Original Research Article

A Study of Metabolic Alterations and Complications in Low BMI Diabetic Patients

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Abstract: The clinical and biochemical profile of type 2 diabetic patients is entirely different in Indian population as compared to western population. 97 patients of type 2 DM were subdivided into obese, nonobese and lean groups and their clinical and biochemical parameters were studied. About 20% of patients were lean (BMI < 19). The mean age of type 2 DM was 51yrs. The WHR was also not statistically different in three groups implying greater prevalence of central adiposity in Indian population. The lean diabetic patients had higher fasting (192mg/dl), postprandial glucose (277mg/dl) and mean HBA1C (9.03%) values as well as significantly higher triglyceride levels (229mg/dl) suggesting possibility of both greater endogenous insulin deficiency and insulin resistance. However, the obese diabetics had higher LDL (142mg/dl) which is reflected by the greater incidence of ischemic heart disease (25%) and stroke (7%) in this subgroup. The findings regarding microvascular events were converse, the lean patients had microalbuminuria (42.85%), nonproliferative retinopathy (29%), proliferative retinopathy (14%) gloves and stocking anaesthesia (43%) and absent ankle jerk (19%) which were significantly higher than other two subgroups. The study shows that lean diabetic patients are at higher risk of metabolic derangements and microvascular complications and thus need aggressive management.
Keywords: biochemical profile, diabetic patients, triglyceride, retinopathy.

INTRODUCTION

Diabetes mellitus is the most common endocrine disease characterized by metabolic abnormalities and long term complications involving eyes, kidneys, nerves and blood vessels with significant morbidity and mortality. Once regarded as a single entity, diabetes is now seen as a heterogenous group of disease, characterized by a single state of chronic hyperglycemia and disturbances of carbohydrate, fat and protein metabolism associated with absolute or relative deficiency in insulin secretion and/or insulin action[1].

Traditionally type 2 DM has been considered a disease of elderly, obese and physically inactive people i.e. a disease resulting from modernization or industrialization[4,5,6,12] but a large majority of Indians that are diagnosed with type 2 diabetes mellitus are non obese, in fact many are lean with BMI in normal range[7,9,14,17]. Recently ADA has also decreased the lower limit of overweight for Asian ethnicity from 25.0 to 23.5 Kg/m[2.] There is also increased prevalence of central obesity in Asian people as compared to western population. So, at similar weight Asians are at higher risk of developing dyslipidemia and type 2 diabetes mellitus[1,3]. This is evident from the fact that the waist circumference at which the prevalence of metabolic syndrome increases, a strong harbinger of type 2 DM is significantly lower in Asian males and females i.e. 90cm and 80cm, respectively.

The present study was done to subclass the Type 2 DM patients on the basis of their Body Mass Index and comparison of their clinical (age, sex, BMI, WHR, complications) and biochemical parameters (serum lipid profile, blood sugar fasting and PP, HbA1c). The aim of the study was to look for the specific parameters unique among our diabetic population, particularly non obese and lean individuals and the clinical and biochemical factors that are most prevalent in these individuals. The prevalence of complications of type 2 DM was further studied in the present study.

AIMS AND OBJECTIVES

The present study was undertaken with the following aims-

- To study clinical profile (age, sex, BMI, Waist/hip ratio, complications) of Type 2 Diabetes Mellitus patients.
- To study biochemical profile (blood sugar, HbA1c, serum lipid profile, urine albumin) of Type 2 Diabetes Mellitus patients.
- Comparison and differentiation of above mentioned parameters into Lean, Obese and Non-obese Type 2 Diabetes Mellitus patients

MATERIAL AND METHODS
Selection of subjects:
Subjects were selected from:
1. Diabetic clinic of KPS institute of Medicine, GSVM College Kanpur.
2. Medicine wards and OPD of LLR and Associated Hospital Kanpur.

INCLUSION CRITERIA
1. Age group 30-70 yrs irrespective of sex.
2. Established cases of type 2 DM categorized into three main groups :
   I. lean patients = BMI $<19 kg/m^2$
   II. Obese patients= BMI $>30 kg/m^2$
   III. Non-obese patients= BMI $19-30 kg/m^2$
       a. Normal = BMI $19-25 kg/m^2$
       b. Overweight= BMI $25-30 kg/m^2$

EXCLUSION CRITERIA
1. Type 1 diabetes patients (ruled out on basis of C-peptide level and requirement of insulin at younger age).
2. Pregnant lady[13].
3. Patients not willing for study.
4. Patients having abnormal pancreatic function.

STUDY DESIGN
Observational study

History
✓ Patients Name
✓ Age
✓ Sex
✓ Family history
✓ Age of onset of Diabetes
✓ Duration of illness

SYMPTOMS
Complaints such as polyuria, polydipsia, polyphagia, unexplained weight loss etc were taken as positive symptoms.

BODY HABITUS
✓ Weight
✓ Height
✓ BMI
✓ Waist Hip ratio[19]

SYSTEMIC EXAMINATION
✓ Cardiac examination
✓ Nervous system
✓ Fundus

INVESTIGATIONS
✓ Blood sugar: fasting and PP after 2hr of 75 gm glucose
✓ Lipid profile: serum cholesterol, TG, LDL, HDL, VLDL
✓ HbA1c
✓ Urine albumin and spot albumin/creatinine ratio
✓ ECG
✓ CT Head
✓ 2D ECHO if indicated

OBSERVATIONS
This study was conducted in Type 2 DM patients. Patients were divided into three groups on the basis of BMI, A=Lean (BMI$<19 kg/m^2$), B=Obese (BMI$>30 kg/m^2$) and C=Non-obese (BMI $19-30 kg/m^2$).The study was conducted over 18 months period. A detailed analysis of clinical, anthropometric and laboratory data were performed and observations taken are depicted in the tabular form as mentioned below.

Table-1: age distribution

Age in years	No. of Patients	Percentage
Total	97	100
31-40	23	24
41-50	19	20
51-60	41	42
61-70	14	14

In the present study the age of patients ranged from 30 yrs to 70 yrs with mean age of 51.34 yrs with SD of 9.04. Majority of the patients are in the 41-60 years age group

Table 2: Distribution of patients on the basis of body mass index (BMI)

Group	No. of patients (TOTAL=97)	percentage	BMI
A. Lean	21	22	18.30±0.45
B.obese	27	28	31.33±1.15
C.Non-obese	49	50	25.00±2.30

	A vs B	A vs C	B vs C
BMI	<0.001	<0.001	<0.001

Table 3: Waist-Hip ratio

Group	Waist-Hip ratio
A. Lean	0.90±0.065
B.obese	1.01±0.120
C.Non-obese	0.95±0.094

P value	A vs B	B vs C	A vs C
WHR	>0.05	>0.05	>0.05

Table 4: Fasting Venous Plasma Glucose

Group	Fasting blood sugar(mg/dl)
A. Lean	192.34±35.16
B.obese	160.62±19.98
C.Non-Obese	181.15±32.98

P value	A vs B	B vs C	A vs C
FBS	<0.05	<0.05	>0.05

Table 5: Post Prandial Venous Plasma glucose

Group	Post Prandial Sugar(mg/dl)
A. Lean	277.61±34.89
B.obese	243.46±32.03
C.Non-Obese	254.15±39.66

P value	A vs B	B vs C	A vs C
PP blood sugar	<0.05	>0.05	<0.05

Table 6: Glycosylated Hemoglobin Level (HbA1c)

Group	HbA1c Level
A. Lean	9.03±0.44
B.obese	8.22±0.38
C.Non-obese	8.64±0.42

P value	A vs B	B vs C	A vs C
HbA1c	<0.05	>0.05	<0.05

Table 7: Total Cholesterol

Group	Total Cholesterol (mg/dl)
A. Lean	204.03±30.65
B.obese	237.54±33.21
C.Non-obese	220.70±35.68

P value	A vs B	B vs C	A vs C
Total cholesterol	<0.05	>0.05	<0.05

Table 8: Triglycerides

Group	Triglycerides(mg/dl)
A. Lean	229.87±96.46
B.obese	136.60±47.43
C.Non-obese	117.85±36.54

P value	A vs B	B vs C	A vs C
Triglyceride	<0.05	>0.05	<0.05

Table 9: LDL Cholesterol

Group	LDL Cholesterol(mg/dl)
A. Lean	112.00±27.03
B.obese	142.03±28.46
C.Non-obese	121.10±33.03

P value	A vs B	B vs C	A vs C
LDL Cholesterol	<0.05	<0.05	>0.05

Table 10: HDL Cholesterol

Group	HDL Cholesterol(mg/dl)
A. Lean	43.45±2.84
B.obese	39.01±6.54
C.Non-obese	46.69±5.09

P value	A vs B	B vs C	A vs C
HDL Cholesterol	>0.05	<0.05	<0.05

Table 11: VLDL Cholesterol

Group	VLDL Cholesterol(mg/dl)
A. Lean	43.09±19.90
B.obese	25.68±9.17
C.Non-obese	23.36±5.42

P value	A vs B	B vs C	A vs C
VLDL Cholesterol	<0.05	<0.05	>0.05

Table 12: Urine Albumin

Group	Normal (<30mg/24hr)	Microalbuminuria (30-300mg/24hr)	Macroalbuminuria (>300mg/24hr)
Total no.pts	No. ofpts(%)	No. of pts(%)	No. of pts(%)
A.Lean (21)	10(47.61%)	9(42.85%)	2(9.52%)
B.obese (27)	21(77.78%)	5(18.51%)	1(3.70%)
C.Non-obese (49)	40(81.63%)	7(14.28%)	2(4.08%)

Table 13: Fundus Examination

Group	Normal	Proliferative changes	Non-proliferative changes
Total No. of patients	No. of patients (%)	No. of Patients (%)	No. of Patients (%)
A. Lean(21)	12(57%)	3(14%)	6(29%)
B.obese(27)	23(85%)	1(4%)	3(11%)
C.Non-obese(49)	40(82%)	3(6%)	6(12%)

Table 14: Neurological Examination

Group	Normal	Absent ankle reflex	Glove & stocking anaesthesia
Total No. of patients	No. of patients (%)	No. of Patients (%)	No. of Patients (%)
A. Lean(21)	8(38%)	4(19%)	9(43%)
B.obese(27)	24(89%)	1(4%)	2(7%)
C.Non-obese(49)	38(77%)	3(6%)	8(16%)

Table 15: Evaluation for IHD

Group	Normal	ECG changes s/o recent or old MI	history of angina
Total No. of patients	No. of patients (%)	No. of Patients (%)	No. of Patients (%)
A. Lean(21)	16(76%)	2(9%)	3(14%)
B.obese(27)	10(37%)	10(37%)	7(25%)
C.Non-obese(49)	34(69%)	9(18%)	6(12%)

OBSERVATION

In India majority of Type 2 DM patients are non-obese. Almost 80% of our Type 2 DM patients are non-obese whereas in west 60-80% is obese. A unique sub-set of these patients are really thin(20%), below the ideal body weight for height and have a very low BMI ($<19kg/m^2$) even at diagnosis.

In India about 20% of Type 2 DM patients have BMI $<19kg/m^2$ in various studies. In our study there were 20% of such lean Type 2 DM patients[7].

There were randomly selected 97 patients include in this study. They were divided into three groups based on BMI. The maximum number of patients fell down in group C (Non-obese) with BMI $19-30kg/m^2$.It was followed by 27 patients in group B(obese) with BMI $>30kg/m^2$ and 21 patients in group A (lean) with BMI$<19kg/m^2$.The majority of our NIDDM patients were Non-obese.

The mean age of patients was 51.34±9.04. Most of the patients in our study fall in 41-60 years of age group. The present study shows a male preponderance with ratio of male: female is 2.3:1.

Most of the patients were having high Waist-Hip Ratio irrespective of groups. It indicates the significance of truncal obesity even greater than BMI in association with Type 2 DM in our population

On comparing venous plasma fasting and post prandial glucose values, the group A (lean Type 2 DM) was found to be having the highest values (192.34±35.16 and 277.61±34.89).These values are highest in group A(lean Type2 DM) and least in group B(Obese Type 2 DM).

Glycosylated haemoglobin level is highest in group A (lean Type 2 DM) (9.03±0.44) indicating poor glycemic control and lowest in group B (Obese Type 2 DM) (8.22±0.38).

In group B (Obese Type 2 DM) the total cholesterol level (237.54±33.21) was higher than normal .It is least in Group C patients (Non-obese Type 2 DM) in our study. Serum Triglyceride values were maximum in groups A (lean Type 2 DM) (229.87±96.46). The LDL cholesterol value of group B (Obese Type 2 DM) (142.03±28.46) were significantly raised. It is least in group A (Lean Type 2 DM) (112.00±27.03). The HDL cholesterol values in our patients irrespective of their groups were on lower side and least in group B (Obese Type 2 DM) (39.01±6.54).

The VLDL values in our study were maximum in group A (Lean Type 2 DM) (43.09±19.90) and least in group C (Non-obese Type 2 DM) (23.36±5.42).

Evidence of microvascular complications like neuropathy, nephropathy and retinopathy were also maximum in group A (Lean) and minimum in group B (obese). Incidence of microvascular complications like stroke and IHD were maximum in group B (obese) and minimum in group A (Lean).

CONCLUSION

This study shows that Type 2 DM patients can be subdivided on the basis of body weight and also waist-hip ratio. Lean Type 2 DM patients appeared to have relatively more severe form of Diabetes mellitus characterized by higher level of fasting and post prandial venous plasma glucose as well as high level of triglyceride, VLDL cholesterol, glycated haemoglobin, albuminuria. Thus, there is possibility of both greater endogenous insulin deficiency and insulin resistance

Moreover, microvascular complications like neuropathy, nephropathy and retinopathy are much more common in Lean type 2 Diabetes patients while macro vascular complications like stroke and IHD are more common in obese type of diabetes. So lean diabetic patients should be targeted for more intensive therapy and aggressively looked for microvascular complications as well as biochemical alterations[9,14,17]. This also signifies the fact that, there should be high index of suspicion for type 2 DM in lean individuals presenting with typical or atypical presentation, as the traditional risk factors might not be evident in Indian population

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