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**Original Research Article**

# Correlation between triglyceride level and carotid intima media thickness in patients with type 2 diabetes mellitus

**Kavita Bendwal*, Suresh Bendwal, R. G. Dhawale**

Department of Medicine, R. D. Gardy Medical College, Ujjain, Madhya Pradesh, India

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***Correspondence:**
Dr. Kavita Bendwal,
E-mail: dr.sureshbendwal@gmail.com



## ABSTRACT

**Background:** Type 2 diabetes mellitus (T2DM) is associated with the development of premature atherosclerosis and high cardiovascular morbidity and mortality. Diabetic dyslipidemia is believed to play an important role in the pathogenesis of accelerated atherosclerosis in this condition. The aim of present study was to find out the role of fasting and postprandial triglyceride level and its relation with carotid intima media thickness in patients of T2DM.
**Methods:** 120 patients of T2DM were included in this study. All patients didn't have any peripheral vascular disease, IHD or stroke and all were between 30 to 70 years of age. Ultrasonographic evaluation done in all patients to measure CIMT and its correlation seen with fasting and postprandial triglyceride level and other parameters.
**Results:** All patients are divided into 3 groups according to their triglyceride level NN, NH and HH. The mean CIMT in the NN, NH and HH group was 0.96±0.26, 1.64±0.39 and 1.94±0.57 mm respectively. The CIMT was higher in the NH and HH groups in comparison with that in NN group which is statistically significant ($p<0.001$).
**Conclusions:** Fasting and postprandial triglyceride level both correlate significantly with carotid intima media thickness. But the correlation of postprandial triglyceride level with CIMT is better than that of fasting triglyceride level.

**Keywords:** Type 2 diabetes mellitus, Carotid intima media thickness, Fasting triglyceride, Postprandial triglyceride

## INTRODUCTION

Diabetes mellitus is the commonest metabolic disorder affecting the people all over the world. T2DM is the most common endocrine disorder of humans characterized by metabolic abnormalities leading to long term complications involving many organ systems. Type 2 diabetes mellitus (T2DM) is one of the most common secondary causes of dyslipidemia.[1] Insulin resistance and obesity both combine to cause dyslipidemia and hyperglycemia.[2]

T2DM is associated with development of premature atherosclerosis that leads to high cardiovascular morbidity and mortality.[3-5] Diabetic dyslipidemia have an important role in pathogenesis of accelerated atherosclerosis.[6,7] Lipid abnormality in T2DM are characterized by high triglyceride concentration particularly post prandially (post prandial lipidemia), low high density lipoprotein cholesterol (HDL) and normal or high concentration of low density lipoprotein cholesterol (LDL).[8] Also patients with T2DM have higher carotid intimal thickness value than non diabetic subjects.[9] B-mode ultrasound enables non-invasive, direct visualization of the arterial wall. The intima media thickness of carotid artery (CIMT) quantified using this technique is a reliable marker of atherosclerotic burden. Furthermore, it demonstrates greater sensitivity in detecting early atherosclerosis as compared to angiography.[10]

There is paucity of data from India on the role of fasting and post prandial hypertriglyceridemia and its association with carotid intima media thickness in type 2 diabetic patients. So present study was conducted to find out this correlation.

## METHODS

The present study was conducted on 120 patients of T2DM in the period of August 2016 to September 2017.

### *Inclusion criteria*

T2DM having diabetes for more than 5 years. Patients with age between 30 to 70 years of the age were included in this study. All patients were diagnosed as diabetic as per recommendation of WHO and national diabetes group (American Diabetes Association 2011).

### *Exclusion criteria*

Patients of type 1 diabetes mellitus, gestational diabetes, patients with previous history of hypertension, stroke, IHD and peripheral vascular disease, patients having diabetes for less than 5 years, patients less than 30 and more than 70 years of age were excluded from this study.

All patients were on conservative treatment. A pre-informed consent was obtained. All patients were subjected to detailed history, anthropometric measurement (BMI), clinical examination and bio-chemical investigations including lipid profile, blood sugar, urine examination and HbA1c level. All patients of T2DM were divided into 3 groups according to their serum triglyceride level. Ultrasonographic examinations of all patients were performed by radiologist. CIMT is measured using a 7.5 MHz linear transducer probe. Results obtained in all patients with T2DM, CIMT is measured and correlation of triglyceride level with CIMT was studied. Statistical analysis was done. $P<0.05$ was taken as significant.

## RESULTS

120 patients of type 2 diabetes were studied. All patients were between 30 to 70 years of age group. Out of 120 patients, 73 were males and 47 were females. Physical characteristics of all studied diabetic patients were shown in Table 1. 71% patients (85 out of 120) were in age group 41 to 70 years indicating long asymptomatic period of type 2 diabetes and its late diagnosis. Mean age of the patients was 54±10 years.

All patients were divided into 3 groups according to their fasting and post prandial triglyceride level as shown in Table 2. The first group was normo-normo (NN) group of 32 patients having normal fasting and normal post prandial triglyceride level, second group was normo-hyper (NH) group of 36 patients having fasting but high post prandial triglyceride levels and third group was hyper- hyper (HH) group of 32 patients with high fasting and high post prandial triglyceride level. Out of 120 patients, 39 (32.5%) were in the NN group, 42 (35%) in NH group and 39 (32.5%) in the HH group.

Carotid intima media thickness (CIMT) is measured in all 3 groups as shown in Table 3. In the NN group, the mean CIMT was 0.96±0.26 mm with a range of 0.6–1.6 mm. In the NH group, the mean CIMT was 1.64±0.39 mm with a range of 0.9–2.4 mm. In the HH group, the mean CIMT was 1.94±0.57 mm with a range of 1.2–2.8 mm. So CIMT value is increasing as triglyceride value increased.

**Table 1: Physical and biochemical characteristics of diabetic patients.**

| S. No. | Characteristics | Cases (n=120) |
|---|---|---|
| 1. | **Age (yrs)** | |
| | Range | 30-70 |
| | Mean±SD | 54.64±9.53 |
| 2. | **Weight (kg)** | |
| | Range | 35-81 |
| | Mean±SD | 57.82±10.64 |
| 3. | **Male: female ratio** | 73:47 |
| 4. | **Blood pressure (mm of Hg) (Mean±SD)** | |
| | SBP | 144.8±29.49 |
| | DBP | 86±16.90 |
| 5. | **Lipid profile (Mean±SD)** | |
| | Total cholesterol (mg/dl) | 297.21±128.76 |
| | Triglyceride (mg/dl) | 415.02±280.32 |
| | LDL | 148.62±72.78 |
| | HDL | 41.95±13.74 |
| 6. | **HbA1c (%) (Mean±SD)** | 7.9±2.30 |
| 7. | **BMI (kg/ $m^2$) (Mean±SD)** | 28.75±10.25 |

SBP= Systolic blood pressure; DBP= Diastolic blood pressure; BMI= Body mass index.

**Table 2: Distribution of patients based on FTG and PPTG level.**

| | Classification | Number | % |
|---|---|---|---|
| **Group A** | Normo- normo group (NN) (FTG ≤150 mg/dl; PPTG ≤150 mg/dl) | 39 | 32.5 |
| **Group B** | Normo- hyper group (NH) (FTG ≤150 mg/dl; PPTG ≥150 mg/dl) | 42 | 35 |
| **Group C** | Hyper- hyper group (HH) (FTG ≥150 mg/dl; PPTG ≥150 mg/dl) | 39 | 32.5 |
| **Total** | | (N=120) | 100 |

**Table 3: Assessment of mean CIMT in various groups.**

| | Classification | CIMT (mm) | |
|---|---|---|---|
| | | Range | Mean±SD |
| **Group A** | Normo- normo group (NN) (FTG ≤150 mg/dl; PPTG ≤150 mg/dl) | 0.6-16 | 0.96±0.26 |
| **Group B** | Normo- hyper group (NH) (FTG ≤150 mg/dl; PPTG ≥150 mg/dl) | 0.9-2.4 | 1.64±0.39 |
| **Group C** | Hyper- hyper group (HH) (FTG ≥150 mg/dl; PPTG ≥150 mg/dl) | 1.2-2.8 | 1.94±0.57 |

**Table 4: Assessment of mean CIMT according to FBS and PPBS level.**

| | Value | CIMT (mm) | |
|---|---|---|---|
| | | Range | Mean±SD |
| **FBS (mg/dl)** | <150 | 0.6–2.5 | 1.48±0.61 |
| | 150–200 | 1.0–2.8 | 1.73±0.64 |
| | >200 | 0.8–2.6 | 1.46±0.51 |
| **PPBS (mg/dl)** | <150 | 0.7–1.8 | 0.90±0.51 |
| | 150–200 | 0.9–2.5 | 1.47±0.53 |
| | >200 | 0.6–2.8 | 1.80±0.59 |

**Table 5: Comparative analysis of CIMT with various variables under study.**

| Variable | 'r' value | 'p' value | Significance |
|---|---|---|---|
| **Age** | 0.324 | p<0.05 | Significant |
| **Duration of diabetes** | 0.456 | p<0.001 | Highly significant |
| **FBS** | 0.041 | p>0.05 | Not significant |
| **PPBS** | 0.442 | p<0.05 | Significant |
| **TC fasting** | 0.08 | p>0.05 | Not significant |
| **TC post prandial** | 0.00 | p>0.05 | Not significant |
| **LDL fasting** | 0.00 | p>0.05 | Not significant |
| **LDL post prandial** | - 0.13 | p>0.05 | Not significant |
| **HDL fasting** | -0.247 | p>0.05 | Not significant |
| **HDL post prandial** | -0.241 | p>0.05 | Not significant |
| **VLDL fasting** | 0.436 | p<0.05 | Significant |
| **VLDL post prandial** | 0.357 | p<0.05 | Significant |
| **TG fasting** | 0.45 | p<0.001 | Highly significant |
| **TG post prandial** | 0.67 | p<0.001 | Highly significant |

All patients are divided into 3 groups according to their fasting and post prandial blood sugar value and relationship between sugar value and CIMT was shown in Table 4. In this study there was no significant correlation found between FBS and CIMT but there correlation between PPBS and CIMT is significant.

A comparative analysis of CIMT with various variables like age, duration of diabetes, VLDL, cholesterol, VLDL and LDL was done as shown in Table 5.

## DISCUSSION

Diabetes mellitus is the commonest metabolic disorder affecting many organ system of the body and comprises clusters of abnormalities such as dyslipidemia, hypertension, obesity and insulin resistance as a central pathognomic factor.

The present study is a cross sectional study, in which observations seen are compared with published literature on the same topics. Similar and contradictory findings had been elaborated and possible explanation given.

In this study the patients were distributed into 3 groups based on the fasting and post prandial triglyceride levels NN, NH and HH. The mean CIMT in the NN, NH, and HH group was 0.96±0.26, 1.64±0.39 and 1.94±0.57 mm respectively. The CIMT was higher in the NH, HH group as compared to NN group. In other words as the serum triglyceride value increased, CIMT also increased. These findings were statistically significant ($p<0.005$). This is consistent with the study of Teno et al who observed that CIMT was significantly higher in NH and HH groups than that of NN group ($p<0.001$) and CIMT of patients with fasting and post prandial hypertriglyceridemia was greater than that of patients with normal triglyceride levels.[11] Mori et al found that the CIMT value was significantly higher in diabetic patients with fasting and post prandial hypertriglyceridemia as compared to that of in those with normal triglyceride levels.[12] Ahmed et al found that CIMT was significantly increased in NH and HH group as compared to NN group.[13] Dharmalingam et al also found that fasting triglyceride level correlate significantly with carotid intima media thickness.[14] Rao et al also found significant correlation of hypertriglyceridemia and carotid intima media thickness in T2DM patients.[15] Idei et al found that mean postprandial triglyceride concentration is an independent risk factor for carotid intima media thickness.[16]

However in other study Christen et al supports use of fasting triglyceride concentration instead of postprandial triglyceride responses for cardiovascular risk stratification in clinical practice.[17] Batluk et al observed that fasting triglyceride but not post prandial triglycerides associated with common carotid artery intima media thickness.[18]

In the present study, it was observed that although both FTG and PPTG levels were significantly correlating with CIMT but the PPTG levels ($r=0.67$) were more significantly correlating with CIMT as compared to the FTG levels ($r=0.45$). Also it was observed that CIMT was higher in patients with high PPTG level despite normal FTG levels so it can be concluded that PPTG levels may be better predictor of CIMT than that of FTG levels in patients with T2DM. Shinichi et al observed that PPTG level was more strongly and independent correlate with CIMT than that FTG level.[11] It was concluded that postprandial hypertriglyceridemia despite normal FTG levels may be an independent risk factor for early atherosclerosis in T2DM. Ahmed et al observed that PPTG level had strongest statistical influence on CIMT value.[13] Xiang et al observed that the CIMT in patients with postprandial hypertriglyceridemia was significantly greater than that in patients with postprandial normal triglyceride level ($p<0.05$), which remained significant after adjustment for fasting triglyceride level.[19]

In this study the CIMT value is assessed according to FBS and PPBS levels. There was no statistical correlation found between FBS and CIMT ($p>0.05$). This was similar to that observed by Esposito et al, who reported that CIMT did not correlate with fasting blood sugar level ($p>0.005$).[20] It was observed that PPBS correlated significantly with the CIMT ($p<0.01$). This result was similar to that obtained by Esposito et al who reported statistically significant correlation of post prandial blood sugar with CIMT.[20]

In this study, it is clearly evident that ages, duration of diabetes, PPBS, fasting and post prandial VLDL as well as fasting and post prandial triglyceride have a significant impact on the CIMT. On the other hand FBS, fasting and post prandial cholesterol, LDL and HDL having no significant impact on CIMT.

## CONCLUSION

Fasting and postprandial triglyceride level both correlate significantly with carotid intima media thickness. But the correlation of postprandial triglyceride level with CIMT is better than that of fasting triglyceride level.

The postprandial triglyceridemia despite normal fasting triglyceride level can be considered as an important risk factor for atherosclerosis in T2DM. Evaluating not only the fasting triglyceride level but also the postprandial triglyceride level during the clinical assessment of patient with T2DM is very important.

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