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Research

Evaluation of Serum Insulin Level as a Marker of Insulin Resistance in Obese with and without Diabetes Type-2

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ABSTRACT

Introduction: Insulin resistance is the greatest risk factor for development of obesity and Type-2 DM. Euglycemia with increased insulin level is one of the salient features in insulin resistance. Techniques for assessment of insulin resistance by HOMA, QUICKI are very tedious, expensive and time-consuming as reported in various researches. On the contrary, estimation of fasting serum insulin is a very easy tool to measure the presence and progression of Insulin resistance but this methodology is not widely explored.

Aim and objective: To measure level of serum insulin in obese persons with and without Diabetes in comparison to normal non-obese non-diabetic controls for determination of Insulin resistance.

Material and methods: This observational case-control study was done in SRMS IMS, Bareilly. A total 60 obese subjects with or without Diabetes as per WHO criteria were chosen from OPD of Medicine Department. They were divided into two groups. Group I consisted of 30 patients without Diabetes and Group II consisted of 30 with Diabetes. They were compared with 30 non-obese non-diabetic controls. Fasting Plasma Sugar and Fasting Serum Insulin were analyzed in all subjects by GOD-POD and ELISA method respectively.

Results: Serum Insulin level in obese persons with Diabetes (Group I) was 38.9+15.29 IU/L and in obese without Diabetes (Group II) was 54.67+24.41 IU/L. There was significant difference between two groups (p=0.002). The level in normal controls (21.11+6.10 IU/L) was also statistically significant (p=0.000) as compared to both the study groups.

Conclusion: Serum insulin level estimation has not only a diagnostic importance but it also has a prognostic and therapeutic importance to prevent high risk population from future disease development and its complication.

Keywords: Insulin Resistance, Serum Insulin Level, BMI, Obesity, Type2 diabetes mellitus (Type 2 DM).

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INTRODUCTION

The association of obesity with Type-2 Diabetes Mellitus (DM) has been recognized for decade and the major basis for this link is the ability of obesity to endanger insulin resistance, which is the fundamental aspect of the etiology of Type-2 DM [1]. Insulin resistance is the greatest risk factor for the development of Type-2 Diabetes Mellitus and is perhaps the greatest current health threat to our nation [2].

Techniques for assessment of insulin resistance by HOMA, QUICKI are very tedious, expensive and time-consuming as reported in various researches. On the contrary, estimation of fasting serum insulin is a very easy tool to measure the presence and progression of Insulin resistance but this methodology is not widely explored. Insulin resistance can be determined effectively from Serum insulin and fasting blood glucose level estimation in obese with and without diabetes persons [3].

Obesity also plays a central role in the insulin resistance syndrome, which includes hyperinsulinemia, hypertension, hyperlipidemia, Type-2 Diabetes Mellitus, and an increased risk of atherosclerotic cardiovascular disease. Globally the incidence of diabetes reported in children and adult has increased alarmingly [4,5].

For further understanding of development of T2 DM in obese persons without it in long run, it is essential to estimate serum insulin level in both the category (obese with T2 DM and without T2 DM). It is found in western countries that there is a significant increase in serum insulin level for many years in obese patient before they become permanently diabetic [6].

Moreover, serum insulin level estimation has not only a diagnostic importance but it also has a prognostic and therapeutic importance to prevent high risk population from future disease development and its complication [7].

So in our study, we want to investigate serum insulin level as a biochemical marker for insulin resistance in obese person with and without T2 DM to know whether there is hyperinsulinemia present or not and side by side the correlation of obesity (BMI) with serum insulin level in both these group of subjects in comparison to normal controls in our local population, Bareilly, Uttar Pradesh.

AIM AND OBJECTIVES

Aim

The aim of this study was to measure level of serum insulin for identification of insulin resistance in obese persons with or without diabetes in comparison to non-obese non-diabetic controls.

Objectives

- To measure fasting serum Insulin Level, FBG in obese persons with or without Diabetes in comparison to non-obese non-diabetic control group.
- To find out correlation between BMI and fasting Serum Insulin level in all these groups.

MATERIALS AND METHODS

This study was done in the Department of Biochemistry and Medicine, Shri Ram Murti Smarak Institute of Medical Sciences (SRMS IMS), Bareilly, U.P

It is an observational case control study. 60 (30 male and 30 females) obese persons (>40 years age) were participated for the study attended in Medicine department OPD of SRMS IMS. Out of 60 subjects, 30 were clinically and laboratory confirmed freshly diagnosed obese diabetic (as per WHO criteria) 8 and rests 30 were obese without diabetes (as per WHO criteria) [8]. Age and Sex matched 30 non-obese non-diabetic control subjects were also included in this study for comparison.

After obtaining written informed consent from all the 90 subjects under study, Serum Insulin and fasting Plasma glucose were estimated in Department of Biochemistry, SRMS IMS. This study was conducted from January 2015 to December 2015.

The study Commenced after obtaining due permission from Institutional Ethical Committee. Proper informed written consent was obtained from all the subjects after describing all pros and cons of the study.

All the subjects were divided into 3 groups selected on the basis of BMI.

Group I Consisted of 30 obese persons (BMI>25) freshly diagnosed as Type-2 diabetes mellitus confirmed by clinical and laboratory investigations.

Group II Consisted of 30 obese persons (BMI>25) without Type-2 DM

Group III Consisted of 30 non obese non diabetic healthy persons (BMI<25).

METHODOLOGY

The estimation of Plasma glucose and Serum Insulin was done by the following method.

Method of Fasting Plasma Glucose estimation (FPG)

FPG was estimated by enzymatic method, making use of Glucose oxidase and Peroxidase (GOD-POD) method as described by Trinder (1969).

Method of serum insulin level estimation

The quantitative estimation of Insulin in human serum was done by ELISA method using ELISA kit from IBL International GMBH, Flughafenstr. 52A, 22335 Hamburg, Germany. The Insulin ELISA is an enzyme immunoassay for the quantitative in vitro diagnostic measurement of Insulin in serum and plasma.

OBSERVATION AND RESULTS

Table 1 shows the distribution of subjects within 30 obese diabetic, 30 obese non-diabetic and 30 healthy non obese non-diabetic controls.

Table 1: Distribution of subjects with 30 obese diabetic and 30 obese non-diabetic and 30 healthy non obese non-diabetic controls.

Group	BMI (Kg/m^2)	No. of cases
Obese	>25	60
Obese without type 2 DM	>25	30
Obese with type 2 DM	>25	30
Control	<25	30

Table 2 shows the variation of BMl in obese cases with and without DM Type 2.

Table 2: No significant variation in BMI in both the groups.

Group	No. of cases	BMI			p value
		Range	Mean	SD	
Obese without DM Type 2	30	26.4-41.0	32.4	2.78	0.0849
Obese with DM Type 2	30	26.4-41.2	30.88	3.85	

Variation of Fasting Blood Glucose level in obese cases without type 2 DM and control Group was shown in **Table 3**.

Table 3: Statistically insignificant FBG variation among Normal and obese without Type-2 DM groups.

Group	No. of cases	Fasting blood glucose (mg/dl)			p value
		Range	Mean	SD	
Obese without DM Type 2	30	83-125	104.76	10.66	
Control group(Normal)	30	54-112	86.63	12.47	0.105

Comparison of serum insulin levels in three groups was shown in **Table 4**.

Table 4: Significant difference in serum Insulin level in between all the three groups.

One way ANOVA test (Analysis of variance)					
	Sum of squares	df	Mean square	F	Sig.
Between groups	16917.795	2	8458.897	29.262	0.000
Within groups	25149.878	87	289.079		
Total	42067.673	89			

Post Hoc tests with multiple comparisons. The significant difference in serum Insulin level between all the three groups was shown in Table 5.

Table 5: The significant difference in serum Insulin level between all the three groups.

Group	Group	Mean difference	Std. error	Sig.	95% Confidence interval	
					Lower bound	Upper bound
1	3	17.79000*	4.38998	0	7.0734	28.5066
2	1	15.77333*	4.38998	0.002	5.0567	26.4899
	3	33.56333*	4.38998	0	22.8467	44.2799
3	2	-33.56333*	4.38998	0	-44.2799	-22.8467
* The mean difference is significant at the 0.05 level 1: Obese with Diabetes group; 2: Obese without Diabetes; 3: Normal controls						

The p value between group 1 and 2 (i.e.; between obese with diabetes and obese without diabetes) is 0.002 (<0.05). The p value between group 1 and 3 (i.e.; between obese with diabetes and normal controls) is 0.002 (<0.05).The p value between group 2 and 3 (i.e.; between obese without diabetes and normal controls) is 0.000 (<0.05).

The 3-D diagram of variation in serum Insulin level in obese persons (both the groups with diabetes and without diabetes) than normal controls was shown in Figure 1.

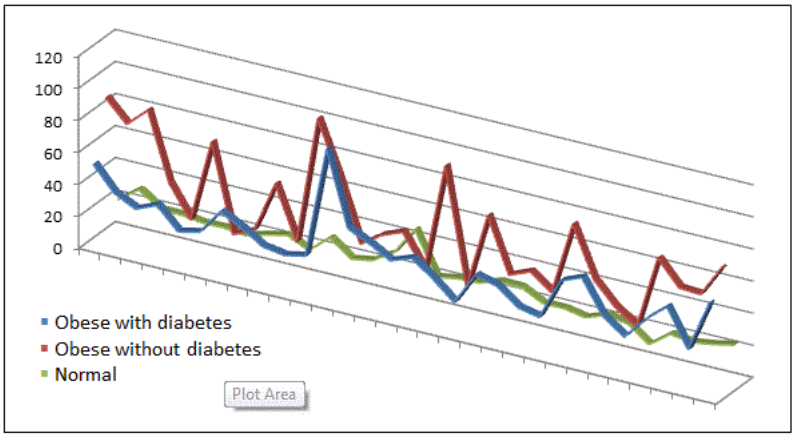

Figure 1: The variation in serum Insulin level in obese persons (both the groups with diabetes and without diabetes) than normal controls.

Correlation between BMI and serum insulin in obese with and without diabetes and normally healthy controls are shown in Tables 6-8.

Table 6: The positive correlation between fasting serum Insulin level and BMI in Obese with Diabetes Group.

Pearson correlation	BMI	Insulin
BMI in obese with Diabetes	r=0.231*	
Sig. (2-tailed)		
*Correlation is significant at the 0.05 level (2-tailed).		

Table 7: The positive correlation between fasting serum Insulin level and BMI in Obese without Diabetes Group.

Pearson correlation	BMI	Insulin
BMI in obese without Diabetes	r=+ 0.191*	
Sig. (2-tailed)		
*Correlation is significant at the 0.05 level (2-tailed).		

Table 8: The negative correlation between fasting serum Insulin level and BMI in normal healthy control Group.

Pearson correlation	BMI	Insulin
BMI in normal healthy Controls	r=-0.079*	
Sig. (2-tailed)		
*Correlation is significant at the 0.05 level (2-tailed).		

DISCUSSION

Obesity and Type-2 Diabetes Mellitus (T2 DM) is a global health problem. Worldwide more than 150 million people are suffering from these diseases presently. Asian Indian phenotype has an increased susceptibility to diabetes mellitus. India has been described as the diabetes capital of the world, every fifth diabetic in the world is an Indian.

Panag et al. [9] in their study clearly evaluated fasting serum insulin level as a very specific and sensitive marker for assessment of insulin resistance. They said that fasting insulin (FI) level can be used as an easy test to detect insulin resistance in obese patients. They also said that FI test had significant sensitivity and specificity when compared to McA, HOMA and QUICKI indices.

FI gives parallel results to the assessment of IR by other methods. Significant positive correlation was found between FI and BMI in study group ($P<0.005$). Coefficient of correlation was +0.40. Mean ± SD of FI and BMI was 25.9 ± 1.58 and 27.29 ± 8.64, respectively.

In our study we also observed that serum insulin level correlates well with BMI in obese with and without diabetes group (r=+0.231 and +0.191 respectively) (Tables 6-8).

It is very much evident from natural history of Diabetes that before onset of permanent Type 2DM for a long period (4-7 years) [6] there was progressively increasing insulin resistance as well as decreasing serum insulin level. At the critical point where the decreasing serum insulin level is not sufficient enough to normalize the blood glucose level flu-fledged diabetes develop. So, as the insulin resistance is getting higher and higher, more and more insulin is required to meet the increased sugar level to make it normal and it creates more pressure on beta cell machinery to produce it. In this high demand (a stressful situation) earlier beta cell failure takes place and the situation worsen more rapidly leading to Diabetes.

In our study we found a significant change in the level of Insulinbetween all the three groups of people, i.e. in between the obese with DM-2 and control subject (normal persons), between obese without DM-2 and control subject and also in between obese with DM-2 and obese without DM-2 (Table 5).

We also found that the Increased Levels of serum Insulinin the Obese without Diabetes Mellitus and Obese with Diabetes Mellitus in this study. The levels were 54.67 ± 24.41 IU/L and 38.90 ± 15.29 IU/L respectively.

Chaour et al. [10] said that increased fasting serum insulin level not associated with hypoglycemia, it is considered to be a practical indicator of the insulin resistance syndrome, a frequent risk factor for atherosclerosis in industrialized countries. In that study they examined the correlations between the insulin resistance syndrome and 'true' fasting serum insulin level.

They found that there was a significant correlation between elevated 'true' fasting serum insulin level and various constituents of the insulin resistance syndrome, such as obesity, dyslipidemia (hypertriglyceridemia, increased apolipoprotein B and decreased high-density lipoprotein cholesterol and apolipoprotein A1 concentrations), increased serum glucose, as well as increased frequency of diabetes. Most of these correlations were also noted in non-diabetic people. Thus an increase of 'true' fasting serum insulin level is a useful practical index to identify patients with the insulin resistance syndrome exposed to increased risk of coronary artery disease.

Similar kind of results had also been observed in our result regarding fasting blood glucose level variation in all the three groups ($p<0.0001$).

Hyperinsulinemia is a well-established marker of insulin resistance [11] in obese and pre-diabetes who in future may develop permanent diabetes (type 2). It is evident from our study that there is a significant increased level of Hyperinsulinemia (I.e.: insulin resistance) in both the group of patients (obese without diabetes and obese who are newly diabetic) than normal population.

It can also be concluded from above study that the moment beta cell failed to produce such high level of insulin due to high insulin resistance, patient became diabetic (level of serum insulin is lower in diabetic people than obese without diabetes).

CONLUSION

It is evident from our study that the level of serum insulin is lowering in obese with diabetic people than obese without diabetes. As the incidence of obesity and pre-diabetic population is growing very rapidly, it is very significant to estimate the status of insulin resistance (by measuring serum insulin level) in this population group so that effective preventive measures can be initiated at very early stage.

So, this study will help us in future to guide more and more patients and their physicians to correlate between obesity and diabetes.

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