/dl, 60 (30%) had borderline high levels of 200- 239mg/dl and 3 (1.5%) had high total cholesterol levels of ≥240mg/dl.

Discussion

Today, it is generally accepted that dyslipidemia is associated with T2DM. Patients with combined high TG and low HDL-C levels had 12.75 and 4.89 times higher odds of developing diabetes and prediabetes, respectively

[14]. Diabetic dyslipidemia is often characterized by high TC, high TG, low HDL cholesterol, and increased level of LDL [15, 16]. A lipid profile assessment in T2DM FDRs may be useful to reduce the risk of disease progression and also for early intervention. The exact mechanism of this risk is not fully understood, but at first, this may be due to genetic factors. For instance, a study of Japanese-American males reported an increased risk of diabetes incidence among those with a parental history of diabetes (odds ratio 1.73) [17]. Bjørnholt *et al*. analyzed healthy Caucasian male FDRs with normal fasting blood glucose. They found that maternal diabetes is associated with an increased risk of diabetes [18].

The Strong Heart study aimed at investigating if combined high Tg and low HDL-C status, also known as "atherogenic dyslipidemia", were more likely to be present in T2DM individuals [19]. This study, based on a prospective cohort, showed that high fasting Tg level in combination with a low HDL-C level were associated with increased risks of CAD and ischemic stroke, particularly in those with diabetes. It was further shown that 60% of the participants with combined high TG and low HDL levels had T2DM, whereas the corresponding figure for non-diabetics was 30%.

In our study, according to ATP III classification, 88 (44%) participants had normal serum triglycerides levels which is level of serum triglycerides. Among the 112 participants with abnormal triglycerides, 32.5% had borderline high levels (150-199mg/dl), 19% had high levels (200-499 mg/dl) and 4.5% participants had very high triglycerides (≥500 mg/dl).A study done by Bharadwaj *et al*. in North India showed that hypertriglyceridemia was present in 42.7% of subjects who were diabetics [20]. A study done in four selected regions of India showed that 29.5% had hypertriglyceridemia with the highest prevalence in Chandigarh and the common risk factors being obesity, diabetes and dysglycemia [21].

To determine the exact mechanism of the effects of TG, VLDL, and non-HDL cholesterol in T2DM, decades of research have been performed. Diabetic dyslipidemia is not yet fully understood; however, IR and relative insulin deficiency are commonly observed in patients with T2DM. Moreover, some adipocytokines, such as adiponectin, may contribute to the development of diabetic dyslipidemia [22].

The effect of high levels of lipid factors on increasing the risk of diabetes was also confirmed by previous studies. For instance, Azmatulla *et al* examined the body fat distribution, cardiorespiratory fitness, and lipid profile of T2DM FDRs. They showed that an abnormal lipid profile in FDRs was associated with the development of other disorders, such as severe cardiovascular impairments [23]. Iraj *et al*. analyzed 793 individuals with prediabetes in T2DM FDRs. They reported that the mean level of LDL was significantly higher in the isolated impaired fasting glucose group than in the isolated impaired glucose tolerance group [24]. In addition, our subgroup analysis showed that dyslipidemia increased the risk of diabetes mostly in female FDRs. Similarly, Jafari-Koshki *et al*. reported that although there was a significant association between risk of diabetes in FDRs and waist circumference and waist/hip ratio, these findings were present only in females, and not in males [25].

Several factors are related to diabetic dyslipidemia including insulin effects on liver apoprotein production, regulation of lipoprotein lipase, actions of cholesteryl ester transfer protein (CETP), and peripheral actions of insulin on adipose and muscle tissue [26]. The process for the development of cardiac complication is based on the dyslipidemia- insulin resistance (IR)–hyperinsulinemia cycle, well known as the "vicious cycle hypothesis" [27]. In an insulin-resistant state, hypertriglyceridemia is primarily due to an increased hepatic production of very low density lipoprotein (VLDL) particles, postprandial hyperlipidemia, and low lipoprotein lipase (LPL) levels. This hypertriglyceridemia enhances the CETP mediated interchange of Tg from Tg-rich lipoproteins to HDL-L/HDL-VL and the subsequent Tg-enrichment of HDL-C. Hepatic lipase has greater activity against Tg and will, thus, convert large HDL particles to small HDL particles, which are also cleared more rapidly from the circulation by the kidney, consequently reducing the concentration of HDL particles (HDL-P) [28, 29].

Conclusion

This study found that lipid profile is associated with T2DM. Hence in view of the associated cardiovascular mortality and morbidity, optimum care of these patients include not only adequate glycemic control but effective measure to control the dyslipidemia as well. The appropriate treatment for glycemic control should go concomitantly with lipid lowering drugs and lifestyle modifications.

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