ORIGINAL ARTICLE

Comparison of Serum Insulin Levels in Obese Hypertensive, Non-Hypertensive and Healthy Males

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ABSTRACT

Background: High blood pressure (BP) is considered to be the major cause of cardiovascular problems like cerebral stroke, myocardial infarction and heart failure. The relationship between hypertension and obesity, which are most common and major health hazards, is long being explored. Metabolic syndrome is the commonest complication seen in obese individuals in which there is insulin resistance that leads to failure of pancreatic β-cells, hence glucose tolerance is deranged resulting in type 2 DM, hypertension and heart diseases.
Aim: To measure and compare serum insulin levels in obese hypertensive, non-hypertensive and healthy males and to determine the role of insulin resistance in hypertension as insulin resistance in obesity.
Methods: A comparative study was conducted at Lahore General Hospital LGH, Lahore, on 84 male subjects (age 35-55 years) divided into obese non-hypertensive (n=32) and obese hypertensive (n=32) groups, according to WHO classification of obesity and 7th JNC report for evaluation of blood pressure and are compared with healthy controls (n=20). The anthropometric profile (height and weight) was taken and BMI was calculated and BP was recorded. Serum insulin was assessed in three groups, using standard laboratory techniques.
Results: Insulin levels are higher in obese hypertensive and non-hypertensive groups
Conclusion: Compensatory hyperinsulinemia in obesity maintains blood sugar levels and its role in hypertension, is excluded as levels of insulin are increased equally in non-hypertensive group.
Keywords: Insulin, hyperinsulinemia, obesity, hypertension

INTRODUCTION

In recent years the prevalence of obesity has increased radically and is commonly related with DM, hypertension and coronary artery disease. Resistance to insulin is an important facet of these diseases grouped together as metabolic syndrome. Insulin resistance is a condition that is dependent on extra amount of insulin to obtain the desired effects which normally are obtained by a lower level of insulin (Kadowaki et al., 2006). Evidence shows that metabolic derangements associated with insulin resistance may amplify the risk of cardiovascular disease like hypertension (Hall et al., 2014).

Obese individuals have noticeably higher levels of insulin which are essential for the maintenance of metabolism of glucose and fatty acids. Furthermore as these subjects have insulin resistance, the peripheral tissues are therefore affected. Hyperinsulinemia is considered as a main factor leading to obesity related hypertension in the recent years. . It is believed by many researchers that resistance to insulin has a role in the regulation of BP, as in an insulin resistant state the insulin mediated vasodilatation is impaired which may lead to hypertension. Experimentally in healthy subjects it is observed that when insulin is infused it stimulates the action of endothelin-1 and NO. In hypertensive individuals it is seen that there is decreased insulin dependent vasodilatation which is related to markedly lower NO production in the endothelium. It is also seen that insulin enhances reabsorption of sodium by the kidneys (Aneja et al., 2004). Insulin regulates the pathways calculating lipid uptake at different levels. Elevated insulin levels are linked to obesity, relative hyperinsulinemia could enhance weight gain that leads to beta-cell collapse (Templeman et al., 2017).

In obese individuals elevated levels of insulin are attributed to diminished sensitivity to insulin. It is well developed that insulin promotes glucose entry and consumption by skeletal muscle and adipose tissue. Moreover, predominantly carbohydrate intake in the diet is proposed to be responsible for the high levels of insulin. Other factors contributing to the resistance of insulin in obesity include increased mass of adipose tissue as large hypertrophic adipocytes are less sensitive to insulin. In animal and human studies it is observed that predisposition to hypertension by stimulation of the SNS is mediated by insulin. The sympathetic nerve endings release noradrenaline that increases BP by enhancing reabsorption of Na^+ ions by the kidneys, increasing the peripheral vascular resistance and finally increase cardiac output (Landesberg, 1986).

SUBJECTS AND METHODS

This Cross Sectional, Comparative study was conducted in the Department of Physiology, PGMI bird wood road, Lahore, over a period of 1 year. A total of 84 subjects, between the ages of 35-55 were selected from the medical OPD of Lahore General Hospital, Lahore. They were divided into 3 groups; Group A including 20 healthy males, Group B 32 obese non-hypertensive males and Group C obese hypertensive males. After obtaining fully informed written consent from each subject, general and systemic examinations were conducted to rule out any underlying

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disease. Blood pressure was estimated with a mercury sphygmomanometer. Body mass index was calculated using the formula:

$$BMI = \frac{\text{body weight (kg)}}{\text{height } (m^2)}.$$

The patients were asked to fast overnight before the blood sample was collected. Five milliliters of blood was drawn from the anterior cubital vein of the subjects, in sealed disposable syringes after ensuring strict asepsis. The sample was allowed to clot in the syringes. Blood glucose was estimated. Finally, the sample was centrifuged and the serum was separated. It was stored in aliquots in serum cups and placed in freezers at a temperature of -40 ºC. Insulin was measured by using an ELISA kit by NovaTec Immunodiagnostica GmbH, Technologie & Waldpark, Waldstr. 23 A6 D-63128 Dietzenbach, Germany.

RESULTS

Table 1 shows that the mean (mean±SD) serum insulin levels were highly significant in group B and C as compared to controls ($p < 0.001$). The mean serum insulin level in group A was 14.75±9.96µU/ml, in group B was 26.52±12.36 µU/ml and in group C was 27.17±13.18 µU/ml. Multiple comparisons in Table 2 reveals that the difference of mean serum insulin level was highly significant between group A and B having a p- value of 0.003, between group A and C was again highly significant having a p-value of 0.002 and between group B and C was non significant having a p- value of 0.974.

Table 3 reveals that the one way Anova is non-significant for the comparison of blood glucose between the controls and cases (p=0.801). The mean (mean±SD) blood glucose level in group A was 100±7.24 mg/dl, in group B was 100.18±10.19 mg/dl and in group C was 98.75± 9.11 mg/dl. Table 4 shows the difference of mean blood glucose level between the group A and B, it was non significant (p=0.997), between groups A and C was non significant (p=0.881) and between groups B and C was also non significant (p= 0.801). Non significant correlation was found between insulin and blood glucose for any of the groups or the total study population ($r = 0.016$, $p = 0.88$) (Fig. 1).

Table 1 Comparison of means (ANOVA) of insulin in groups A, B and C.

Variables	Group A mean ± SD	Group B mean ± SD	Group C mean ± SD
Insulin (µU/ml)	14.75±9.97	26.52±12.37	27.18±13.19

P value 0.001, Normal fasting insulin levels < 25 µU/ml
** = highly significant

Table 2: Post hoc Tukey test for comparison of insulin between groups A, B and C

Variable	(I) groups	(J) groups	Mean Difference (I-J) µU/ml	p-value
Insulin	A	B	-11.76725	0.003**
		C	-12.42819	0.002**
	B	A	11.76725	0.003**
		C	-.66094	0.974†
	C	A	12.42819	0.002**
		B	.66094	0.974†

**= highly significant †= non significant

Table 3:Comparison of means (ANOVA) of blood glucose in groups A, B and C.

Variables	Group A mean ± SD	Group B mean ± SD	Group C mean ± SD
Blood glucose (mg/dl)	100.00±7.24	100.19±10.19	98.75±9.12

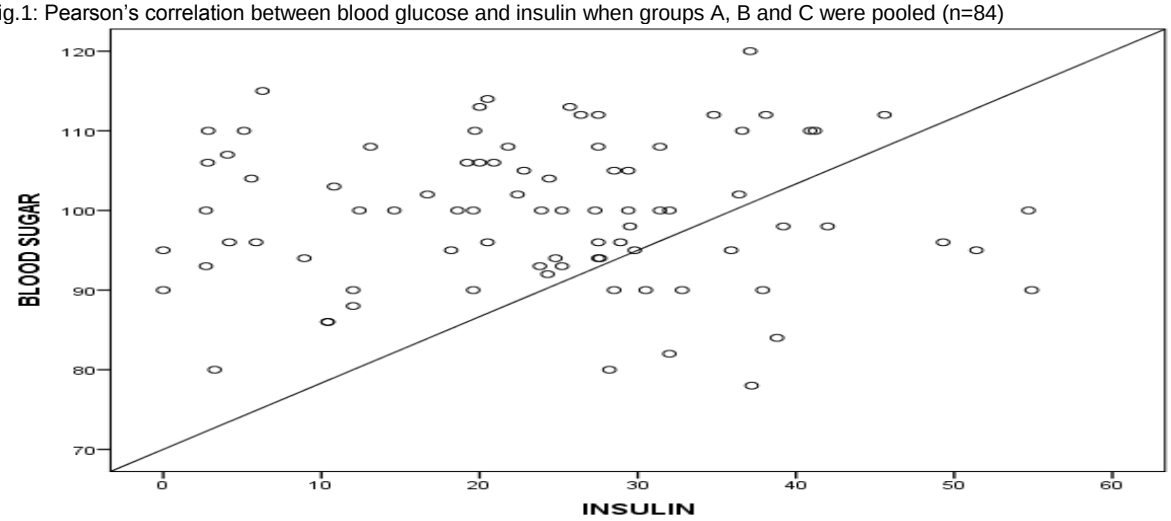
P value 0.801, 0.801†
Normal fasting blood glucose levels 80-100 mg/dl
†= non significant

Table 4: Post hoc Tukey test for comparison of blood glucose between groups A, B and C

Variable	(I) groups	(J) groups	Mean Difference (I-J) µU/ml	p-value
Insulin	A	B	-.1875	0.997†
		C	1.2500	0.881†
	B	A	.1875	0.997†
		C	1.4375	0.805†
	C	A	-1.2500	0.881†
		B	-1.4375	0.805†

†= non significant

Fig.1: Pearson's correlation between blood glucose and insulin when groups A, B and C were pooled (n=84)



Pearson's correlation of insulin and blood glucose in groups A, B and C.

Variables	Group A (n=20)		Group B (n-32)		Group C(n=32)		Overall (n=84)	
	r	p	r	p	r	p	r	p
Insulin and glucose	-.278	0.235†	.189	0.299†	-.024	0.894†	0.016	0.88†

† p- value >0.05 was considered non significant

DISCUSSION

Hypertension is the most important health issue throughout the world, because of the towering pervasiveness and affiliated risk factor for cardiovascular, cerebrovascular and renal diseases (Wang and Scherer, 2007). Over the last decade hypertension has shown escalating trends in economically developing countries and it has been predicted that the number of hypertensive subjects will increase to 1.56 billion by the year 2025 globally (Naik et al., 2012).

Hypertension is directly related with BMI, it indicates that there is increased risk of developing hypertension with raised BMI of a subject, the risk for hypertension rises for both males and females and is strongly related with age and gender (Humayun et al. ,2009).

Insulin levels were significantly higher in the obese non-hypertensive and the obese hypertensive groups when compared to controls with p value of 0.003 and 0.002 respectively.

Despite that the relationship between essential hypertension, insulin resistance and hyperinsulinemia, has been widely studied in the last few years, the underlying link between the aforementioned variables is still questioned. Undeniably, there is even no accord existing to determine the physiological association among resistance to insulin, hyperinsulinemia and the regulation of BP (Reaven 2003).

There may be compensatory hyperinsulinemia in obesity which may excessively stimulate the SNS which in turn releases noradrenaline from the nerve endings of the heart, blood vessels and the kidneys. This results in enhanced reabsorption of sodium, increased cardiac output by the heart and amplified peripheral vascular resistance. All these effects lead to raised BP. The effect of insulin on the renal and SNS present a credible physiological elucidation in the progression of hypertension in obesity (Landsberg 1986).

Compensatory hyperinsulinemia in our study groups keeps the glucose levels within normal range Previously published findings determined that with increased insulin resistance there is higher incidence of type 2 DM, but our study shows the evidence of hyperinsulinemia without presence of diabetes, hence excludes it from the metabolic syndrome.

CONCLUSION

Hyperinsulinemia is abnormally high levels of insulin in the body. This hormone is responsible to maintain proper blood glucose levels. Hyperinsulinemia is most frequently caused by insulin resistance, a condition in which body is unable to respond well to the effects of insulin and the pancreas compensates it by making extra insulin. So resistance to insulin may eventually lead to the development of type 2diabetes and hypertension.

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