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Original Research Article

The cross-sectional study on changes in fasting lipid profile and liver enzyme in type 2 diabetic patients in tertiary healthcare

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ABSTRACT

Background: Type 2 Diabetes Mellitus (T2DM) is associated with metabolic dysfunctions, including Dyslipidemia and liver enzyme abnormalities. Elevated fasting lipid profiles and liver enzymes have been linked to poor glycaemic control, increasing the risk of cardiovascular disease and non-alcoholic fatty liver disease (NAFLD). This study aims to investigate the correlation between glycaemic status, lipid abnormalities, and liver enzyme alterations in T2DM patients.
Methods: A cross-sectional observational study was conducted at Dr. M.K. Shah Medical College & Research Centre and Smt. S.M.S. Multispecialty Hospital, Ahmedabad. A total of 125 T2DM patients were enrolled based on ADA guidelines. Demographic data, glycaemic parameters (FBS, PPBS, HbA1c), fasting lipid profile, and liver function tests (SGOT, SGPT) were analyzed. Data were statistically assessed using SPSS version 20, with a p value <0.05 considered significant.
Results: A significant association was observed between poor glycaemic control (HbA1c>10%) and elevated liver enzymes, with a fivefold increase in SGOT and SGPT levels (p<0.05). Dyslipidemia was highly prevalent, with increased triglycerides and LDL levels strongly correlating with worsening glycaemic status. HDL levels showed no significant association.
Conclusions: The findings emphasize the importance of monitoring liver function and lipid profiles in T2DM patients to prevent complications such as NAFLD and cardiovascular disease. Early detection of metabolic abnormalities can aid in risk stratification and targeted therapeutic interventions for better diabetes management.

Keywords: Fasting lipid profile, Glycaemic, Liver enzymes, Type 2 diabetes mellitus

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a rapidly growing global health issue, accounting for approximately 98% of all diabetes cases worldwide, with significant regional variations in prevalence.[1] According to the International Diabetes Federation (IDF), an estimated 537 million adults (aged 20-79 years) were living with diabetes in 2021, with projections indicating a rise to 783 million by 2045).[2] The increasing burden of T2DM is largely driven by sedentary lifestyles, unhealthy dietary habits, and the rising prevalence of obesity and metabolic syndrome.[3]

The liver plays a pivotal role in glucose metabolism through glycogen storage, gluconeogenesis, and lipid metabolism.[4] Dysregulation of liver function in diabetes has been linked to insulin resistance, increased hepatic glucose output, and lipid abnormalities.[5] However, routine liver function tests (LFTs) are often overlooked in clinical assessments of diabetes, despite growing evidence of hepatic involvement in diabetes pathogenesis.[6] Studies have shown that elevated liver enzyme levels, particularly

alanine aminotransferase (ALT) and aspartate aminotransferase (AST), are commonly observed in T2DM patients and are associated with a higher risk of disease progression and complications.[7,8]

Insulin resistance plays a central role in T2DM and is strongly associated with hepatic steatosis, commonly referred to as non-alcoholic fatty liver disease (NAFLD).[9] NAFLD is now recognized as the most common liver disorder worldwide, affecting up to 70% of individuals with T2DM.[10] It is characterized by excessive fat accumulation in hepatocytes, which can progress to non-alcoholic steatohepatitis (NASH), fibrosis, cirrhosis, and hepatocellular carcinoma.[11] Inflammatory cytokines such as tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6) play a key role in hepatocyte injury and insulin resistance, exacerbating both hepatic and systemic metabolic dysfunction.[12]

Apart from liver function abnormalities, dyslipidemia is a well-established metabolic disturbance in T2DM patients. Diabetic dyslipidemia is characterized by elevated triglycerides (TG), low-density lipoprotein cholesterol (LDL-C), and reduced high-density lipoprotein cholesterol (HDL-C), contributing to an increased risk of cardiovascular disease (CVD).[13] Dyslipidemia and altered liver enzyme levels share a common pathophysiological basis in insulin resistance, oxidative stress, and chronic low-grade inflammation.[14] Several studies have reported a significant correlation between increased liver enzyme levels and dyslipidemia in T2DM patients, suggesting a possible link between hepatic dysfunction and lipid abnormalities.[15,16]

Cardiovascular disease remains the leading cause of mortality in T2DM patients, with dyslipidemia and NAFLD acting as independent risk factors.[17] The progression from hepatic insulin resistance to Dyslipidemia and atherosclerosis highlights the importance of monitoring both liver function and lipid metabolism in diabetes management.[18] Early identification of liver dysfunction and lipid abnormalities in T2DM patients can help implement timely interventions, including lifestyle modifications, pharmacological therapy, and risk stratification for complications such as cardiovascular disease and liver fibrosis.[19]

Despite growing evidence of the interconnection between T2DM, liver dysfunction, and Dyslipidemia, there is a lack of consensus on the most reliable biomarkers for early detection and disease monitoring.[20] Identifying the most predictive liver enzyme or lipid parameter for diabetes progression remains an area of active research. This study aims to investigate the relationship between liver function parameters and glycaemic status, as well as to establish correlations between liver enzymes and lipid profiles in T2DM patients attending tertiary healthcare facilities. Understanding these associations will aid in developing better screening strategies and targeted therapeutic approaches for improving metabolic health in diabetes patients.

This study aimed to study the changes in fasting lipid profile and liver enzyme levels in type 2 diabetes mellitus (T2DM) patients in tertiary healthcare settings. The secondary objective was to study the association between lipid profile and liver function tests in T2DM patients.

METHODS

This study is a cross-sectional, observational study conducted at the Department of General Medicine, Dr. M.K. Shah Medical College & Research Centre and Smt. S.M.S. Multispecialty Hospital, Chandkheda, Ahmedabad. The study was carried out from the approval date of the Institutional Ethics Committee until June 2024. The study population included patients with a history of Type 2 Diabetes Mellitus (T2DM) who visited the General Medicine outpatient department or were admitted to the tertiary care hospital. A total of 125 patients were enrolled based on a non-random purposive sampling method. The sample size was calculated using the formula n=4pql2n = \franc{4pq}{l^2}, where the prevalence of diabetes (pp) was taken as 8.9%, and an allowable error (ll) of 5% of pp was considered.[21]

Patients were included if they were diagnosed with T2DM as per the American Diabetes Association (ADA) guidelines, aged above 18 years, and provided informed consent for participation.[22] Exclusion criteria comprised patients with type 1 diabetes mellitus, pregnant females, chronic alcoholics, those taking hypolipidemic drugs, and individuals with other causes of hepatitis, including infectious, autoimmune, metabolic, drug-induced, or toxic hepatitis.[23]

Upon enrollment, detailed demographic data, medical history, physical examination, and vital parameters were recorded.[24] Laboratory investigations included Complete Blood Count (CBC), Fasting Blood Sugar (FBS), Postprandial Blood Sugar (PPBS), Glycated Hemoglobin (HbA1c), Renal Function Test (RFT), Liver Function Test (LFT), fasting lipid profile, Urine Routine & Microscopy, and Ultrasonography (USG) of the abdomen and pelvis.[25,26] Data collection was performed systematically, and laboratory results were documented in a structured proforma .[27]

All collected data were entered into Microsoft Excel 2014 and analyzed using SPSS version 20.[28] Statistical analysis involved double-checking for outlier values and ensuring accuracy. Categorical variables were summarized as proportions and percentages, while continuous variables were analyzed using means and standard deviations.[29] The chi-square test was used to determine statistical significance, with a p value <0.05 considered statistically significant.[30] The results were presented in tables and graphical formats for better visualization and interpretation.[31]

RESULTS

A total of 125 patients with type 2 diabetes mellitus (T2DM) were enrolled in this study. The analysis focused on demographic characteristics, liver enzyme levels, fasting lipid profile, and their associations with glycaemic control.

Table 1: Demographic characteristics of participants.

Parameter	Categories	N (%)
Age group (years)	<40	18 (14.4)
	40-50	45 (36.0)
	51-60	41 (32.8)
	>60	21 (16.8)
Gender	Male	64 (51.2)
	Female	61 (48.8)
Duration of diabetes	<1 year	19 (15.2)
	1-5 years	62 (49.6)
	5-10 years	37 (29.6)
	>10 years	7 (5.6)

The study population consisted of 51.2% males and 48.8% females. The majority of patients (68.8%) were in the 40-60 years age group, with 16.8% above 60 years and 14.4% below 40 years. Most participants (49.6%) had been diagnosed with T2DM for 1 to 5 years, while 29.6% had diabetes for 5 to 10 years.

The fasting blood sugar (FBS) levels were between 151-180 mg/dl in 65.6% of patients, while 10.4% had levels above 180 mg/dl. The majority (66.4%) had HbA1c levels between 6.5-8.0%, while 4.8% had levels above 10.0%. Elevated liver enzyme levels (SGOT/SGPT) were more prevalent in patients with poor glycaemic control.

A statistically significant association was observed between higher FBS/HbA1c levels and elevated liver enzymes ($p<0.05$). Patients with poor glycaemic control (FBS>180 mg/dl, HbA1c>10%) had the highest liver enzyme elevations.

Dyslipidemia was highly prevalent among the study population. A strong correlation was observed between poor glycaemic control (high HbA1c and FBS) and abnormal lipid levels, particularly elevated total cholesterol, LDL, and triglycerides.

Elevated triglyceride and LDL levels were significantly associated with poor glycaemic control (high FBS and HbA1c) ($p<0.05$). HDL levels showed no significant correlation with glycaemic status.

Table 2: Glycaemic control and liver function test correlations.

Glycaemic parameters	Categories	N (%)	SGOT (AST) elevated (>40) (%)	SGPT (ALT) elevated (>40) (%)
FBS (mg/dl)	126-150	30 (24.0)	10 (33.3)	5 (16.7)
	151-180	82 (65.6)	31 (37.8)	20 (24.4)
	>180	13 (10.4)	7 (53.8)	6 (46.2)
HbA1c (%)	6.5-8.0	83 (66.4)	27 (32.5)	23 (27.7)
	8.1-10.0	36 (28.8)	16 (44.4)	3 (8.3)
	>10.0	6 (4.8)	5 (83.3)	5 (83.3)

Table 3: Lipid profile and its association with glycaemic control.

Lipid profile	Normal (%)	Borderline (%)	Elevated (%)	Associated with poor glycaemic control
Total cholesterol	80 (64.0)	31 (24.8)	14 (11.2)	Yes ($p<0.05$)
Triglycerides	73 (58.4)	37 (29.6)	15 (12.0)	Yes ($p<0.05$)
LDL cholesterol	90 (72.0)	29 (23.2)	6 (4.8)	Yes ($p<0.05$)
HDL cholesterol	98 (78.4)	25 (20.0)	2 (1.6)	No significant correlation

DISCUSSION

This study investigated the relationship between glycaemic control, liver enzyme abnormalities, and lipid profile alterations in Type 2 Diabetes Mellitus (T2DM) patients. The findings indicate a strong association between poor glycaemic control and elevated liver enzymes, as well as dyslipidemia, which is consistent with previous research.

The study revealed that SGOT (AST) and SGPT (ALT) levels were significantly elevated in T2DM patients with poor glycaemic control (FBS >180 mg/dL and HbA1c >10%). These findings align with the results of Kim et al. (2013), who found that liver enzyme elevations were three times higher in diabetic patients compared to non-diabetics.[32] Similarly, Bril and Cusi et al (2016) reported that insulin resistance contributes to hepatic inflammation and increased aminotransferase levels, supporting our observation of elevated SGOT and SGPT in uncontrolled diabetes.[33]

Insulin resistance plays a crucial role in the development of Non-Alcoholic Fatty Liver Disease (NAFLD) in diabetic patients, leading to hepatocellular injury and increased liver enzyme levels. Our findings correlate with a study by Targher et al (2010), which identified a direct relationship between worsening glycaemic status and the risk of NAFLD progression.[34] Given the significant prevalence of liver enzyme abnormalities in T2DM, early screening and management of liver function in diabetic patients should be emphasized.

Our study demonstrated a strong correlation between poor glycaemic control and elevated triglycerides and LDL levels, with HDL levels remaining largely unaffected. This aligns with findings from the Framingham Heart Study, which reported that patients with HbA1c >8% had significantly higher triglyceride and LDL levels, increasing cardiovascular risk.[35]

The lipid abnormalities observed in our study are characteristic of diabetic Dyslipidemia, which is marked by high triglycerides, elevated LDL, and low HDL. Similar results were reported by Schuster and Gaillard et al (2005), who described dyslipidemia as a hallmark of metabolic syndrome in diabetes.[36] Additionally, the Chennai Urban Population Study found that 80% of diabetic individuals had lipid profile abnormalities, emphasizing the importance of lipid monitoring in diabetes management.[37]

The statistically significant association ($p<0.05$) between glycaemic control, liver function abnormalities, and lipid disturbances underscores the interrelated nature of metabolic dysfunctions in diabetes. Previous studies, including that by Lonardo et al (2016), support these findings by identifying a bidirectional relationship between diabetes, dyslipidemia, and liver dysfunction.[38]

The presence of both liver enzyme abnormalities and Dyslipidemia in diabetes significantly increases the risk of cardiovascular complications and non-alcoholic steatohepatitis (NASH). The CARDIA study suggested that elevated liver enzymes in diabetics are predictive of cardiovascular disease (CVD), reinforcing the need for comprehensive metabolic monitoring.[39]

This study has several limitations. Being cross-sectional in design, it cannot establish causal relationships between glycaemic control, liver enzyme alterations, and dyslipidemia. Conducted at a single tertiary care center with a relatively small, non-random sample, the findings may not be generalizable to wider populations. Additionally, potential confounding factors such as diet, physical activity, and socioeconomic status were not assessed. The reliance on liver enzyme levels without imaging or histological confirmation limits the accuracy in detecting NAFLD. Excluding patients with coexisting liver conditions or on lipid-lowering therapy may also have led to selection bias.

CONCLUSION

Significantly elevated SGOT and SGPT levels were observed in patients with poor glycaemic control, with HbA1c levels above 10% being associated with a fivefold increase in liver enzyme abnormalities. Dyslipidemia was highly prevalent among diabetic patients, with elevated triglyceride and LDL levels strongly correlating with poor glycaemic control. A statistically significant association ($p<0.05$) was found between glycaemic status and both liver function abnormalities and lipid profile alterations, highlighting the interrelationship between metabolic disturbances in type 2 diabetes mellitus.

Recommendations

The findings of this study highlight the critical need for routine screening of liver function and lipid profile in diabetic patients, particularly those with poor glycaemic control. The strong association between elevated liver enzymes, dyslipidemia, and worsening glycemia suggests that early detection and intervention can help prevent long-term complications such as NAFLD, CVD, and metabolic syndrome. Future research should focus on identifying specific biomarkers that predict disease progression and evaluating targeted therapeutic approaches for managing hepatic and lipid dysfunction in T2DM patients.

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