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ASSOCIATION OF POSTPRANDIAL HYPERTRIGLYCERIDEMIA AND CAROTID ATHEROSCLEROSIS IN PATIENTS WITH TYPE 2 DMSuresh Harsoor¹, Akshaya Kinagi², Akshay S. Chincholi³**HOW TO CITE THIS ARTICLE:**

Suresh Harsoor, Akshaya Kinagi, Akshay S. Chincholi. "Association of Postprandial Hypertriglyceridemia and Carotid Atherosclerosis in Patients with Type 2 DM". Journal of Evolution of Medical and Dental Sciences 2014; Vol. 3, Issue 66, December 01; Page: 14386-14397, DOI: 10.14260/jemds/2014/3929

ABSTRACT: The dyslipidemia that accompanies type 2 diabetes plays an important role in the pathogenesis of accelerated atherosclerosis. Several studies have proved that in type 2 diabetes, elevated triglyceride levels may be a better predictor of Ischemic heart disease (IHD) than elevated LDL cholesterol levels. Although triglyceride levels are generally increased in the postprandial periods, the association between postprandial triglyceride levels and atherosclerosis has not been investigated in diabetic patients. The carotid intima media thickness (CIMT) is increased in patients with postprandial hypertriglyceridemia despite normal fasting triglyceride levels. So to investigate the role of postprandial hypertriglyceridemia in early atherosclerosis there is a need to correlate between postprandial triglyceride levels and carotid intima media thickness values. **METHODS:** This is a comparative study in which 50 patients of Diabetes mellitus type 2 >1 year duration of age 35-75 years were included. Carotid artery Doppler was done by B-mode ultrasound using a 7.5 MHZ transducer with annular array ultrasound imaging system. Blood samples were obtained after an overnight fast and blood samples were taken again 4 hrs after the meal. **OBSERVATIONS AND RESULTS:** The study population (Type 2 diabetics) is divided into 3 groups based on fasting and postprandial triglyceride levels. **NORMO-NORMAL (NN) GROUP:** This group consists of subjects with normal fasting triglyceride level (≤ 150 mgs/dl) and normal postprandial triglyceride levels (≤ 200 mgs/dl). **NORMO-HYPER (NH) GROUP:** This group consists of subjects with normal fasting triglyceride level (≤ 150 mgs/dl) and elevated postprandial triglyceride levels (> 200 mgs/dl). **HYPER - HYPER (HH) GROUP:** This group consists of subjects with elevated fasting triglyceride level (> 150 mgs/dl) and elevated postprandial triglyceride levels (> 200 mgs/dl). **CONCLUSION:** Postprandial hypertriglyceridemia, despite normal fasting triglyceride levels may be an independent risk factor for early atherosclerosis in type 2 diabetes. Hence, evaluating not only FTG level but also PPTG level during clinical assessment of patients with type 2 diabetes is important.

KEYWORDS: Dyslipidemia; Low-density Lipoprotein (LDL); Carotid Intima Media Thickness (CIMT); Fasting triglycerides (FTG); Postprandial hypertriglyceridemia (PPTG); Doppler Ultrasonography; Ischemic Heart Disease (IHD).

INTRODUCTION: Diabetes mellitus comprises a group of metabolic disorders that share the phenotype of hyperglycemia. India is frequently referred to as the diabetic capital of the world. Diabetes mellitus is widely prevalent in our country and its incidence is rising in alarming proportions. The worldwide prevalence of diabetes has risen dramatically over the past two decades, from an estimated 30 million cases in 1985 to 177 million in 2000. Based on current trends, >360 million individuals worldwide will have diabetes by the year 2030. Although the prevalence of both type 1 and type 2 diabetes is increasing worldwide, the prevalence of type 2 diabetes is rising much more rapidly because of increasing obesity and reduced activity levels as countries become more industrialized.¹

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Atherosclerosis accounts for approximately 80% of all mortality caused by diabetes and for most of the hospitalizations necessitated by complications of diabetes. Diabetic patients are frequently hyperlipidemic (approximately 70% of diabetic patients are dyslipidemic) and are at a higher risk for coronary heart disease. The major risk factors contributing to excess of cardiovascular disease caused by diabetes include hyperglycemia, insulin resistance, dyslipidemia, hypertension, smoking, albuminuria and pro-coagulant state.

Type 2 diabetes is associated with the development of premature atherosclerosis. Diabetic dyslipidemia is believed to play an important role in the pathogenesis of accelerated atherosclerosis. The most important components of this dyslipidemia are elevated very low-density lipoproteins (VLDL), total triglycerides (TG's) and a decreased high-density lipoproteins (HDL) concentration in the serum. Several studies have proved that in type 2 diabetes, elevated triglyceride levels maybe a better predictor of ischemic heart disease (IHD) than elevated low-density lipoprotein (LDL) cholesterol levels. Fasting hypertriglyceridemia has been consistently shown to be associated with a greater risk for coronary artery disease and atherosclerosis in those with type 2 diabetes.²

It is now increasingly being recognized that atherosclerosis is a postprandial phenomenon. Serum triglycerides are generally increased maximally 3-6hrs after a meal particularly in diabetics. Once postprandial hypertriglyceridemia occurs, it is exacerbated by the next meal and persists for the entire day. The vascular tree is exposed to this postprandial metabolic milieu most of the time.

Atherosclerosis, unless in a severe form, is often asymptomatic, so that a direct examination of the vessel wall is necessary to detect affected individuals in the early stages. Measurement of the intimal-medial thickness (IMT) of the common carotid artery (CCA) by B-mode ultrasound was found to be a suitable noninvasive method to visualize the arterial walls and to monitor the early stages of the atherosclerotic process. Carotid intima media thickness is considered as a surrogate marker of atherosclerosis. An increased carotid IMT was observed in type 2 diabetic patients. This increase in carotid intima media thickness is associated with an increased risk of Ischemic heart disease (IHD) and cerebrovascular disease (CVD) in diabetics.³

As type 2 diabetic patients have significant postprandial lipid abnormalities, which have strong and independent association with carotid IMT, the carotid intima media thickness (IMT) is increased in patients with postprandial hypertriglyceridemia despite normal fasting triglyceride levels.⁴

AIMS AND OBJECTIVES OF THE STUDY:

- Estimation of fasting and postprandial triglyceride levels in patients with type 2 diabetes mellitus.
- Estimation of carotid intima media thickness by Doppler ultrasonography.
- To correlate postprandial triglyceride levels and carotid intima media thickness.

MATERIALS AND METHODS:

- This study was done at Basaveshwar Teaching and General Hospital attached to M.R. Medical College, Gulbarga between November-2009 to April-2011.
- This is a comparative study which comprises of 50 patients of age between 35-75 years with type 2 diabetes mellitus of more than 1 year duration without evidence of ischemic heart disease, cerebrovascular disease and peripheral vascular disease.

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- The patients of type 2 diabetes mellitus >1 year duration were included in the study. Carotid artery Doppler was done by B-mode ultrasound using a 7.5 MHZ transducer with annular array ultrasound imaging system. Blood samples were obtained after an overnight fast and then the patients ate a standard meal that had a total energy of 9Kcal/Kg with 60-65% of this energy being supplied by carbohydrate, 15-20 % by protein and 20% by fat after taking insulin or oral hypoglycemic agent. Blood samples were taken again 4 hrs after the meal. Total cholesterol, fasting and postprandial triglycerides, HDL were measured by standard laboratory technique. LDL cholesterol was calculated with Friedewald's formula. $LDL\ Cholesterol = Total\ Cholesterol - (HDL + Triglycerides/5)$.

INCLUSION CRITERIA: Those patients of type 2 diabetes mellitus admitted to the Basaveshwar Teaching and General Hospital, Gulbarga.

EXCLUSION CRITERIA:

- Those patients who are below 35 years and patients more than 75 years.
- Those patients with evidence of IHD, Cerebrovascular disease and peripheral vascular disease.
- Those patients who are known diabetic for less than 1 year.

CLINICAL DATA RECORDING: All patients included in study were evaluated as per proforma given herewith. Each patient underwent detailed clinical history, physical examination and routine investigations.

STATISTICAL ANALYSIS: The level of significance was estimated by applying the χ^2 -test (Chi square test), p value <0.05 was taken as significant and <0.01 was taken as highly significant. Intergroup comparison was done by ANNOVA.

ETHICAL CLEARANCE: This study was approved by ethical committee of M.R. Medical college, gulbarga.

RESULTS: The study population (Type 2 diabetics) is divided into 3 groups based on fasting and postprandial triglyceride levels.

DIFFERENCE IN FASTING AND POSTPRANDIAL TRIGLYCERIDES AND CIMT AMONG NN, NH AND HH GROUP:

Variable	NN group	NH group	HH group	
Fasting triglycerides (mg/dl)	100.11±21.04	116.0±20.8	197.28±65.76	P<0.01
Postprandial triglycerides (mg/dl)	152.52±31.15	274.26±54.33	296.92±65.76	P<0.01
CIMT (mm)	0.93±0.32	1.48±0.54	1.79±0.45	P<0.01

- NORMO-NORMAL (NN) GROUP:** This group consists of subjects with normal fasting triglyceride level (≤ 150 mgs/dl) and normal postprandial triglyceride levels (≤ 200 mgs/dl).

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2. **NORMO-HYPER (NH) GROUP:** This group consists of subjects with normal fasting triglyceride level (≤ 150 mgs/dl) and elevated postprandial triglyceride levels (> 200 mgs/dl).
3. **HYPER - HYPER (HH) GROUP:** This group consists of subjects with elevated fasting triglyceride level (> 150 mgs/dl) and elevated postprandial triglyceride levels (> 200 mgs/dl). One patient with fasting hyper triglyceridaemia (> 150 mg/dl) with normal postprandial triglyceride level (< 200 mg/dl) who did not belong to any of these three groups was excluded from the study.

Age Group (in years)	Subjects (NN Group)		Subjects (NH Group)		Subjects (HH Group)	
	Number	%	Number	%	Number	%
35-40	1	5.88	0	-	0	-
41-45	2	11.76	4	21.05	2	14.29
46-50	4	23.52	2	10.54	2	14.29
51-55	3	17.66	2	10.54	4	28.58
56-60	3	17.66	4	21.05	0	-
61-65	2	11.76	3	15.78	3	21.42
66-70	1	5.88	3	15.78	0	-
71-75	1	5.88	1	5.26	3	21.42
TOTAL	17	100	19	100	14	100

Table 1: Distribution of Subjects by Age Group

Range	36-74
Mean	55.12
Std. dev	9.77

Range	44-71
Mean	57.63
Std. dev	± 9.13

Range	41-75
Mean	58.43
Std. dev	± 10.98

$$F = 1.03$$

$$P > 0.05$$

The age of the patients varied from a minimum of 35 years to a maximum of 75 years. The mean age of the patients in the NN, NH and HH group were 55.12 ± 9.77 , 57.63 ± 9.13 and 58.43 ± 10.98 respectively

Sex	Subjects (NN Group)		Subjects (NH Group)		Subjects (HH Group)	
	number	%	number	%	number	%
Male	8	47.06	13	68.42	8	57.15
Female	9	52.94	6	31.58	6	42.85
Total	17	100	19	100	14	100

Table 2: Sex wise distribution of subjects among three groups

$$X^2 = 1.82$$

$$p > 0.05$$

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Among the total of 50 patients 29 were males (58%) and 21 were females (42%).

In the NN group 8 were males (47.06%) and 9 were females (52.94%).

In the NH group 13 were males (68.42%) and 6 were females (31.58%).

In the HH group 8 were males (57.15%) and 6 were females (42.85%).

Risk factor	Subjects (NN Group)		Subjects (NH Group)		Subjects (HH Group)	
	Number	%	Number	%	Number	%
Smoking	3	17.64	6	35.57	5	35.71
Hypertension	4	23.52	8	42.11	10	71.42

Table 3: Distribution of subjects according to risk factors

$$\chi^2=0.65$$

$$p>0.05$$

In the NN group 3 were smokers (17.64%) and 4 were hypertensives (23.52%).

In the NH group 6 were smokers (35.57%) and 8 were hypertensives (42.11%).

In the HH group 5 were smokers (35.71%) and 10 were hypertensives (71.42%).

BMI	Subjects (NN Group)		Subjects (NH Group)		Subjects (HH Group)	
	Number	%	Number	%	Number	%
15-20	6	35.29	4	21.05	7	50
21-25	8	47.05	8	42.10	5	35.71
26-30	3	17.64	5	26.31	1	7.14
31-35	0	-	2	10.52	0	-
≥35	0	-	0	-	1	7.14
Total	17		19		14	

Table 4: Distribution of subjects by BMI in different groups

Range	20.27-29.2
Mean	22.86
Std. dev	2.77

Range	18.2-31.88
Mean	24.68
Std. dev	4.08

Range	17.9-35.5
Mean	22.30
Std. dev	4.38

$$F = 1.48$$

$$P > 0.05$$

Serum total cholesterol (in mg/dl)	Subjects (NN Group)		Subjects (NH Group)		Subjects (HH Group)	
	Number	%	Number	%	Number	%
≤200	16	94.12	15	78.95	11	78.58
>200	1	5.88	4	21.05	3	21.42
Total	17	100	19	100	14	100

Table 5: Distribution of subjects by serum total cholesterol in different groups

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Range	94-221
Mean	148.47
Std. dev	32.60

$$F = 2.81$$

Range	110-240
Mean	174.0
Std. dev	37.63

$$P < 0.05$$

Range	124-266
Mean	181.07
Std. dev	33.79

The mean serum total cholesterol in the NN group was 148.47 ± 32.60 with a range of 94-221. The mean serum total cholesterol in the NH group was 174.0 ± 37.63 with a range of 110-240. The mean serum total cholesterol in the HH group was 181.07 ± 33.79 with a range of 124-266.

Serum HDL (in mg/dl)	Subjects (NN Group)		Subjects (NH Group)		Subjects (HH Group)	
	Number	%	Number	%	Number	%
≤ 40	14	82.35	16	84.22	11	78.58
> 40	3	17.65	3	15.78	3	21.42
Total	17	100	19	100	14	100

Table 6: Distribution of subjects by serum HDL in different groups

Range	28-46
Mean	36.23
Std. dev	5.02

$$F = 0.59$$

Range	26-48
Mean	35.26
Std. dev	5.55

$$P > 0.05$$

Range	28-44
Mean	36.28
Std. dev	4.39

The mean serum HDL cholesterol in the NN group was 36.23 ± 5.02 with a range of 28-46. The mean serum HDL cholesterol in the NH group was 35.26 ± 5.55 with a range of 26-48. The mean serum HDL cholesterol in the HH group was 36.28 ± 4.39 with a range of 28-44.

Serum LDL (in mg/dl)	Subjects (NN Group)		Subjects (NH Group)		Subjects (HH Group)	
	Number	%	Number	%	Number	%
< 100	9	52.94	8	42.11	5	35.72
100-130	7	41.18	2	10.53	7	50.00
> 130	1	5.88	9	47.36	2	14.28
Total	17	100	19	100	14	100

Table 7: Distribution of subjects by serum LDL in different groups

Range	35-165
Mean	92.23
Std. dev	32.28

$$F = 2.16$$

Range	43-182
Mean	115.47
Std. dev	39.94

$$P < 0.05$$

Range	60-169
Mean	105.28
Std. dev	29.86

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The mean serum LDL cholesterol in the NN group was 92.23 ± 32.28 with a range of 35-165.
The mean serum LDL cholesterol in the NH group was 115.47 ± 39.94 with a range of 43-182.
The mean serum LDL cholesterol in the HH group was 105.28 ± 29.86 with a range of 60-169.

Serum fasting triglycerides (in mg/dl)	Subjects (NN Group)		Subjects (NH Group)		Subjects (HH Group)	
	Number	%	Number	%	Number	%
<150	17	100	19	100	-	-
150-249	-	-	-	-	11	78.57
≥ 250	-	-	-	-	3	21.42
Total	17		19		14	

Table 8: Distribution of subjects by serum fasting triglycerides in different groups

Range	64-147
Mean	100.11
Std. dev	21.04

F= 5.37

Range	84-145
Mean	116.0
Std. dev	20.8

P <0.01

Range	154-304
Mean	197.28
Std. dev	65.76

The mean serum fasting triglyceride in the NN group was 100.11 ± 21.04 with a range of 64-147.
The mean serum fasting triglyceride in the NH group was 116.0 ± 20.8 with a range of 84-145.
The mean serum fasting triglyceride in the HH group was 197.28 ± 65.76 with a range of 154-304.

Serum postprandial triglycerides (in mg/dl)	Subjects (NN Group)		Subjects (NH Group)		Subjects (HH Group)	
	Number	%	Number	%	Number	%
<200	17	100	-	-	-	-
200-299	-	-	14	73.68	9	64.28
300-399	-	-	4	21.05	4	28.57
≥ 400	-	-	1	5.26	1	7.14
Total	17		19		14	

Table 9: Distribution of subjects by serum postprandial triglycerides in different groups

Range	98-198
Mean	152.52
Std. dev	31.15

F = 7.52

Range	207-413
Mean	274.26
Std. dev	54.33

p < 0.01

Range	204-460
Mean	296.92
Std. dev	65.76

The mean serum postprandial triglyceride in the NN group was 152.52 ± 31.15 with a range of 98-198.

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The mean serum postprandial triglyceride in the NH group was 274.26 ± 54.33 with a range of 207-413.

The mean serum postprandial triglyceride in the HH group was 296.92 ± 65.76 with a range of 204-460.

CIMT (in mm)	Subjects (NN Group)		Subjects (NH Group)		Subjects (HH Group)	
	Number	%	Number	%	Number	%
0.5-1.09	13	76.47	5	26.31	1	7.14
1.1-1.59	3	17.64	6	31.57	3	21.42
1.6-2.09	1	5.88	4	21.05	7	50
2.1-2.59	-	-	3	15.78	2	14.28
2.6-3.09	-	-	1	5.2	1	7.14
Total	17		19		14	

Table 10: Distribution of subjects by CIMT in different groups

Range	0.56-1.7
Mean	0.93
Std. dev	0.32

F = 5.86

Range	0.74-2.64
Mean	1.48
Std. dev	0.54

p < 0.01

Range	0.83-2.64
Mean	1.79
Std. dev	0.45

In the NN group the mean carotid IMT was 0.93 ± 0.32 with a range of 0.56-1.7.

In the NH group the mean carotid IMT was 1.48 ± 0.54 with a range of 0.74-2.64.

In the HH group the mean carotid IMT was 1.79 ± 0.45 with a range of 0.83-2.64.

Postprandial triglycerides (mg/dl)	Subjects	
	Number	CIMT (mean) in mm
<200	17	0.92 ± 0.33
200-299	23	1.61 ± 0.48
300-399	8	1.62 ± 0.46
≥ 400	2	1.46 ± 0.23
Total	50	

Table 11: Distribution of postprandial triglycerides with CIMT

F = 3.58

p < 0.01

The mean carotid IMT of subjects with postprandial triglyceride < 200 was 0.92 ± 0.33 .

The mean carotid IMT of subjects with postprandial triglyceride 200-299 was 1.61 ± 0.48 .

The mean carotid IMT of subjects with postprandial triglyceride 300-399 was 1.62 ± 0.46 .

The mean carotid IMT of subjects with postprandial triglyceride ≥ 400 was 1.46 ± 0.23 .

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Graph 1: Bar graph distribution of postprandial triglycerides with CIMT

Graph 2: Bar graph distribution of Postprandial Triglyceride Levels with CIMT in Patients with Normal Fasting Triglyceride Level

Postprandial triglycerides (mg/dl)	Subjects	
	Number	CIMT (mean) in mm
<200	17	0.92±0.33
200-299	14	1.52±0.57
≥300	5	1.66±0.45

Table 12: Distribution of Postprandial Triglyceride Levels with CIMT in Patients With Normal Fasting Triglyceride Level

F = 2.83

p > 0.05

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The mean carotid IMT of subjects with postprandial triglyceride < 200 with normal fasting triglyceride was 0.92 ± 0.33 .

The mean carotid IMT of subjects with postprandial triglyceride 200-299 with normal fasting triglyceride was 1.52 ± 0.57 .

The mean carotid IMT of subjects with postprandial triglyceride ≥ 300 with normal fasting triglyceride was 1.66 ± 0.45 .

DISCUSSION: 50 patients with type 2 diabetes mellitus in the age group of 35-75 years attending Basaveshwar teaching and general hospital, Gulbarga were taken. Carotid intima media thickness was measured using carotid artery Doppler. Fasting triglyceride and postprandial triglyceride levels were estimated. Patients were divided into three groups. The first group is normo-normo (NN) group i.e., patients having normal fasting and postprandial triglyceride levels. Second group is normo-hyper (NH) group i.e., patients having normal fasting but high postprandial triglyceride levels. Third group is hyper-hyper (HH) group i.e., patients with high fasting and postprandial triglyceride levels.

Although several studies have shown fasting triglyceride levels to be associated with Coronary artery disease in both diabetic and non-diabetic subjects, relatively little attention has been given to postprandial triglycerides in this regard, especially in diabetic subjects. In the present study, it was observed that carotid intima media thickness (CIMT) was increased in patients with postprandial hypertriglyceridemia despite normal fasting triglyceride levels, and the postprandial triglyceride levels showed the strongest influence on CIMT.

In the present study the mean age group of the subjects in the NN, NH and HH group were 55.12 ± 9.77 , 57.63 ± 9.13 and 58.43 ± 10.98 years respectively with a range of 36-74, 44-71 and 41-75 years respectively (Ref. Table No. 1). In a study done by Shinichi Teno et al: In their study on evaluation of postprandial hypertriglyceridemia with carotid intima-media thickness in type 2 diabetes mellitus have shown that the mean age group in the NN, NH and HH group were 52.5 ± 6.2 , 54.7 ± 9.1 and 54.9 ± 7.7 years respectively.

In the present study out of 50 patients, 22 were on OHA (44.0%), 8 were on Insulin (16.0%) and 20 were on both OHA and Insulin (40.0%). (Ref. Table No. 4). In a study done by Shinichi Teno, 35 patients were on OHA and 8 patients were on insulin.

Among the 50 patients, 14 were smokers (28.0%) and 22 were hypertensives (44.0%). The mean BMI in the NN, NH and HH group were 22.86 ± 2.77 , 24.68 ± 4.08 and 22.30 ± 4.38 respectively. (Ref. Table No. 6). In a study done by Shinichi Teno, the mean BMI in the NN, NH and HH group were 23.5 ± 3.1 , 25.9 ± 4.1 and 25 ± 2.5 respectively.

The mean serum total cholesterol in the NN, NH and HH group were 148.47 ± 32.60 , 174.0 ± 37.63 , 181.07 ± 33.79 (mg/dl) respectively. (Ref. Table No. 7). Shinichi Teno et al in their study the mean serum total cholesterol in the NN, NH and HH group were 194.9 ± 28.0 , 220.7 ± 23.4 and 228.4 ± 44.2 (mg/dl) respectively.

The mean serum HDL in the NN, NH and HH group were 36.23 ± 5.02 , 35.26 ± 5.55 and 36.28 ± 4.39 respectively. (Ref. Table No.8). The mean serum LDL in the NN, NH and HH group were 92.23 ± 32.28 , 115.47 ± 39.94 , and 105.28 ± 29.86 respectively. (Ref. Table No. 9). The mean serum fasting triglyceride in the NN, NH and HH group were 100.11 ± 21.04 , 116.0 ± 20.8 and 197.28 ± 65.76 respectively. (Ref. Table No.10). The mean serum postprandial triglycerides in the NN, NH and HH group were 152.52 ± 31.15 , 274.26 ± 54.33 and 296.92 ± 65.76 respectively. (Ref. Table No. 11)

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In a study done by shinichi teno, the mean serum total cholesterol in the NN, NH and HH group were 194.9 ± 28.0 , 220.7 ± 23.4 and 228.4 ± 44.2 respectively. The mean serum HDL in the NN, NH and HH group were 53 ± 13.5 , 59.6 ± 11.9 and 49.9 ± 13.1 respectively. The mean serum LDL in the NN, NH and HH group were 119.9 ± 25.1 , 137.7 ± 23.9 and 121.4 ± 36.7 respectively. The mean serum fasting triglycerides in the NN, NH and HH group were 111.1 ± 39.9 , 125.3 ± 21.3 and 270.2 ± 110.2 respectively. The mean serum postprandial triglycerides in the NN, NH and HH group were 145.5 ± 44.4 , 263.1 ± 42.6 and 391.9 ± 23.7 respectively.

In the present study, the mean CIMT in the NN, NH and HH group were 0.93 ± 0.32 , 1.48 ± 0.54 and 1.79 ± 0.45 mm respectively with a range of 0.56 - 1.7, 0.74 - 2.64 and 0.83 - 2.64 respectively.

In this study CIMT had a significant correlation with duration of diabetes, FTG and PPTG levels. There was no correlation of CIMT with other parameters like BMI or complications of diabetes.

In this study there was a significant correlation between CIMT and FTG levels ($p < 0.05$). There was a significant correlation between CIMT and PPTG ($p < 0.01$).

The F value is 3.58, which was higher than association of FTG levels and CIMT ($F = 2.78$) which shows that PPTG level is a better predictor of CIMT than FTG. Both FTG and PPTG levels are significantly correlating with CIMT, but, PPTG is more significantly correlating with CIMT compared to FTG.

In this study, it was seen that high PPTG level was significantly associated with CIMT in patients with normal FTG level ($p < 0.05$). Also, in spite of normal FTG levels, PPTG levels were significantly associated with CIMT. PPTG levels were more strongly and independently correlated with CIMT than FTG levels. These results were similar to other studies. Therefore, PPTG levels may be a better predictor of carotid intima media thickness than FTG in patients with type 2 diabetes.

In a study done by shinichi teno, the mean CIMT in the NN, NH and HH group were 0.73 ± 0.13 , 0.86 ± 0.13 and 0.85 ± 0.12 mm respectively. In their study, although a positive correlation existed between FTG levels and CIMT in the patients with fasting hypertriglyceridemia, no correlation existed in patients who had normal FTG levels. Furthermore, PPTG levels were more strongly and independently correlated with CIMT than FTG levels.⁵ These observations are similar to our study.

In a study done by chen xiang, the CIMT in patients with postprandial hypertriglyceridemia was significantly greater than that in patients with normal PPTG levels (0.90 mm vs 0.81 mm, $p < 0.05$), which remained significant after adjustment for FTG and HDL levels.⁶ This result was again similar to our study.

In a study done by jamal ahmad, the mean CIMT in the NN, NH and HH group were 0.59 ± 0.09 , 0.79 ± 0.09 ($p < 0.001$ versus NN group) and 0.82 ± 0.06 mm ($p < 0.001$ versus NN group) respectively. So in their study, it was observed that CIMT was increased in patients with postprandial hypertriglyceridemia despite normal FTG levels, and the PPTG levels showed the strongest influence on CIMT. These results were similar to our study.

In a study done by susanna boquist, it was observed that in the postprandial state, the plasma triglycerides, total triglyceride area under curve, incremental triglyceride area under curve were significantly associated with CIMT ($p < 0.05$).⁷

In a study done by Mohan V. on intimal-medial thickness of carotid artery in the south Indian diabetic and non-diabetic, it was shown that the mean intimal-medial thickness of the diabetic

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subjects 0.95 ± 0.31 mm were significantly higher than those of non-diabetic subject 0.74 ± 0.14 mm with $P < 0.001$.⁸

CONCLUSION: In conclusion, our chief observation in the present study was that elevated fasting triglyceride level was significantly correlated with carotid intima media thickness, but higher correlation was found in this study between elevated postprandial triglyceride level and carotid intima media thickness. So, postprandial hypertriglyceridemia, despite normal fasting triglyceride levels, may be an independent risk factor for early atherosclerosis in type 2 diabetes. Hence, evaluating not only FTG level but also PPTG level during clinical assessment of patients with type 2 diabetes is important.

BIBLIOGRAPHY:

1. Fauci: "Harrisons Principles of Internal Medicine" Mc Graw Hill Health Professional Division Publication, New York, 18th ed. p2968.
2. Braunwald, Douglas P: "Heart Disease - A Text Book of Cardiovascular Medicine", W. B. Saunders Company, Philadelphia, 9th Edition: 995-1008.
3. Kawamori R, Yamasaki Y, Matsushima H, Nishizawa H, Nao K, et al: Prevalence of carotid atherosclerosis in diabetic patients. Diabetes Care 1992; 15: 1290-1294.
4. Dodson PM et al: "Lipids, diabetes and Vascular disease" Science Press Limited, Middlesex house, London. Pages 15-19.
5. Shinichi Teno, Yuko Uto, Hirotaka Nagashima, et al: Association of postprandial hypertriglyceridemia and carotid Intima-Media thickness in patients with Type 2 Diabetes. Diabetes care 2000; 23: 1401-1406.
6. CHEN Xiang: Association between fasting and postprandial triglyceride levels and carotid intima-media thickness in type 2 diabetes patients CMJ 2003; 116 (12):1933-1935.
7. Boquist S, Ruotolo G, Tang R, Bjorkegren J. et al: Alimentary Lipemia, Postprandial Triglyceride-Rich Lipoproteins, and Common Carotid Intima-Media Thickness in Healthy, Middle-Aged Men Circulation 1999; 100; 723-728.
8. Mohan V, Ravikumar R, Rani S S, Deepa R: Intimal medial thickness of the carotid artery in South Indian diabetic and non-diabetic subjects: the Chennai Urban Population Study. Diabetologia (2000) 43:494-499.

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Date of Submission: 07/11/2014.
Date of Peer Review: 08/11/2014.
Date of Acceptance: 27/11/2014.
Date of Publishing: 01/12/2014.