

Pattern of Dyslipidemia in Diabetes Mellitus

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Abstract- Diabetes Mellitus being panmetabolic disorder is characterized by alteration in lipid profile. Although diabetes and hyperlipidemia represent different genetic disorders, each of these disorders is common in the general population and the two disorders may co-exist in the same individual.

This study of lipid profile in diabetics is undertaken to see how often hyperlipidemias are associated with diabetes mellitus. This case control study consists 100 patients, 50 with diabetes and 50 with non diabetic controls. Type of diabetes, diabetic treatment were recorded fasting lipid profile was done in both controls and diabetics and levels were compared. Marked elevation of triglycerides, total cholesterol and low density lipoproteins and lower levels of serum HDL cholesterol were observed in both types of diabetes when compared to controls.

Index Terms- Diabetes Mellitus (DM), Dyslipidemia, Type 1 & Type 2 Diabetes and Fasting Blood Sugar (FBS)

I. INTRODUCTION

The worldwide prevalence of DM has risen dramatically over the past two decades, from an estimated 30 million cases in 1985 to 285 million in 2010. Based on current trends, the International Diabetes Federation projects that 438 million individuals will have diabetes by the year 2030.

Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Several distinct types of DM are caused by a complex interaction of genetics and environmental factors. Depending on the etiology of the DM, The metabolic dysregulation associated with DM causes secondary pathophysiologic changes in multiple organ systems that impose a tremendous burden on the individual with diabetes and on the health care system¹

The main types of diabetes are type 1 and type 2 diabetes. Type 1 diabetes results from an irreversible loss of pancreatic B-cells and type-2 diabetes is primarily caused by impaired insulin action⁷

DM if left untreated diabetes can lead to serious problems like macrovascular and microvascular complications. The microvascular complications include retinopathy, nephropathy, and neuropathy (both distal polyneuropathy and autonomic neuropathy)⁵ while the macrovascular complications of diabetes include angina, myocardial infarction, transient ischemic attack, and stroke³

Diabetes is commonly associated with abnormalities in plasma lipids and lipoprotein levels commonly referred to as "dyslipidemia" .about 50% of all diabetic patients have

dyslipidemia. Lipid abnormalities are more common in type 2 diabetes than in type 1 diabetes.⁶

Individuals with DM may have several forms of dyslipidemia (Chap. 356). The most common pattern of dyslipidemia is hyper triglyceridemia and reduced HDL cholesterol levels. DM itself does not increase levels of LDL, but the small dense LDL particles found in type 2 DM are more atherogenic because they are more easily glycosylated and susceptible to oxidation.

According to guidelines of the ADA and the American Heart Association, the target lipid values in diabetic individuals (age >40 years) without cardiovascular disease should be as follows: LDL < 2.6 mmol/L (100 mg/dL); HDL >1 mmol/L (40 mg/dL) in men and >1.3 mmol/L (50 mg/dL) in women; and triglycerides <1.7 mmol/L (150 mg/dL). In patients >40 years, the ADA recommends addition of a statin, regardless of the LDL level in patients with CHD and those without CHD, but who have CHD risk factors.¹

The rationale of this study was to detect lipid abnormalities pattern in both type 1 and type 2 diabetes mellitus.

II. METHODS

In our series we studied 50 healthy non diabetic volunteers as controls and in the second group we studied 50 of cases of uncomplicated diabetes mellitus. These cases were randomly selected from the in-patient and out-patient services of Government General Hospital, Kurnool. The patients belonging to both insulin dependent diabetes mellitus as well as non insulin dependent diabetes mellitus were chosen.

The patients were investigated after a through clinical check up. Blood was drawn from all patients for the study of FBS and serum lipids. After 12 hours over night fasting 10ml of venous blood was drawn into a dry test tube, serum was separated by keeping it in a slanting position on a wooden rack. The separated serum was analyzed for the following.

1. Naked eye examination of examination of plasma kept at 4^o C for 16hrs for the observance of any cream formation on top by the chylomicrons or for the general turbidity of the plasma due to very low density lipoproteins.
2. Serum HDL cholesterol by phosphotungstic acid magnesium method (Ref. Practical Clinical Chemistry by Harold Varley).
3. Serum LDL cholesterol, by Freidweld method (Clinical diagnosis and management by laboratory methods, Todd, Sanford Davidson 12th Edition).

Table showing demography and lipid profile in type 1 diabetes

S.No	Sex	Age	Type of DM	Duration	OHA / Insulin	FBS	Total Cholesterol	Tri glycerides	HD L	LD L	VLD L
1	M	25	1	8 yrs	Insulin	125	237	180	35	166	36
2	M	25	1	2 yrs	Insulin	120	242	175	33	174	35
3	M	25	1	2 yrs	Insulin	120	244	150	38	176	30
4	M	20	1	4 yrs	Insulin	170	208	380	37	95	76
5	M	25	1	3 yrs	Insulin	160	264	325	33	166	65
6	M	20	1	6 yrs	Insulin	170	284	365	37	174	73
7	F	20	1	5 yrs	Insulin	160	269	361	31	166	72
8	M	25	1	3 yrs	Insulin	125	291	175	38	218	35
9	F	22	1	2 yrs	Insulin	145	342	340	33	241	68
10	F	21	1	5 yrs	Insulin	120	330	275	29	246	55
11	F	25	1	2 yrs	insulin	140	294	350	37	187	70
12	F	26	1	2 yrs	Insulin	120	203	280	31	116	56
13	F	25	1	3 yrs	Insulin	135	240	381	32	132	76
14	M	30	1	9 yrs	Insulin	140	282	380	30	176	76
15	M	25	1	2 yrs	Insulin	120	213	238	33	132	48
16	M	23	1	4 yrs	Insulin	120	220	175	28	157	35
17	F	30	1	7 yrs	Insulin	160	170	370	28	68	74
18	F	25	1	2 yrs	Insulin	170	295	339	33	194	68
19	M	19	1	6 yrs	Insulin	130	315	250	33	232	50
20	F	24	1	9 yrs	Insulin	120	279	167	27	219	33
21	M	23	1	8 yrs	Insulin	140	269	325	30	174	65
22	M	21	1	7 yrs	Insulin	150	242	350	38	134	70
23	F	22	1	2 yrs	Insulin	120	349	130	33	290	26
24	M	22	1	8 yrs	Insulin	150	306	325	27	214	65

III. RESULTS

We randomly selected 50 controls from healthy volunteers of whom 26 were males and 24 were females, the mean age being 32.5 years. We made a random selection of 50 diabetic patients, Type 1 DM n=24 of whom 14 were males and 10 were females and Type 2DM n=26 of whom 15 were males and 11 were females. Mean age in type 1 diabetes is 24.4 and type 2 diabetes is 44.7.

Table showing Demography and Lipid Profile in Type 2 Diabetes

S.No	Sex	Age	Type of DM	Duration	OHA / Insulin	FBS	Total Cholesterol	Triglycerides	HD L	LDL	VLD L
1	M	58	2	10 yrs	OHA	140	243	285	32	154	57
2	M	40	2	10 yrs	OHA	148	340	226	28	267	45
3	F	35	2	1 yr	OHA	130	333	170	26	273	34
4	F	40	2	4 yrs	OHA	140	220	388	34	108	78
5	F	46	2	8 yrs	OHA	135	287	224	31	211	45

6	M	50	2	2 yrs	OHA	150	243	345	34	140	69
7	F	40	2	2 yrs	OHA	140	325	280	30	239	56
8	M	36	2	1 yr	OHA	125	264	160	37	195	32
9	M	42	2	2 yrs	OHA	160	260	330	39	155	66
10	F	44	2	4 yrs	OHA	145	277	350	38	169	70
11	M	55	2	4 yrs	OHA	150	285	340	30	187	68
12	M	45	2	6 yrs	OHA	145	279	300	32	187	60
13	M	54	2	8 yrs	OHA	125	257	228	36	175	46
14	M	40	2	7 yrs	OHA	150	323	346	36	218	69
15	M	50	2	9 yrs	OHA	120	286	232	33	207	46
16	M	22	2	4 yrs	Insulin	125	206	187	33	136	37
17	M	46	2	2 yrs	OHA	135	260	333	39	154	67
18	F	40	2	5 yrs	Insulin	125	227	150	30	167	30
19	M	42	2	10 yrs	OHA	130	272	287	35	180	57
20	F	50	2	5 yrs	OHA	125	239	250	36	153	50
21	F	42	2	5 yrs	OHA	130	240	350	39	131	70
22	M	56	2	2 yrs	OHA	145	292	380	36	180	76
23	F	44	2	3 yrs	OHA	145	303	350	36	197	70
24	F	30	2	5 yrs	OHA	130	287	185	38	212	37
25	M	50	2	6 yrs	OHA	150	248	300	39	149	60
26	M	40	2	5 yrs	OHA	120	202	100	26	156	20

Table showing demography and lipid profile in controls

S.NO	SEX	AGE	FBS	TC	TG	HDL	LDL	VLDL
1	M	45	75	183	106	30	132	21
2	M	40	82	130	80	37	77	16
3	F	42	74	130	109	36	72	22
4	M	36	81	143	92	32	93	18
5	M	51	65	174	151	36	108	30
6	F	43	81	134	62	30	92	12
7	M	52	72	192	85	38	137	17
8	F	37	75	192	76	39	138	15
9	M	48	80	148	116	31	94	23
10	M	36	75	108	130	30	52	26
11	M	56	90	172	123	35	112	25
12	F	38	80	188	120	33	131	24
13	M	40	65	196	126	36	135	25
14	F	43	75	153	123	37	91	25
15	M	42	86	178	146	35	114	29
16	F	50	90	193	133	41	125	27
17	M	45	72	144	121	39	81	24

18	F	36	65	194	141	40	126	28
19	M	41	80	198	139	35	135	28
20	M	43	85	178	137	39	112	27
21	M	39	81	199	152	42	127	30
22	F	46	64	184	138	39	117	28
23	M	51	62	195	116	44	128	23
24	M	46	69	153	120	38	91	24
25	F	43	70	199	126	37	137	25
26	M	45	62	168	112	40	84	44
27	F	34	80	135	70	34	67	14
28	M	39	86	175	100	43	92	20
29	F	40	75	163	130	46	78	26
30	M	41	84	152	132	42	84	26
31	F	34	82	197	67	45	139	15
32	F	52	84	168	130	38	104	26
33	M	42	84	198	153	36	113	30
34	F	37	82	197	115	41	123	23
35	M	38	84	205	133	38	120	37
36	F	42	82	207	150	44	130	33
37	F	40	75	162	125	40	97	25
38	F	38	71	194	128	30	138	26
39	M	42	76	183	151	71	70	42
40	F	36	72	162	122	38	111	24
41	F	38	84	166	131	47	93	26
42	F	40	86	153	154	43	77	31
43	M	41	75	150	91	45	88	18
44	F	30	74	181	85	45	109	17
45	M	39	72	196	126	42	117	37
46	F	41	79	201	113	36	143	22
47	M	49	80	170	126	33	123	24
48	F	36	82	182	130	36	145	21
49	M	37	86	167	123	38	135	32
50	F	40	89	189	122	36	116	25

TABLE SHOWING CORRELATION OF FBS WITH LIPID PROFILE

GROUP	MEAN FBS	MEAN TG	MEAN TC	MEAN LDL	MEAN HDL
controls	77.5	132	175	117	31
type1DM	138.5	288	220	127	27
type 2DM	147.42	300	221	136	25

The following table shows that there is elevation of in total cholesterol, LDL cholesterol levels and triglycerides while the HDL cholesterol showing a decrease in Type 1 DM and

Type2DM groups compared to the control group correlating with the Fasting blood sugar levels.

Number of patients in controls, type 1 diabetes and type 2 diabetes with total cholesterol >200mg/dl are n=3, n=23 and n=26 respectively, triglycerides >150mg/dl are n=6, n=24 and n=24, low density lipoprotein cholesterol >100 mg/dl are n=27, n=23 and n=26. and high density lipoprotein cholesterol <40 mg/dl in males and <50 mg/dl in females are n= 21/19, n=14/18 and 16/10 respectively. There is significant abnormality in lipid profile in both type 1 and type 2 diabetics when compared to controls.

IV. DISCUSSION

The cost of diabetes care is high and is escalating worldwide. It is estimated by the WHO that the global expenditure for diabetes care would increase from 234 Billion in 2007 to 411 Billion in the next 20 years. The WHO estimate is based on lost productivity due to diabetes, heart diseases, and stroke together show that over the next 10 years, lost national income in billions of USD will amount 336.6 in India²

Carbohydrate metabolism in type 2 diabetes

People with T2DM have elevated fasting glucose levels and excessive glycemic excursions following carbohydrate ingestion. Insulin secretion in those with T2DM is typically decreased and delayed following food ingestion^{11,10}. Defects in insulin secretion are observed early in the evolution of T2DM. In fact, alterations in both the timing and amount of insulin secreted have been reported in relatives of patients with T2DM prior to the development of hyperglycemia.

Chronic hyperglycemia alone or in combination with elevated FFA impairs insulin secretion. Abnormalities in glucose sensing insulin processing or intracellular signalling can alter insulin secretion⁹. In addition, Beta cell mass decreases with increasing duration of diabetes⁸. Alterations in beta cell morphology occur in most people with T2DM with extensive intra islet deposition of amylin commonly being observed⁴.

Lipid levels and their interpretations in different type of DM
Type 1 DM: This is a typical situation where insulin production is minimal to nil and therefore its concentration is low both in the porto hepatic circulation and peripheral blood. The lipoprotein composition is accordingly affected with low high density lipoprotein cholesterol (HDL-C), poor esterification of cholesterol, more of TG with less VLDL clearance. This is more so in inadequately treated patients with poor glycemic control. The activity of enzymes like lecithin cholesterol acyl transferase (L-CAT) and lipases are suppressed due to low circulating insulin levels. This adversely affects HDL metabolism. Besides, higher concentration of free cholesterol in low density lipoprotein (LDL) and intermediate density lipoprotein (LDL) makes them more atherogenic. However, institution of insulin treatment and maintenance of euglycemia rapidly reverses lipid metabolism to normal.

Type 2 DM: In patients with type 2 DM there is global dysfunction of lipoprotein metabolism. The degree of dyslipidemia is more widespread. There is increase in small dense LDL (LDL3) which is highly atherogenic. In patients with poor glycemic control, levels of TG rich lipoproteins are higher.

The HDL levels may not be low in these type of diabetic subjects, more so with fair glycemic control⁵.

V. CONCLUSION

A study of fifty uncomplicated diabetic patients was taken-up to see how often hyperlipidemia is associated with diabetes mellitus. There is a high incidence of hyperlipidemias among uncontrolled diabetic patients. There is no significant correlation between the duration of diabetes and the tendency for abnormal lipid profile pattern.

In both Type 1 DM and Type 2 DM groups the serum triglycerides showed a significant elevation. The serum total cholesterol and serum LDL cholesterol also showed a definite elevation. The serum HDL cholesterol showed a decrease in both Type 1 DM and Type 2 DM patients.

Because of the additive cardiovascular risk of hyperglycemia and hyperlipidemia, lipid abnormalities should be assessed aggressively and treated as part of comprehensive diabetes care.

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