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# Study of Insulin Secretory Response after Oral Glucose Load in Hypertensive Subjects

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**Abstracts**: ***Background: Insulin resistance leads to impaired glucose tolerance, dyslipidemia, and other adverse cardiovascular effects. Increased insulin resistance will lead to hyperinsulinaemia which is a characteristic feature of obesity, hypertension and type 2 Diabetes mellitus. Aims: The present study was designed to investigate insulin secretory response and glucose abnormalities after oral glucose load in hypertensive subjects. Material and Method : The present study was carried out on 25 healthy controls and 25 hypertensive subjects of either sex and of varying age groups attending the Out Patient Department of Medicine, Dr. S.N. Medical College and Associated group of hospitals, Jodhpur. Results: The results obtained in this study showed that the results of standard OGTT and corresponding insulin response during fasting & after 1 hour & 2 hour were significantly higher in patients compared with control subjects .Conclusion: The present study indicates an increased insulin secretory response in hypertensive subjects, which is due to higher insulin resistance.***

**Keywords:** Glucose tolerance, Hypertension, Insulin, Insulin resistance, OGTT

## 1. Introduction

Hypertension is the most common of the cardio-vascular diseases which is the leading cause of morbidity and mortality in the industrial world as well as becoming an increasing common disease in the developing countries [1].Hypertension is defined as SBP level higher than 140 mmHg and DBP higher than 90mmHg. Hypertension is characterized by abnormality of cardiac output systemic vascular resistance and arterial compliance. Approximately 25% of adult populations are affected.[2] . Hypertension is one of the ten leading reported causes of death and about4% deaths were due to hypertensive complication.[3] Untreated hypertension is notorious for increasing the risk of immortality and is often described as a silent killer. Mild to moderate hypertension, if left untreated, is associated with a risk of atherosclerotic disease in 30% of people and organ damage in 50% of people after only 8-10 years of onset[4]. The most important risk factors for the development of hypertension are increased salt intake, obesity, cigarette smoking, lack of physical exercise, genetic factors and stress and strain[5].The combination of insulin resistance and hyperinsulinaemia cause a number of metabolic and cardiovascular changes that result in a syndrome typically characterized by type 2 DM, obesity, dyslipidemia, coronary artery disease and hypertension.[6]. In present study an attempt has been made to examine the insulin secretory response to oral glucose load to test whether hypertension is associated with insulin resistance.

## 2. Materials and Methods

The present study was conducted on 50 subjects with either sex and of varying age gp in the Department of Biochemistry, Dr. S.N. Medical College and Associated group of Hospitals, Jodhpur.

The selected subjects were further grouped as:-
**Group 1**: Healthy control subjects (n=25). It was ensured by routine examination that all the subjects were healthy and there were no signs and symptoms of hypertensive and other disease.

**Group 2**: Hypertensive subjects (n=25). It included the clinically established patients of hypertension. There blood pressure is in range of systolic blood pressure (>140 mmHg) and diastolic blood pressure (>90mmHg) and have no symptoms of diabetes mellitus.

An informed consent was taken from all the healthy control subjects and patients, under study apprising them the nature and objective of the study. All subjects were studied as outpatient. Participant's examination included interviews for medical and nutritional history. Present and past history of each case was recorded in detail regarding their general information i.e. name, age, sex, address, religion, occupation, economic status, nutritional and personal habits, education, medication and history suggestive of any systemic illness. Each subject was then examined for various anthropometric parameters: Weight (Kg), height (meters),BMI(Body Mass Index ) was calculated by Weight (Kg) / height squared ($m^2$) and Blood pressure (BP).

After on overnight fast of 10-12 hours, fasting blood samples were collected. OGTT was conducted in all the groups. Then orally 75 gm dose (normally 1 gm per kg body weight) of glucose was given and after 1 hour and 2 hour blood samples were drawn from anticubital vein of each subject by using aseptic technique. The blood was collected in fluoride and plain tubes for blood glucose and other

parameters respectively. Serum was separated after centrifugation and analysed. Following biochemical parameters were analysed by commercially available reagents and kits on semi autoanalyzers and autoanalyzer in Clinical Biochemistry Laboratory, M.G. Hospital, Dr. S.N. Medical College, Jodhpur.

1) Glucose by GOD-POD method.[7],
2) Serum Insulin by ELISA Method.[8] ,
3) Insulin Resistance: Fasting Insulin Resistance Index (FIRI) by (HOMA-IR) formula. HOMA IR= fasting insulin (µU/mL) ×fasting glucose (mmol/L)]/22.5

## 3. Results

**Table 1:** Characteristics of study population

| Characteristics | GROUP 1 (N:25) | GROUP 2 (N:25) |
|---|---|---|
| Age | 25.24±4.47 | 42.16±6.13 |
| Male | 13 | 13 |
| Female | 12 | 12 |
| BMI | 22.20±1.27 | 25.11±4.19 |
| Systolic BP (mmHg) | 116±5 | 139.64±9.01 |
| Diastolic BP (mmHg) | 75.6±5.07 | 101.28±9.01 |
| Fasting Blood Sugar (mg/dL) | 76.76±6.71 | 86.61±7.27 |
| 1 Hour Blood Sugar (mg/dL) | 97.02±19.42 | 108.48±10.51 |
| 2 Hour Blood Sugar (mg/dL) | 89.95±8.18 | 99.24±11.08 |
| Fasting Serum Insulin (µIU/mL) | 13.52±3.94 | 35.09±9.14 |
| 1 Hour Serum Insulin (µIU/mL) | 32.23±7.16 | 60.20±17.70 |
| 2 Hour Serum Insulin (µIU/mL) | 25.22±6.95 | 50.47±14.39 |
| Serum Insulin Resistance (IR) | 2.55±0.73 | 7.46±1.92 |

**Table 2:** Statistical analysis of blood sugar among the studied (Group II Vs Group I)

| S. No. | Parameter | t value | p value |
|---|---|---|---|
| (1) | Fasting Blood Sugar (mg/dL) | 4.978 | <0.0001[H*] |
| (2) | 1 Hour Blood Sugar (mg/dL) | 2.595 | 0.0125[S*] |
| (3) | 2 Hour Blood Sugar (mg/dL) | 3.373 | 0.0015[V*] |

H* - Highly significant, S* - Significant, V* - Very Significant

**Table 3:** Statistical analysis of serium insulin among the studied (hypertensive vs. healthy control subjects)

| S. No. | Parameter | t value | p value |
|---|---|---|---|
| (1) | Fasting Serum Insulin (µIU/mL) | 10.836 | <0.0001[H*] |
| (2) | 01 hour Serum Insulin (µIU/mL) | 7.325 | <0.0001[H*] |
| (3) | 02 hour Serum Insulin (µIU/mL) | 7.90 | <0.0001[H*] |

H* - Highly significant

**Table 4:** Statistical analysis of serum insulin resistance among the studied (hypertensive vs. healthy control subjects)

| *Parameter* | *p value* | *t value* |
|---|---|---|
| Serum Insulin Resistance (IR) | 11.95 | P<0.0001[H*] |

H* - Highly significant

Table I shows the various baseline characteristics of study population. The mean systolic blood pressure of the healthy controls and hypertensive subjects in the present study was 116.00±5.00 and 139.64±9.01 mmHg . The mean diastolic blood pressure of the healthy controls and hypertensive subjects in the present study was 75.60±5.07 and 101.28±9.01 mmHg respectively.

The mean values for fasting,1 hour and 2 hour plasma glucose for hypertensive subjects were 86.61±7.27, 108.48±10.51, 99.24±11.08 mg/dL whereas 76.76±6.71 , 97.02±19.42, 89.95±8.18 for healthy control subjects respectively (Table 1 and Fig 1).

The Mean fasting serum insulin values were highly significant (t=10.84, p<0.001) in hypertensive subjects (35.09± 9.14 µIU/mL) as compared to the healthy control subjects (13.52± 3.94µIU/mL)(Table 1,3 and Fig 2).

The Mean 1 hour & 2 hour serum insulin levels were 32.23±7.16 µIU/mL & 25.22±6.95 µIU/mL in healthy control subjects and 60.20±17.70, 50.47±14.39 µIU/mL in hypertensive subjects. There difference was highly significant (Table 1,3 and Fig 2).

The mean HOMA IR level was 2.55±0.73 in healthy control subjects, and 7.46±1.92 in hypertensive patients. This difference was highly significant. (p<0.001). )(Table 1,4 and Fig 3).

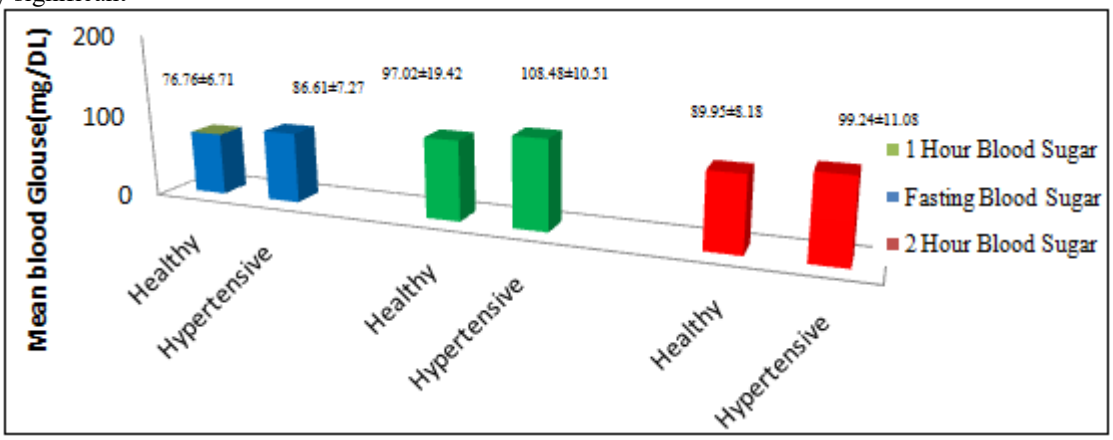


**Figure 1:** The Mean Blood Glucose Level

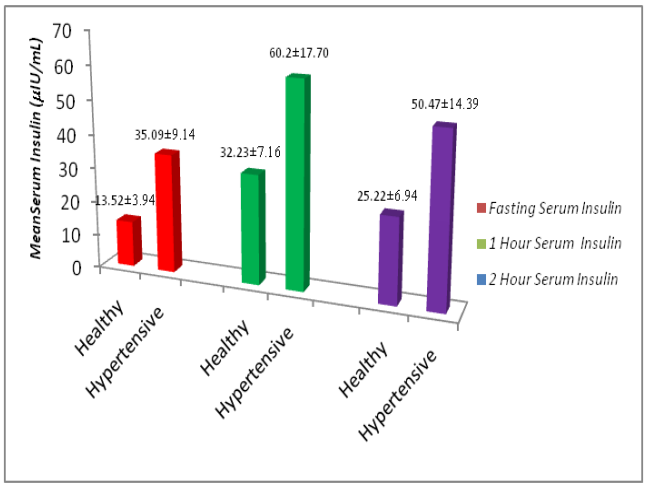


**Figure 2:** The Mean Serum Insulin

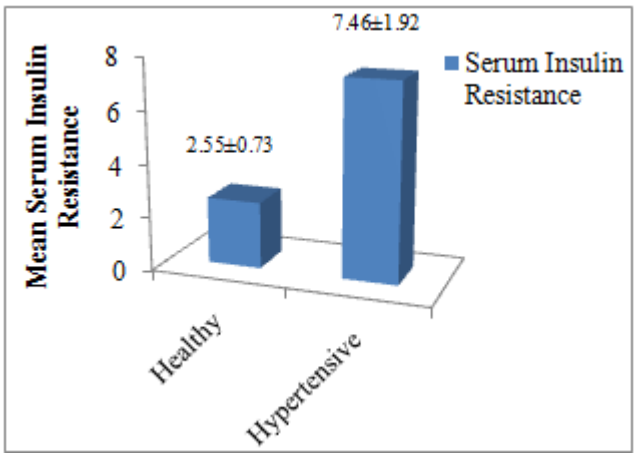


**Figure 3:** The Mean serum Insulin Resistance

## 4. Discussion

Hypertension, obesity, and glucose intolerance (impaired glucose tolerance and noninsulin-dependent diabetes) are so commonly associated as to suggest common pathogenic mechanisms. Impaired glucose tolerance and obesity are characterized by hyperinsulinemia, which reflects peripheral insulin resistance [9]

In this study, we observed Mean fasting blood glucose values were highly significant (t=4.98; p<0.001) in hypertensive subjects (86.58±7.27) as compared to the healthy controls (76.76±6.71). (Table:1, 2 and Fig:1) In accordance to our study, Kumar NL et al[10] (2010) reported a statistically highly significant relation (p<0.001) in fasting blood glucose level in hypertensive subjects (101.62±33.78 mg/dL) as compared to the healthy controls (82.46±10.8 mg/dL).

Our study shows that the mean 1 hour blood glucose values were significant (t=2.59; p<0.05) in hypertensive subjects as compared to the healthy controls. (Table: 2) Costa CH et al [11](1995) also agrees with our study as reported a higher level of blood glucose at 60 min (p<0.05) after oral glucose load in hypertensive (138.7±30.3 mg/dL) as compared with healthy controls (108.7±35.7 mg/dL). Rubies-Part J et al[12] (2001) reported significant higher plasma glucose level at 60 min during OGTT in hypertensive than healthy controls. Pachwani D et al [13](2011) reported significant 1 hour blood glucose level (p<0.05) in hypertensive (174.8±31.8 mg/dL) as compared to the healthy control (132.4±21.6 mg/dL).

In this study ,a statistically highly significant increase in hypertensive subjects (t =4.67; p<0.001) in the mean 2 hour blood glucose values were observed as compared to the healthy control subjects (Table:2) .Our results concur with the study of Shen DC et al[14] (1988) reported highly significant relation (p<0.001) in plasma glucose level after oral glucose load in hypertensive subjects as compared to the healthy controls .Rubies-Prat J et al [12](2001) reported significantly higher plasma glucose level at 120 min during OGTT in hypertensive than healthy controls.

Hyperinsulinemia and insulin resistance are characteristic feature of obesity, non-insulin dependent diabetes mellitus and hypertension[15]. In hypertension, insulin stimulates the sympathetic nervous system with increase sympathetic activity, there is rise in blood pressure through sodium retention. Insulin stimulates the Na+/K+-ATPase pumps .Resistance to insulin leads to an increase in intracellular sodium and a decrease in intracellular potassium as seen in hypertension.[16]

Our study shows that mean fasting serum insulin values were highly significant (t=10.84, p<0.001) in hypertensive subjects (35.09± 9.14 µIU/mL) as compared to the healthy control subjects (13.52± 3.94µIU/mL). (Table:1,3 and Fig: 2) These findings were in accordance with those of Burattini R et al[17] (2009), as they reported a highly significant increase (p<0.001) in fasting serum insulin in hypertensive subjects (53.5±7.0 pmol/L) as compared to the healthy controls (27.7±2.7 pmol/L). Penesova A et al[18] (2011) also observed a highly significant relation (p<0.001) in fasting serum insulin level in between normotensive and hypertensive subjects. Similarly Passa Pet al[19](1993), Zemva A et al[20] (1998) also observed higher fasting insulin concentration in hypertensive as compared to the healthy controls

In present study, a highly significant values (p<0.001) of 1 hour serum insulin was observed when hypertensive subjects were compared with healthy control subjects (Table 3). Similarly Zemva A et al[20](1998) reported higher 1-hour serum insulin level in hypertensive subjects as compared to the healthy controls.

In this study, a highly significant values (p<0.001) of 2 hour serum insulin was observed when hypertensive subjects were compared with healthy control subjects. (Table:3). In accordance to our study, Parchwani D et al[13] (2011) reported a statistically highly significant relation (p<0.001) in 2 hour serum insulin in hypertensive subjects (120.7± 34.2 µU/mL) as compared to the healthy control subjects (46.3± 12.5 µU/mL). Similarly, Shen DC et al[14] (1998) reported a significantly elevated (p<0.001) plasma insulin response after oral glucose load in hypertensive subjects as compared to the healthy controls. Slowinska-Srzednicka J et al[21](1989), Passa Pet al[19](1993) also reported significantly higher insulin response after oral glucose load in hypertensive subjects as compared to the healthy controls.

In the present study, a highly significant correlation ($p<0.001$) in serum Insulin Resistance (IR) was observed when hypertensive subjects were compared with healthy control subjects (Table:4). Similarly, Ferrannini E et al[22] (1987) reported a statistically highly significant relation ($p<0.001$) in serum insulin resistance in hypertensive subjects (6.31±0.42) as compared to the healthy controls (3.80±0.32).Falkner B et al [15](1993) also reported a statistically highly significant relation ($p<0.001$) in serum insulin resistance in hypertensive subjects (6.57±0.63) as compared to the healthy controls (4.69±0.50).

Thus in hypertensive subjects, early diagnosis and treatment of an abnormal glucose metabolism may be particularly important to reduce cardiovascular disease.

## 5. Conclusion

The present study indicates an increased insulin secretory response in hypertensive subjects, which is due to higher insulin resistance. This increased insulin resistance will lead to hyperinsulinaemia which is a characteristic feature of obesity, hypertension and type 2 Diabetes mellitus. Therefore ,all these three are very important risk factors which imposes a cumulative effect on each other and in the etiology and pathogenesis of cardiovascular complications that end up in the development of metabolic syndrome when present together. Subject with either of these should be well screened timely and also after diagnosis.

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