Original Research Article

A study of correlation between alterations of lipid profile with complications of diabetes

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Abstract

Background and objectives: A prospective study was carried out to find the pattern of Dyslipidemia in type - II diabetics in comparison with non diabetic individuals, based on NCEP guidelines and occurrence of vascular complications of type - II diabetes mellitus. **Methods:** Fifty type - II diabetes mellitus and fifty age and sex matched non diabetic individuals were studied. The labeling of dyslipidemia was based on NCEP guidelines and vascular complication based on history clinical examination and necessary investigation. **Results:** Dyslipidemia was present in 92% of diabetic patients with LDL dyslipidemia (LDL > 100 mg/dl) in 60%, HDL dyslipidemia (HDL < 35 mg/dl) in 50% and hypertriglyceridemia (TG > 200 mg/dl) in 48%. The mean age was 49.62 ± 5.38 years and duration of diabetes was 6.69 ± 5.30 years. Total cholesterol was 207.62 ± 49.79 mg/dl triglycerides at 229.69 ± 117.87 LDL at 122.04 ± 46.18 and HDL being 35.64 ±9.00 was observed. **Conclusion:** The alteration of lipid metabolism of type - II diabetics has raised a serious medical concern with respect to vascular complications like coronary artery disease, cerebro vascular diseases and the recommendation of greater routine evaluation of serum lipid profile and its treatment among both newly detected and old cases of type - II diabetes mellitus strongly suggested.

Key words: Lipidprofile; type II diabetes.

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INTRODUCTION

The relationship between alteration of serum lipids and vascular complications is more significant in diabetics than in the general population[1,2]. It is clear from the population based studies that type – 2 diabetes generally is associated with a 50% to 100% elevation in the plasma levels of total and VLDL triglycerides. The most common alteration of lipoprotein in type - II diabetes mellitus is hyper tryglyceridemia caused by an elevation in VLDL concentration. In type – 2 diabetes mellitus with severe hyperglycemia, the clearance rate for LDL apo-B is reduced [3]. Mildly hyperglycemic individuals with type - II diabetes mellitus may have increased LDL production as well. So LDL levels in type -2 diabetes mellitus can be either increased or decreased depending upon hyperglycemia. HDL in type - II diabetes mellitus is usually decreased due to increased rate of HDL clearance as measured by apo-A_1 and apo-A_2 kinetics[4,5]. The above mentioned lipid abnormalities will lead to microvascular and macrovascular diseases in diabetic patients[6]. Lipoprotein abnormalities correlated with large vessel disease are seen in diabetics and non diabetic populations, however atherogenesis is accelerated in diabetics[7]. The most important vascular complication among diabetics are coronary artery disease. The risk factors for cardiovascular disease in diabetes include hypertension, central obesity, dyslipidemia, microalbuminuria, coagulation abnormalities, loss of nocturnal dipping of blood pressure and pulse and left ventricular hypertrophy [15].

This study reveals some of the evidence relating dyslipidemia to type – 2 diabetes mellitus and its vascular complications which were better understood in the last century. The 21st century will continue to focus

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on the premise that the diabetes state may really be prevented or cured through the power of modern science, targeting interventions at the genetically prone person that are aimed at correcting core abnormalities even before the diabetes emerges.

MATERIALS AND METHODS

The present study was undertaken at Krishna institute of medical sciences. and Hospital, Karad from inpatients in department of medicine in the year 2016-2017. Hundred consecutive patients were taken for our study of which fifty were type - II diabetic cases and not on Lipid lowering agent. The remaining fifty formed healthy control group. Of these fifty study cases, thirty seven were males and thirteen were females and their mean age was 49.62 ± 8.38 years. Cases associated with renal disease, thyroid disorders, destroy and presence of jaundice, chronic liver disease, diabetes mellitus, familial hyperlipidemia (history wise), patients under therapy with lipid lowering drugs, protease inhibitors or other drugs known to alter lipid profile were excluded from our study. In all the above cases, for exclusion of the diseases enlisted, mostly we had to resort to clinical examination and where ever indicated urine examination, blood urea, serum creatinine (for renal disorders), T3, T4 and TSH (for thyroid disorders), serum bilirubin, SGPT, SGOT, GGT, ALP, ultrasonography of abdomen (for jaundice or any liver disease)

37 type - II diabetic male (Age : mean ± SEM, 49.21 ± 8.77 years) and thirteen type - II diabetic female (Age : mean ± SEM, 50.76 ± 7.36 years) who were admitted into Krishna hospital, karad were selected for this study. Fifty healthy patients (Age : mean ± SEM of age, 50.84 ± 9.07 yrs) were also selected randomly from inpatient group of Krishna hospital, karad for respective controls. Fasting blood samples from all the diabetic patients as well as controls were collected early morning between 8.00 AM to 9.00 AM. Collected blood samples were centrifuged and allowed to form serum. Serum total cholesterol (TC), serum low-density lipoprotein cholesterol (LDL-C), serum very low-density lipoprotein cholesterol (VLDL-C), serum high-density lipoprotein cholesterol (HDL-C) and serum triglycerides (TG) were assayed using enzymatic estimation kit (ERBA-Diagnostics Manheim, GmbH, Germany) [106,107]. The experimental protocol was ethically cleared by institutional ethical committee as per the guidelines of Declaration of Helsinki R[108].

Mean ± SEM values were calculated for male and female control groups as well as respective HIV positive groups. Student't' test was performed to find out the level of significance between the control group and HIV positive groups of male and female separately.

The following tests were done to evaluate the lipid profile of both the control group and type - II diabetic patients.

a) Total serum cholesterol
b) Serum triglyceride
c) Serum HDL cholesterol
d) Serum LDL cholesterol
e) Serum VLDL cholesterol

Determination of vascular complication of diabetics

1. All diabetic patients were subjected to detailed fundoscopic examination for retinopathy.
2. Hypertension is detected by standard sphygmomanometer (mercury) method
3. Ischemic heart disease was evaluated by history, ECG, TNT and echo study.
4. Nephropathy was confirmed by microalbuminuria study among suspected diabetics.
5. Suspected cases of peripheral vascular diseases were confirmed by peripheral vascular Doppler study.
6. Cerebro vascular diseases cases were confirmed by CT scan brain contrast study.
7. Neuropathy was detected by history and CNS examination like, sensory testing and deep tendon reflex testing.

RESULTS

A total of 50 patients suffering from type - II diabetes were studied. The results of the various clinical and biochemical parameter and their interrelationship are as follows.

Age and Sex Distribution

Table-1: Shows the distribution of the study subjects according to age and sex

Table 1

Age in years	Males	Percentage	Females	Percentage	No.
30-39	5	10%	2	4%	7
40-49	13	26%	4	8%	17
50-59	16	32%	5	10%	21
60-69	3	6%	2	4%	5
Total	**37**	**74.00%**	**13**	**26.00%**	**50**

Total number of males were 37(74%); Total number of females 13(26); Maximum Number of cases i.e. 76% fall between the age group of 40 and 59, male to female ratio was 2.84 :1.

Table 2

Parameter	Total (Diabetic)	Male (Diabetics)	Female (Diabetic)	Control (non Diabetic)
Age in years	49.62 ± 8.38	49.21 ± 8.77	50.76 ± 7.36	50.84 ± 9.04
Duration of Diabetes in years	6.69 ± 5.30	6.71 ± 5.39	6.61 ± 5.26	-
FBS (mg/dl)	183.4 ± 53.37	180.05 ± 52.80	192.92 ± 55.97	108.62 ± 10.80
Total Cholesterol (TC) (mg/dl)	207.62 ± 49.79	199.29 ± 43.52	231.30 ± 60.15	163.66 ± 18.21
Triglycerides (TG) (mg/dl)	224.64 ± 117.87	231.02 ± 123.49	206.46 ± 102.47	100.78 ± 17.78
LDL (mg/dl)	122.04 ± 46.18	113.62 ± 7.79	146 ± 55.05	97.3 ± 17.39
HDL (mg/dl)	35.64 ± 9.00	32.97 ± 7.79	470.92 ± 9.90	50.82 ± 25.14

Mean and Standard Deviation observed in the study; Lipid Profile Changes in Type – 2 Diabetic Patients

Total cholesterol variations in male and female diabetics in comparison with control group with respect to age of subjects. (M = Male, F = Female, CNCLN = Conclusion, MN = Mean, SD = Standard Deviation, P = P-value)

Table 3

	Age Group	30-39		40-49		50-59		60-69	
		Diabetic	Control	Diabetic	Control	Diabetic	Control	Diabetic	Control
M	MN (mg/dl)	191.8	160	189.69	160.86	208.43	171.3	204.66	161.11
	SD	29.31	4.32	50.37	27.01	38.80	5.20	66.42	7.49
	P	0.037		0.040		0.0008		0.187	
	CNCLN	S		S		S		NS	
F	MN (mg/dl)	176.5	158	230.5	158.8	231.8	178	286.5	171.5
	SD	23.33	2	32.22	29.85	48.53	2.82	135.05	12.02
	P	0.232		0.007		0.034		0.22	
	CNCLN	NS		S		S		NS	

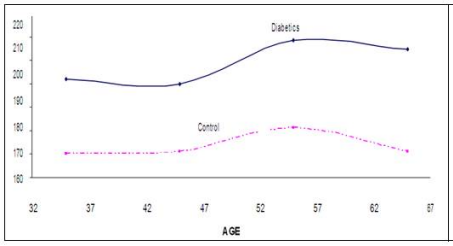

Figure 1

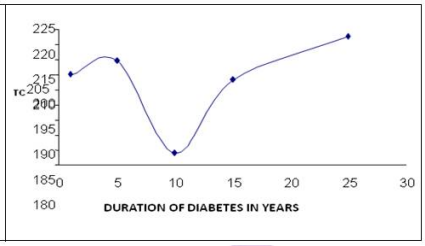

Figure 2

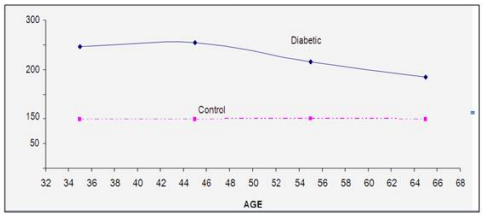

Figure 3

The Fig.- 1 shows graphical representation of total cholesterol variation in type – 2 diabetics and control with respect toage. The Fig. – 2 shows the graphical representation of variation of total cholesterol with respect to duration of diabetes. The Fig.- 3 shows graphical representation of triglycerides variation in type – 2 diabetics and control with respect to age.

30-39 year age group males had triglyceride level of 246.21 ± 40.81 mg/dl as compared to 99.5 ± 17 of control and comes under high level as per NCEP guidelines and is statistically significant, while females of same age group had only borderline triglyceride levels of 193± 60.81 mg/dl, p = 0.128 and was higher than control values of 113 ± 47.1 but statistically not significant.

Total cholesterol (TC) in 30-39 years males and females were within the desirable levels of National Cholesterol Education Programme (NCEP) ATP-III guide lines hence notsignificant.

While the total cholesterol of 40-49 age group male was within the desirable value but in the females of the same age group it was in the borderline i.e. 230.50 □ 32.22 mg/dl p = 0.007 while the control had only 159 □ 29.9 mg/dl. The total cholesterol values of both males and females were statistically significant when compared to control.

In 50-59 age group males the value of diabetic male TC was 208.44±38.80 mg/dl, p= 0.0008 as compared to control of 178.3±5.208 which was in the borderline, even the females was the same age group the TC level 231.8±48.53 mg/dl, p=0.0345 (control = 178±2.82) was also in the border line. The total cholesterol values of both males and females were statistically significant when compared to control.

Among the diabetic males of 60-69 age group the TC in the borderline with 204.67±66.424, p = 1873 (control = 161.11±7.49) and females of this diabetic age group has TC at 286.5±135.06 mg/dl, p = 0.2212 and was under the high level category of more than 240 mg/dl according NCEP guidelines but was not statistically significant when compared to control.

Table 4

	Age Group	30-39		40-49		50-59		60-69	
		Diabetic	Control	Diabetic	Control	Diabetic	Control	Diabetic	Control
M	MN (mg/dl)	246.20	99.50	255.00	99.27	215.56	101.00	184.33	99.33
	SD	40.81	17.00	171.42	18.92	100.10	7.62	101.16	15.13
	P	0.0002		0.0034		0.0002		0.1421	
	CNCLN	S		S		S		NS	
F	MN (mg/dl)	193.00	113.00	192.00	105.20	197.00	99.50	272.50	92.00
	SD	60.81	47.09	89.83	10.64	90.76	33.23	234.05	22.63
	P	0.1282		0.0752		0.0461		0.2369	
	CNCLN	NS		NS		S		NS	

Triglycerides variations in male and female diabetics in comparison with control group with respect to age of subjects. (M = Male, F = Female, CNCLN = Conclusion, MN = Mean, SD = Standard Deviation, P = P-value)

Among 40-49 age group males the TG level was 255 ± 171.42 mg/dl (control= 99.3 ± 18.9 mg/dl) which is high level as per NCEP guide lines, while among females it was 192 ± 89.83, p = 0.752 (control = 105 ± 10.6 mg/dl) taken as borderline tohigh. Among 50-59 age group males had mean TG levels of 215.56 □ 100.1 mg/dl , p=0.0002 (control 101 □ 7.616) which is high level and females had 197 ± 90.763 mg/dl, p = 0.0461 (control = 99.5 □ 33.23) is considered borderline high as per NCEP guidelines and was statistically significant for both males and females of this age group.
60-69 age group males had TG levels of 184.33 ± 101.16 mg/dl, p = 0.0142 (control 99.33 ± 15.13) taken as borderline high and female of this age group had
272.5 ± 234 shows high level of TG as per NCEP guideline but statistically not significant for both males and females.

Table 5

	Age Group	30-39		40-49		50-59		60-69	
		Diabetic	Control	Diabetic	Control	Diabetic	Control	Diabetic	Control
M	MN	30.2	72	33.62	43.73	33.25	43.2	33.33	55.89
	SD	8.64	50.68	8.54	4.91	7.76	5.53	5.77	34.71
	P	0.1007		0.0007		0.0005		0.0469	
	CNCLN	NS		S		S		S	
F	MN	34.5	80	41	46.8	44.2	47	39	47
	SD	0.71	58.92	13.11	2.68	11.34	1.41	1.41	1.41
	P	0.156		0.224		0.308		0.015	
	CNCLN	NS		NS		NS		S	

HDL variations in male and female diabetics in comparison with control group with respect to age of subjects. (M = Male, F = Female, CNCLN = Conclusion, MN = Mean, SD = Standard Deviation, P = P-value)
30-39 age group males had mean HDL value of 30.2 ± 8.643 mg/dl, p=0.101 (control 46.83 ± 3.68), and females HDL level was 34.5 ± 0.707 mg/dl, p = 0.156 (control 46.66 ± 2.68) mg/dl, both males and females low level as per NCEP guideline and statistically notsignificant.
Males of 40-49 age group had HDL values of 33.615 ± 8.53 mg/dl, p=0.00007 (control 43.7 ± 4.91), low level as per NCEP, hence statistically significant. Females of the same age group had HDL level 41 ± 13.11, p = 0.2241 (control 43.8 ± 2.68) again low level but statistically not significant.
50-59 age group males had 33.25 ± 7.75 mg/dl HDL level with p = 0.0005 which is low level, and females 44.2 ± 11.34 mg/dl, p = 0.3085 (control 47 ± 1.414) which is borderline high as per NCEP guideline.
60-69 age males HDL level was 33.33 ± 5.77 mg/dl, p = 0.0469 (Control 44.77 ± 4.37) and females 39 ± 1.4142 mg/dl, p = 0.0149 (control 47 ± 1.4142) both low levels as per NCEP guideline the HDL level is substantially decreased as compared to control hence statistically significant for both males andfemales.

Table 6

	Age Group	30-39		40-49		50-59		60-69	
		Diabetic	Control	Diabetic	Control	Diabetic	Control	Diabetic	Control
M	MN (mg/dl)	117.60	102.00	97.85	99.87	130.75	98.20	84.00	94.44
	SD	21.43	4.90	42.70	4.94	38.49	5.12	27.06	32.20
	P	0.0878		0.4341		0.0021		0.3055	
	CNCLN	NS		NS		S		NS	
F	MN (mg/dl)	104.50	98.67	151.50	98.60	139.20	106.00	193.50	63.00
	SD	10.61	4.62	35.26	5.27	63.05	14.14	91.22	52.33
	P	0.299		0.029		0.159		0.111	
	CNCLN	NS		S		NS		NS	

LDL variations in male and female diabetics in comparison with control group with respect to age of subjects. (M = Male, F = Female, CNCLN = Conclusion, MN= Mean, SD = Standard Deviation, P = P-value)

The males of 30-39 age group had LDL levels of 117.6 ± 21.43 mg/dl, p=0.088 (control 102 ± 4.9) and females of this age group had 104.5 ± 10.61 mg/dl, p=0.299 (control 98.7 ± 4.62) both of which were near optimal as between 100 – 129 mg/dl as per NCEP guidelines and statistically not significant.

In 40-49 age group males LDL was 97.846 ± 42.7 mg/dl, p = 0.434 (control 99.9 ± 4.94 mg/dl) which was optimal i.e. < 100 mg/dl females of the same age group shows LDL levels of 151.5 ± 35.25 mg/dl, p=0.029 (control 98.6 ± 5.27) which is borderline high and statistically significant.

In 50-59 year old males, LDL was 130.75 ± 38.49 mg/dl, p=0.0021 (control 98.2 ± 5.116 mg/dl) which is borderline high as per NCEP guideline and statistically significant when compared to control. Females of the same age group had LDL levels of 139.2 ± 63.04 mg/dl, p=0.158 (control 106 ± 14.14 mg/dl) which was borderline high but statistically not significant.

Among 60-69 years old males LDL was 84 ± 27.05 mg/dl, p=0.3055 (control 94.44 ± 32.19 mg/dl) which was optimum as per NCEP and females of the same age group had LDL levels of 193.5 ± 91.217 mg/dl, p=0.1107 (control 63 ± 52.32 mg/dl) which was very i.e. more than 190 mg/dl as per NCEP both the values were statistically not significant.

The percentage elevation of total cholesterol among diabetics was 34% (Total Cholesterol more than 200 mg/dl) and Triglyceride was 64% (more than 150 mg/dl) HDL was 72% (HDL less than 40 mg/dl) and LDL was 60% (LDL more than 100 mg/dl), 92% of the 50 diabetics had dyslipidemia.

Table 7

Complications	Males	Females	Total
Retinopathy	9 (24.32%)	2 (15.38%)	11 (22%)
Hypertension	25 (67.56%)	8 (61.5%)	33 (66%)
IHD	16 (43.24%)	7 (53.84%)	23 (46%)
Nephropathy	2 (5.40%)	0 (0%)	2 (4%)
Peripheral Vascular Disease	3 (8.10%)	2 (15.38%)	5 (10%)
Cerebro Vascular Diseases	6 (16.21%)	2 (15.38%)	8 (16%)
Neuropathy	6 (16.21%)	4 (30.76%)	12 (24%)

Table 7 depicts percentage of vascular complications among type - II diabetic subjects selected for this study. Hypertension was seen in majority (66%) of the population, followed by IHD (46%) and Neuropathy (24%). Other complications like Retinopathy, PVD, Cerebro Vascular complications and Neuropathy were also seen.

DISCUSSION

An interestingly higher percentage of dyslipidemia (92%) has been found in type - II diabetic in present study as compared western data (60%– 80 %) the major concern with this study is the high percentage of HDL dyslipidemia (72%) while LDL was 60% similar to western data (60 – 80%) [112]. While hyper triglyceridemia of more than 200 mg/dl was seen in 48% as compared to 39% of PROCAM study[113]. Low HDL < 35 mg/dl was seen in 50% while PROCAM study showed only 27% although patients with diabetes tend to have high triglycerides levels than non diabetics some studies suggest that diabetics are not generally hyper tryglyceridemic (more than 200 mg/dl) [114]

Comparison of various studies on vascular complication with present study [124,125,126]

Complications	Suri *et al* 1979	McCaulay *et al* 1988	Young *et al* 1985	Montour *et al* 1989		Present Study
				Male	Female	
Retinopathy	28.60%	-	-	27%	8%	22%
Hypertension	23.20%	71%	-	65%	75%	66%
Ischemic Heart Diseases	19.6%	48%	17%	41%	54%	66%
Nephropathy	10.80%	5%	5%	6%	2%	4%
Peripheral Vascular Diseases	1.80%	12%	-	12%	13%	10%
Cerebro Vascular Diseases	-	13%	7%	15%	13%	16%
Neuropathy	-	5%	5%	12%	0%	24%

CONCLUSION

Type -2 diabetes mellitus causes alteration in the lipid profile associated with various vascular complications. 50 type - II diabetic patients (males = 37 and female = 13) not on lipid lowering agent were compared to 50 diabetic healthy patients who were selected randomly. The fasting blood samples of all the type - II diabetics as well as controls were collected and serum lipid profile was assayed. Results indicate a significance increase in serum VLDL – C, TG and LDL along with a significant decrease in serum HDL-C among diabetics as compared to non diabetics. Total cholesterol, TG and LDL was increased among 34%, 64% and 60% of the study group when cutoff values were taken as TC > 200 mg/dl, TG > 150 mg/dl and LDL > 100 mg/dl. HDL was reduced among 72% of the study subjects when HDL < 40 mg/dl was taken as cutoff values. The alteration of lipid metabolism of type - II diabetics has raised a serious medical concern with respect to vascular complications like coronary artery disease, cerebro vascular diseases and the recommendation of greater routine evaluation of serum lipid profile and its treatment among both newly detected and old cases of type - II diabetes mellitus strongly suggested. Results of our present study shows ischaemic heart disease and hypertension are being most common complication with prevalence of 66% each, with neuropathy and retinopathy being other common complications needs to be diagnosed and treated early.

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