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A Study of Correlation between Fasting Triglycerides and Carotid Intima Media Thickness in Type 2 Diabetes Mellitus

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Abstract
Background *_ Globally, the number of people with diabetes is expected to rise from the current estimate of 285 million in 2010 to 438 million in 2030, both figures substantially higher than even recent estimates. T2DM has become one of the world's most important public health problems. a. The most common diabetic dyslipidemia is moderate hypertriglyceridemia and low HDL. An important mechanism for the development of diabetic atherosclerosis is dyslipidemia. Majority of diabetic patients suffer from intense atherosclerosis. Out of all the sonographic parameters, carotid intima-media thickness (CIMT) has been established as the most effective prognosticator*
Methodology *- The study will be performed on the out patients and also inpatients admitted in Basaveshwara Teaching and General Hospital attached to Mahadevappa Rampure Medical College Kalaburagi*
RESULTS*-In our study among 100 type 2 diabetes mellitus we found that majority patient belong to age group mean age of 57.64 ±12.99.In our study we found that Mean FBS - 152.76,PPBS -223.41 FTG 191.10,Total cholesterol 175.44 Mean HDL 33.20. The carotid intima media thickness 1.58 ± 0.51 was found in diabetes with duration of more than 5 years has significant correlation with fasting blood glucose levels and post prandial blood glucose levels and dyslipidaemia.*
CONCLUSION*-As prevalence of atherosclerosis is increasing in diabetic patients early screening of diabetic patient for dyslipidemia and early intervention will prevent future cardiovascular complication.Diabetic dyslipidemia is characterized by high triglycerides ,and low HDL.CIMT will serve as non invasive tool for detection of atherosclerosis and can be used screening tool for detection of atherosclerosis in diabetic*

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I. Introduction

Type 2 diabetes mellitus (T2DM) is the predominant form of diabetes worldwide, accounting for 90% of cases globally.1,2,

Diabetes mellitus is characterized by chronic hyperglycaemia with disturbances in carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both.3 The global figure of people suffering from diabetes mellitus is estimated to rise from current estimate of 415 million to 642 million by 2040. The number of people with type 2 diabetes mellitus is increasing in every country and 75% of people with diabetes mellitus are living in developing countries. With an increasing incidence worldwide, diabetes mellitus will be a likely leading cause of morbidity and mortality in the future.

It is well established that dyslipidemia is a major risk factor for macrovascular complications in patients with type-2 diabetes mellitus (T2DM) and affects 10%-73% of this population

. The dyslipidemia associated with type 2 diabetes and insulin resistance typically consists of elevated triglycerides and decreased HDL cholesterol level (4). In such individuals, LDL cholesterol levels are generally not significantly abnormal, although they may be somewhat elevated in whites (5) and lower in other racial/ethnic groups. The frequently mild abnormality in LDL cholesterol concentration associated with diabetes belies a qualitative abnormality in the LDL structure, i.e., decreased size and increased density of the LDL particle (6)

Dyslipidemia in diabetes commonly manifests as raised low density lipoprotein cholesterol (LDL-C), decreased high-density lipoprotein cholesterol (HDL-C) levels, or elevated triglyceride (TG) levels. Furthermore, data from the United Kingdom Prospective Diabetes Study suggest that both decreased HDL-C and elevated LDL-C predict CVD in diabetes. All national and international guidelines recommend aggressive management of lipids in this population.

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.

High resolution B-mode ultrasound is a non-invasive technique widely used to assess atherosclerosis in superficial arteries. It allows the accurate measurement of the distance between blood–intima and media–adventitia interfaces of the carotid wall, which is defined as carotid intima-media thickness (CIMT)

Several authors have suggested that CIMT is a marker of atherosclerosis in other vascular beds Indeed, an increased CIMT has been associated with a number of atherosclerosis risk factors with the prevalence and extent of coronary artery disease (CAD)11 and with the incidence of new coronary and cerebral events12 In view of these relationships, carotid IMT has been proposed as a surrogate endpoint to be used in clinical trials as an alternative to coronary atherosclerosis

II. Materials And Methods

Comparative study of 100 type 2 diabetes mellitus patients of age group 30-65 years with average duration of diabetes 1-10 yrs are included.

The source of data will be collected from inpatient and outpatients of Basaweshwara Teaching and General Hospital, Kalaburagi during the study period.

Inclusion Criteria

- 1.Patients with Type 2 diabetes mellitus
- 2.age more than 18years of either sexes.

Exclusion Criteria

- 1.patients receiving lipid lowering agents.
- 2.patient who have had Cerebrovascular disease
- 3.patients with existing Ischemic heart disease as determined by history and ECG.
- 4.age less than 18 years

III. Methodology

• Method of collection of data : The study will be performed on the out patients and also inpatients admitted in Basaveshwara Teaching and General Hospital attached to Mahadevappa Rampure Medical College Kalaburagi. A detailed history will be obtained from qualifying patients using a pre-designed, structured proforma.Further, a detailed systemic examination , followed by relevant investigations will be conducted and the results will be noted

IV. Results

Table No.1: Age and Gender Distribution

Age (Years)	Male N(%)	Female N(%)	P value
≤ 40	08(8)	03(3)	0.018*
41-55	31(31)	10(10)	
56-70	18(18)	11(11)	
>70	09(09)	10(10)	
Mean±SD (Range)	57.64±12.99 (28-88)		

Inference: Statistically significant association is observed between age and gender

Most diabetics were in age group between 41-55 years in our study there were 66 males and 34 females

Table No.2: Age and Insulin

	Yes N(%)	No N(%)	P value
≤ 40	08(08)	03(03)	0.001*
41-55	07(07)	34(34)	
56-70	03(03)	26(26)	
>70	04(04)	15(15)	
Total	22(22)	78(78)	

Inference: Statistically significant association is observed between age and insulin intake

Table No.3: Age and OHA

	Yes N(%)	No N(%)	P value
≤ 40	04(04)	07(07)	0.001*
41-55	38(38)	03(03)	
56-70	27(27)	02(02)	
>70	18(18)	01(01)	
Total	87(87)	13(13)	

Inference: Statistically significant association is observed between age and OHA

Table No.4: Comparison of the variables based on age groups (Kruskal-Wallis test)

		N	Mean	SD	P value
FBS	≤ 40	11	152.27	41.78	0.694
	41-55	41	152.76	41.08	
	56-70	29	144.34	25.99	
	>70	19	138.68	26.20	
PPBS	≤ 40	11	217.55	38.11	0.922
	41-55	41	223.41	54.65	
	56-70	29	215.62	30.46	
	>70	19	210.21	38.75	
FTG	≤ 40	11	193.91	47.93	0.444
	41-55	41	191.10	58.99	
	56-70	28	175.32	43.32	
	>70	19	173.63	51.04	
TC	≤ 40	11	165.55	27.70	0.665
	41-55	41	175.44	36.02	
	56-70	29	170.97	27.67	
	>70	19	167.05	33.56	
LDL	≤ 40	11	96.73	29.65	0.614
	41-55	41	104.34	26.94	
	56-70	29	107.66	25.12	
	>70	19	105.68	31.78	
HDL	≤ 40	11	34.27	4.38	0.545
	41-55	41	33.20	5.22	
	56-70	29	33.38	3.48	
	>70	19	34.37	3.04	
VLDL	≤ 40	11	34.45	10.36	0.458
	41-55	41	36.59	11.31	
	56-70	29	38.03	10.13	
	>70	19	33.84	9.25	
CIMT	≤ 40	11	1.52	.40	0.537
	41-55	41	1.32	.49	
	56-70	29	1.38	.37	
	>70	19	1.42	.56	

Inference: No Statistically significant difference is observed for the variables based on age group
In our study we found mean FBS - 152.76,PPBS -223.41 FTG 191.10,Total cholesterol 175.44 Mean HDL 33.20 was found in our study there was stastically significant. No significant difference was observed between age groups
The study demonstrates the typical dyslipidemia characterized by High triglycerides,low HDL.
Sultania et al 2017 also showed is characterized by low HDL.high Triglyceides

Table No.: 5: Age and lipid parameter

	Range	<40 N(%)	41-55 N(%)	56-70 N(%)	>70 N(%)
FBS	**100-125**	**3(3.0)**	**9(9.0)**	**7(7.0)**	**7(7.0)**
	≥126	**8(8.0)**	**32(32.0)**	**21(21.0)**	**13(130)**
PPBS	**140-199**	**4(4.0)**	**15(15.0)**	**11(11.0)**	**9(9.0)**
	>200	**7(7.0)**	**26(26.0)**	**17(17.0)**	**11(11.0)**
LDL	**<100**	**7(7.0)**	**17(17.0)**	**14(14.0)**	**11(11.0)**
	100-129	**3(3.0)**	**19(19.0)**	**9(9.0)**	**6(6.0)**
	130-159	**0**	**3(3.0)**	**3(3.0)**	**0**
	160-189	**1(1.0)**	**2(2.0)**	**2(2.0)**	**3(3.0)**
	≥190	**0**	**0**	**0**	**0**
TC	**<200**	**10(10.0)**	**32(32.0)**	**24(24.0)**	**18(18.0)**
	200-239	**1(1.0)**	**6(6.0)**	**4(4.0)**	**1(1.0)**
	≥240	**0**	**3(3.0)**	**0**	**1(1.0)**
FTG	**<150**	**3(3.0)**	**11(11.0)**	**10(10.0)**	**7(7.0)**
	150-199	**3(3.0)**	**13(13.0)**	**12(12.0)**	**9(9.0)**
	200-499	**5(5.0)**	**17(17.0)**	**6(6.0)**	**4(4.0)**
	≥500	**0**	**0**	**0**	**0**
HDL	**<40**	**10(10.0)**	**37(37.0)**	**27(27.0)**	**19(19.0)**
	>60	**1(1.0)**	**4(4.0)**	**1(1.0)**	**1(1.0)**
CIMT	**<0.75**	**0**	**6(6.0)**	**2(2.0)**	**1(1.0)**
	>0.75	**11(11.0)**	**35(35.0)**	**26(26.0)**	**19(19.0)**

	Range	Male N (%)	Female N (%)
FBS	100-125	3(3.0)	23(23.0)
	≥126	31(31.0)	43(43.0)
PPBS	140-199	12(12.0)	27(27.0)
	>200	22(22.0)	39(39.0)
LDL	<100	21(21.0)	28(28.0)
	100-129	8(8.0)	29(29.0)
	130-159	3(3.0)	3(3.0)
	160-189	2(2.0)	6(6.0)
	≥190	0	0
TC	<200	30(30.0)	54(54.0)
	200-239	3(3.0)	9(9.0)
	≥240	1(1.0)	3(3.0)
FTG	<150	10(10.0)	21(21.0)
	150-199	15(15.0)	22(22.0)
	200-499	9(9.0)	23(23.0)
	≥500	0	0
HDL	<40	30(30.0)	63(63.0)
	>60	4(4.0)	3(3.0)
CIMT	<0.75	2(2.0)	7(7.0)
	>0.75	32(32.0)	59(59.0)

Table No.5: Correlation between variables (Spearmans Correlation test)

		FBS	PPBS	FTG	TC	LDL	HDL	VLDL	CIMT
Duration	Correlation Coefficient	0.304	0.292	0.172	0.117	0.074	0.125	0.211	0.292
	P value	0.002*	0.003*	0.088	0.245	0.466	0.217	0.035*	0.003*
FBS	Correlation Coefficient	-	0.786	0.629	0.520	0.298	0.04	.524	0.510
	P value	-.	0.001*	0.001*	0.001*	0.003*	0.691	0.001*	0.001*
PPBS	Correlation Coefficient	-	-	0.722	.644	0.390	0.054	0.538	0.557
	P value	-.	-.	0.001*	0.001*	0.001*	0.594	0.001*	0.001*
FTG	Correlation Coefficient	-	.-	-	0.602	0.237	0.007	0.703	0.662
	P value	-.	-	-.	0.001*	0.018*	0.948	0.001*	0.001*
TC	Correlation Coefficient	-	-	-	-	0.766	0.202	0.527	0.504
	P value	-.	-.	-.	-.	0.001*	0.044	0.001*	0.001*
LDL	Correlation Coefficient	-	-	-	-	-	0.072	0.193	0.216
	P value	-.	-.	-.	-.	-.	0.475	0.054	0.031*
HDL	Correlation Coefficient	-	-	-	-	-	-	0.185	0.087
	P value	-.	-.	-.	-.	-.	-.	0.065	0.391
VLDL	Correlation Coefficient	-	-	-	-	-	-	-	0.465
	P value	-.	-.	-.	-.	-.	-.	-.	0.001*

Table No.6: Correlation between variables (Spearmans Correlation test)

FTG	Correlation Coefficient	P value
FBS	0.629	0.001*
PPBS	0.722	0.001*

Stastically significant correlation between was found between FBS,PPBS and FTG

Table No.7: Correlation between variables (Spearmans Correlation test)

CIMT	Correlation Coefficient	P value
Age	-0.027	0.788
FBS	0.510	0.001*
PPBS	0.557	0.001*
Duration	0.292	0.003*
FTG	0.662	0.001*

Stastically significant correlation was found between CIMT, FBS PPBS and FTG .

Table No.8: Comparison of the variables based on Insulin (Mann-Whitney U test)

Insulin		N	Mean	SD	P value
FBS	No	78	140.27	28.47	0.001*
	Yes	22	173.55	42.53	
PPBS	No	78	209.01	39.05	0.001*
	Yes	22	249.86	45.53	
FTG	No	77	174.73	51.28	0.001*
	Yes	22	214.64	43.62	
TC	No	78	166.73	30.22	0.005*
	Yes	22	188.23	34.13	
LDL	No	78	101.29	24.24	0.067
	Yes	22	116.86	34.69	
HDL	No	78	33.53	3.86	0.549
	Yes	22	33.82	5.62	
VLDL	No	78	35.37	10.55	0.103
	Yes	22	39.36	9.77	
CIMT	No	78	1.28	0.43	0.001*
	Yes	22	1.74	0.42	

Inference: Statistically significant difference is observed for the FBS, PPBS, FTG, TC, CIMT variable

Table 9: Comparison of FTG & CIMT based on risk factors

Variables		FTG	P value	CIMT	P Value
Alcohol Consumption	Present	207.84±51.68	0.029*	1.52±0.48	0.111
	Absent	177.84±50.95		1.35±0.45	
Smoking	Present	192.36±51.79	0.136	1.38±0.47	0.001*
	Absent	176.58±51.93		1.01±0.36	
BMI	<18.5	159.50±85.56	0.014*	1.57±1.08	0.104
	18.5-24.9	177.10±53.38		1.29±0.45	
	25.0-29.9	199.70±45.43		1.56±0.40	
	30.0-34.9	-		-	
	35.0-39.9	-		-	
	≥40	-		-	
Hba1c	<6.5	142.50±43.21	0.001*	1.48±0.44	0.001*
	>6.5	195.34±48.67		1.02±0.34	
Duration	<5 years	178.30±51.91	0.155	1.28±0.41	**0.002***
	5-10 years	193.94±51.16		1.58±0.51	

Inference: Statistically significant difference in FTG was observed for those who consume alcohol and for HbAIc level
Statistically significant difference is observed for CIMT level for BMI and HBA1c and smoking

GENDER	CIMT (<0.74) N(%)	CIMT (>0.74) N(%)	P value
Male	07(07)	59(59)	0.434
Female	02(02)	32(32)	
Total	09(09)	91(91)	

stastically significant difference was observed between males and females for CIMT .increased in CIMT was more among males in comparision to females

V. Discussion

Age distribution
In our study we found that majority patient belong to age group 41-55 years

Ajagnakar et al and Vaishnava et al who"s study implied that the incidence of Diabetes was greater among the male population compared to females

Sex distribution –in our study there were 66 males and 43 females

Type of therapy In our study we found that 87 patients were on OAD and 22 patients were on insulin and 8 patients received both insulin and OAD.The study did not reveal any co relation between type of therapy and its influence on the alteration in lipid profile

LIPID PROFILE-In our study we found that Mean FBS - 152.76,PPBS -223.41 FTG 191.10,Total cholesterol 175.44 Mean HDL 33.20 was found in our study there was statistically significant no significant difference was observed between age groups

Our study demonstrated typical dyslipidemia with high triglycerides and low HDL.
Patients with Hba1c >6.5% had mean FTG 195.34 statistically significant correlation.
Eglal et al found significant correlation of Hba1c with triglycerides

•According our study High Hba1c increased risk of hypertriglyceridemia 195.34 poor glycemic control increase the risk of hypertriglyceridemia .

Increased risk of a therogenicity due to dyslipidemia associated with poor diabetes control

CIMT-The carotid intima media thickness 1.58 ± 0.51 was found in diabetes with duration of more than 5 years has significant correlation with fasting blood glucose levels and post prandial blood glucose levels and dyslipidaemia

Kirubhakaran K et al was also found to have a strong significant statistical association with blood glucose parameters and lipid parameters with CIMT.
In Cardiovascular Health Study, Daniel H O'Leary et al (1992)7 studied 5201 patients and concluded that prevalence and severity of carotid atherosclerosis continued to increase with age even in late decades of life.
Sang Su Chang et al observed 535 Korean type 2 diabetic patients and found that mean CIMT was positively correlating with age.

Robin et al8 reported that CIMT was independently and positively related to age Bonoro et al11 have studied carotid intima media thickness (CIMT) in a total of 114 patients and concluded that diabetes is characterised by a greater thickness of carotid artery independent of other established risk factors of atherosclerosis.

AK Agarwal et al5 (2008) observed duration of diabetes as a predictor of CIMT, which was statistically proved in his study ($p < 0.002$). In the Chennai Urban Population Study (CUPS) done by V Mohan et al12 in 2000

proved that diabetic subjects have higher intima media thickness values. Butt MU et al13 showed a significant association of duration of diabetes and CIMT ($p < 0.05$)

Shinichi Teno et al14 showed a positive correlation between triglycerides and CIMT ($p < 0.05$).

AK Agarwal et al (2008)11 showed that triglycerides are strong predictors of increase in CIMT.

In the Muscatine study, 21 there is a significant association between triglycerides and CIMT.

Kirubhakaran K. et al: Correlation of blood sugar and lipid Both the blood sugar and the lipid parameters had a statistical significant correlation with carotid intima media thickness along with BMI and waist hip ratio, whereas age, gender,

MODIFIABLE RISK FACTORS- BMI of 25-29.9 was found to have positive correlation fasting triglycerides levels and carotid intima media thickness.
FTG had significant correlation between between who consumed alcohol than non alcoholic.
In our study we found that CIMT was higher in patients with increased BMI
We found that for patient with BMI between 25-29.9 ,CIMT mean value was 1.56.
Stastically significant difference was observed between Hba1c and CIMT with increase in Hba1c there was increase in CIMT.
Statistically significant correlation was found between CIMT and smokers
In our study post prandial blood sugar level correlated significantly with carotid intima media thickness ($p=0.001$)
In our study fasting triglycerides levels correlate significantly with carotid intima media thickness with increase in FTG there was increase in CIMT ($p=0.001$)
Similar results have been reported by Kraml et al, 9 who also observed significant higher CIMT in men than women

- Study conducted by Sunil Kumar Kota et al10 concluded that males are more prone for high CIMT. SBV Journal of Basic, Clinical and Applied Health Science, Volume 3 Issue 1 (January–March 2020) HbA1c has a direct, significant correlation with total cholesterol, triglyceride, VLDL, and LDL but not with HDL among the lipid profile. Significant positive correlation of HbA1c with lipid profiles from our study results implies that HbA1c can also be used as a predictor of dyslipidemia in addition to as a glycemic control parameter for prevention of complication.

Anand. Significance of HbA1c and lipid profile test in diagnosis and prognosis of diabetic and cardio-vascular patients. Int J Med Heal Res 2017;3(2):105–109serum HbA1c levels, adequate glycemic control, and lipid profile screening help to identify high-risk patients for timely diagnosis of hyperlipidemia, hence decreases the incidence of cardiovascular diseases and peripheral vascular complications through appropriate interventions

: © 2018 Baba MM, et al. a significant correlation between CIMT and HbA1c, FBS, SBP, total cholesterol, LDL-c and HDL-c

Niskanen et al17 concluded that there is a small but significant relationship between PPBS and CIMT.

Anita Bhosale et al CIMT had a positive association with hypertension, smoking, and a moderate significance with alcohol use.

• Kirubhakaran k et al 2019 blood sugar and lipid parameters had statistical significant correlation with carotid intima media thickness along with BMI

• CIMT measurement can be used as regular screening tool in diabetic patients for early detection of atherosclerosis

• The present study showed that the BMI had shown statistical significant correlation with CIMT values similar type of results was also shown by masoud Manavait et al 2004

•Dakre, et al.: Evaluation of Carotid Intima-media Thickness in Patients of Type 2 Diabetes Mellitus The mean BMI of patients in the present study was in the overweight range, which further increased spectrum of diabetic patients to be screened routinely for increased CIMT

• Temelkova-Kurktschiev et al. [8] Majority of patients in the present study had CIMT >1 which is taken as the cutoff for atherosclerosis.

There was significant correlation between triglyceride levels and patient who consumed alcohol
© 2020 En-qian Liu et al In conclusion, TyG index was linearly and positively associated with the risk of incident T2DM in the Japanese
cohort after adjusting for age, sex, BMI, waist circumference, HDL-cholesterol, total cholesterol, systolic blood pressure, regular exercise, smoking status, and alcohol consumption

In Our study on comparing males and females higher values of CIMT was found in males comapared to females

J. Evid. Based Med. Healthc., pISSN- 2349-2562, eISSN- 2349-2570/ Vol. 4/Issue 85/Oct. 23, 2017. On comparing males and females higher values of CIMT was found in males than in females in both groups, possibly due to protective effect of female hormones and/or male gender being at a higher risk of atherosclerosis . Similar results have been reported by Kraml et al, 9 who also observed significant higher IMT in men than women and a study conducted by Sunil Kumar Kota et al10 concluded that males are more prone for high CIMT

VI. Conclusion

As prevalence of atherosclerosis is increasing in diabetic patients early screening of diabetic patient for dyslipidemia and early intervention will prevent future cardiovascular complication.
Diabetic dyslipidemia is characterized by high triglycerides ,and low HDL.
CIMT will serve as non invasive tool for detection of atherosclerosis and can be used screening tool for detection of atherosclerosis in diabetics

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