International Journal of Advances in Medicine
Hussain Z et al. Int J Adv Med. 2017 Oct;4(5):1299-1303
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933
DOI: http://dx.doi.org/10.18203/2349-3933.ijam20173731

Original Research Article

A study to find out the relationship between insulin resistance and hypertension

Zakir Hussain[1], Vishwa Deepak Tripathi[2]*

[1]Department of Neurology, Marble City Hospital and Research Centre, Jabalpur, Madhya Pradesh, India
[2]Department of Cardiology, Vindhya Hospital and Research Centre, Rewa, Madhya Pradesh, India

Received: 25 July 2017
Accepted: 11 August 2017

***Correspondence:**
Dr. Vishwa Deepak Tripathi,
E-mail: drvdtripathi@hotmail.com

ABSTRACT

Background: Insulin resistance is the essential defect in the development of type 2 diabetes mellitus, hypertension and cardiovascular diseases. The aim of the present study was to evaluate the correlation between insulin resistance, metabolic syndrome and their associated factors in hypertensive patients.
Methods: This comparative study was conducted on 100 patients who attended to the Department of Medicine, NSCB Medical College, Jabalpur, Madhya Pradesh, India. 50 patients of both sexes having essential hypertension were participated in the study and considered as hypertensive group. Other healthy 50 patients of similar sex and age group were studied as control group (normotensive) for comparison. Insulin resistance was estimated by using homeostasis model assessment (HOMA-IR) method.
Results: Mean age of the patients of hypertensive group was 49.79±17.04 years and mean age of normotensive group was 51.94±16.64 years. Male preponderance was observed in both the groups. Out of 50 from each group, 19 (38%) of hypertensive patients and 7 (14%) of normotensive patients had insulin resistance. Metabolic syndrome was noted in 23 (46%) and 10 (20%) cases of hypertensive and normotensive groups respectively and this difference was found to be statistically significant (p=0.01). The mean fasting and post prandial blood sugar levels were almost similar in both groups (p=0.03). Mean total cholesterol levels were significantly lower in hypertensive groups than that of normotensive group (p=0.03). The mean serum insulin levels were high in hypertensive groups than that of normotensive group which was statistically significant (p=0.00). Mean HOMA-IR, waist size and waist hip ratio (WHR) was significantly (p=0.02) higher in hypertensive group than that of control group.
Conclusions: The results of the present study support the strong correlation between insulin resistance and essential hypertension and also confirmed that insulin resistance was the major risk factor of metabolic syndrome.

Keywords: Correlation, Hypertension, Insulin resistance

INTRODUCTION

Insulin resistance and hyperinsulinemia are recognized risk factors for cardiovascular disease (CVD).[1-3] The resistance to the action of insulin is also accompanied by compensatory increase in insulin secretion by the beta cells and hyperinsulinemia to maintain normoglycemia. The insulin resistance and other cardiovascular disease risk factors seem to be increasing worldwide.[4]

Some reports suggested that insulin resistance syndrome (IRS) is associated with hypertension, while others did not support this view.[4-7] The prevalence of hypertension is rising rapidly worldwide and the impact is particularly being felt in developing countries.[8] This is due to the epidemiological transition taking place in developing countries leading to alarming increases in noncommunicable diseases, especially diabetes and hypertension.[9] India's population has recently crossed the

1 billion mark and it now has the largest number of diabetic patients in any given country in the world.[10] Hypertension is also likely to follow suit. It is possible that risk factors for hypertension vary between developed and developing nations due to changes in genetic and environmental factors (e.g. different levels of obesity, physical activity, and dietary habits). Thus, studies looking at the relationship between insulin resistance and hypertension in developing countries like India are of great interest.

Diabetes mellitus and impaired glucose tolerance (IGT) have been shown to increase the risk of future cardiovascular morbidity and mortality.[11,12] Thus, in hypertensive patients, early diagnosis and treatment of an abnormal glucose metabolism may be particularly important to reduce cardiovascular disease.[13] Hence, the present study was conducted with the aim to evaluate the correlation between insulin resistance, metabolic syndrome and their associated factors in hypertensive patients.

METHODS

This comparative study was conducted on 100 patients who attended to the Department of Medicine, NSCB Medical College, Jabalpur, Madhya Pradesh. 50 patients of both sexes having essential hypertension were participated in the study and considered as hypertensive group. Other healthy 50 patients of similar sex and age group were studied as control group (normotensive) for comparison.

Selection criteria

Adult patients above 14 years and patients who qualify JNC 7 criteria of hypertension were included in the study. Exclusion criteria were patients suffering from diabetes, polycystic ovarian disease, tuberculosis, other systemic illness, liver disorders, renal disorders, congestive cardiac failure, patients on oral contraceptive pills, patients on statins and other medications that are known to affect the study and pregnant women.

Informed consent was taken from all the participants. Anthropometric measurements such as height, weight and BMI were taken for all the patients. Blood samples for the estimation of all the parameters were collected from the patients after an overnight fasting. Insulin levels were assessed by electro-chemiluminescence immuno assay using commercially available kits. Lipid profile and sugar levels were analyzed using commercially available kits. Insulin resistance was estimated by using homeostasis model assessment (HOMA-IR) method.

Statistical analysis

All the data was tabulated and analysed by using mean, standard deviation, proportion and chi square with Rates correction.

RESULTS

Age and sex wise distribution of patients in hypertensive and normotensive group were presented in Figure 1 and 2. Mean age of the patients of hypertensive group was 49.79±17.04 years and mean age of normotensive group was 51.94±16.64 years.

Male preponderance was observed in both the groups. Mean age of males in both the groups was 50.464±17.64 and 52.83±18.86 years respectively and mean age of females in both the groups were 48.78±16.86 and 51.64±15.78 years respectively.

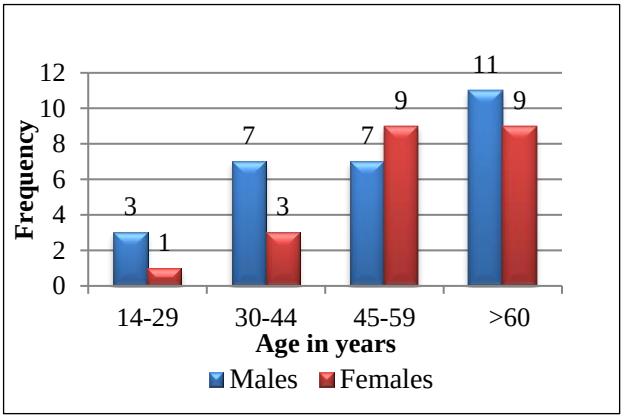

Figure 1: Age and sex wise distribution of patients in hypertensive group.

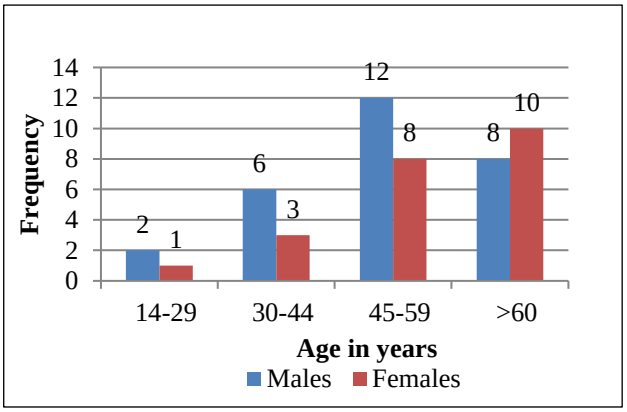

Figure 2: Age and sex wise distribution of patients in normotensive group.

Table 1 presents the incidence of insulin resistance in both hyper and normotensive groups. Out of 50 in each group, 19 (38%) of hypertensive patients and 7 (14%) of normotensive patients had insulin resistance. Statistically significant difference was seen between the two groups with p value of 0.01.

Age and sex wise distribution of insulin resistance was given in Table 2. Insulin resistance was more in the age group of 45-59 and >60 years in both males and females in both groups.

The difference between the incidence of insulin resistance in males in both the groups were found to statistically significant (p=0.03) whereas in case of females an insignificant difference was observed (p=0.09).

Table 1: Incidence of insulin resistance in both hyper and normotensive groups.

Groups	Insulin resistance present n (%)	Insulin resistance absent n (%)
Hypertensive (n=50)	19 (38)	31 (62)
Normotensive (n=50)	7 (14)	43 (86)
Total (n=100)	26 (26)	74 (74)

Table 2: Age and sex wise distribution of incidence of insulin resistance in both groups.

Age group (in years)	Hypertensive group				Normotensive group			
	Male (n=28)		Female (n=22)		Male		Female	
	No	%	No	%	No	%	No	%
14-29	0/3	0	0/1	0	0/2	0	0/1	0
30-44	2/7	28.57	0/3	0	0/6	0	0/3	0
45-59	3/7	42.85	4/9	44.44	2/12	16.66	1/6	16.66
>60	5/11	45.45	5/9	55.55	2/12	16.66	2/8	25
Total	10/28	35.71	9/22	40.90	4/32	12.5	3/18	16.66

From the Table 3, it was observed that out of 50 cases in each group, metabolic syndrome was noted in 23 (46%) and 10 (20%) cases of hypertensive and normotensive groups respectively and this difference was found to be statistically significant (p=0.01).

Table 3: Incidence of metabolic syndrome in both hyper and normotensive groups.

Groups	Metabolic syndrome present n (%)	Metabolic syndrome absent n (%)
Hypertensive (n=50)	23 (46)	27 (54)
Normotensive (n=50)	10 (20)	40 (80)
Total (n=100)	23 (23)	77 (77)

Table 4 demonstrates the age and sex wise distribution of metabolic syndrome in both the groups. Out of 50 cases of hypertensive group, 23 (46%) have metabolic syndrome. Among them 13 (46.42%) males and 10 (45.45%) females had metabolic syndrome. The occurrence of metabolic syndrome was more over the age of >45 years both in males and females. There are 36 cases over the age of >45 years. Out of 36 cases, 21 cases have metabolic syndrome. In normotensive group, the incidence of metabolic syndrome was increased with the increase in age and both sexes showed almost similar number of cases with metabolic syndrome. Statistically significant difference (p=0.04) was seen for the incidence of metabolic syndrome between males of both groups whereas in case of females the difference was statistically insignificant (p=0.33).

Body mass index was calculated for all the patients in both the groups and the results of BMI >25 kg/m2 was presented in Table 5. BMI >25 kg/m2 was present in 27 (54%) patients of hypertensive and 14 (28%) patients of normotensive groups and this difference between the two groups was statistically significant (p<0.01).

Table 4: Age and sex wise distribution of incidence of metabolic syndrome in both groups.

Age group (in years)	Hypertensive group				Normotensive group			
	Male (n=28)		Female (n=22)		Male (n=32)		Female (n=18)	
	No	%	No	%	No	%	No	%
14-29	0/3	0	0/1	0	0/2	0	0/1	0
30-44	2/7	28.57	0/3	05	0/6	0	0/3	0
45-59	4/7	57.14	4/9	44.44	2/12	16.66	2/6	33.33
>60	7/11	63.63	6/9	66.66	3/12	25	3/8	37.5
Total	13/28	46.42	10/22	45.45	5/32	5.62	5/18	27.77

The mean fasting and post prandial blood sugar levels were almost similar in both groups. Mean total cholesterol levels were significantly lower in hypertensive groups than that of normotensive group

(p=0.03). Mean triglyceride values of both the groups were almost similar. The mean serum insulin levels were high in hypertensive groups than that of normotensive group which was statistically significant (p=0.00). Mean HOMA-IR, waist size and waist hip ratio (WHR) was significantly (p=0.02) higher in hypertensive group than that of control group.

Table 5: Body mass index in hyper and normotensive groups.

Groups	BMI >25 kg/m^2 n (%)	BMI <25 kg/m^2 n (%)
Hypertensive (n=50)	27 (54)	23 (46)
Normotensive (n=50)	14 (28)	36 (72)
Total (n=100)	41 (41)	59 (59)

Table 6: Values of metabolic risk factors in hyper and normotensive group patients.

Parameters	Hypertensive	Normotensive	P value
FBS (mmol/l)	5.5±0.6	5.3±0.3	0.03
PPBS (mmol/l)	6.6±0.2	6.1±0.3	0.0000
T. cholesterol (mmol/l)	4.9±0.8	5.3±0.5	0.0034
HDL (mmol/l)	1.06±0.04	1.02±0.08	0.0021
S. triglycerides (mmol/l)	0.45±0.07	0.4±0.08	0.0097
S. insulin (uU/ml)	10.8±0.5	8.6±0.4	0.0000
HOMA-IR	2.81±0.60	2.41±0.7	0.0028
Waist (cm)	88.1±1.2	78.2±1.4	0.0000
WHR	0.88±0.08	0.78±1.6	0.004

DISCUSSION

The prevalence of hypertension is rising rapidly worldwide and the impact is particularly being felt in developing countries.[7] This is due to the epidemiological transition taking place in developing countries leading to alarming increases in non-communicable diseases, especially diabetes and hypertension.[8] India's population has recently crossed the 1 billion marks and it now has the largest number of diabetic patients in any given country in the world. Hypertension is also likely to follow suit.[9]

Present study examined the relationship between insulin resistance and hypertension and we also study the relationship between hypertension and metabolic syndrome. They're very few studies in India on insulin resistance, on the other way diabetes is widely prevalent in India. The International Diabetes Federation (IDF) estimates the total number of diabetic subjects to be around 40.9 million in India and this is further set to rise to 69.9 million by the year 2025.[14]

Although earlier studies suggested an association of hypertension with insulin resistance, the question that still remains unanswered is whether hypertension was associated with insulin resistance per se or with the insulin resistance cluster.[15] Earlier studies have also reported that insulin resistance is associated with hypertension in obese but not in non-obese subjects. In contrast, Ferrannini in an earlier study showed that insulin resistance was associated with hypertension even among lean subjects.[4]

Our study included 50 hypertensive and 50 normotensive persons, and we calculated the insulin resistance by HOMA-IR. The results of the present study showed that fasting blood sugar level, PPBS, HDL cholesterol, serum triglycerides, fasting serum insulin were significantly higher in hypertensive patient as compared to normotensive. These results of our study were comparable with previous study of Sinha et al.[16]

In this study, significantly higher fasting blood sugar (>110 mg/dl) was seen in hypertensive patient (50%) than normotensive patients (24%). Similar findings were noted in the study carried out by Garcia-Puig et al (glucose metabolism in hypertension) and found an abnormal glucose metabolism 68.5% of hypertensive cases.[17]

Increased insulin resistance results in elevated insulin levels that in turn alter the blood pressure by activating sympathetic system and by increasing sodium reabsorption. In our study, HOMA-IR was significantly higher in hypertensive patients 2.81 (±0.6) than in normotensive patients (2.41±0.07). Similar observations were made by Sinha et al.[16]

In our series, metabolic syndrome was present in 46% of hypertensive patient and 20% of normotensive person with a p value of 0.01. Metabolic syndrome was almost equally present in males (46.42%) and females (45.45%) in hypertensive group. But in normotensive group metabolic syndrome was higher in females (27.77%) than males (15.62%). Higher incidence of metabolic syndrome in females compared to males was also reported in studies of Hanefeld et al and Ford et al.[12-13]

In our study, out of 23 hypertensive patients who had metabolic syndrome, 17 (73.91%) hypertensive patient also had insulin resistance and out of 10 normotensive person who had metabolic syndrome, 6 (60%) also had insulin resistance. Higher prevalence rate of metabolic syndrome in females might be related to their higher rates of overweight BMI, as all 5 females who were overweight had metabolic syndrome but not observed in all males.

CONCLUSION

The results of the study confirmed the existence of positive correlation between insulin resistance and hypertension. Correlation between metabolic syndrome, hypertension and insulin resistance was also demonstrated in this study and concluded that majority of the hypertensive patients who had metabolic syndrome are also having insulin resistance and confirms that insulin resistance was the major cause of metabolic syndrome. Hence, accurate therapeutic intervention for controlling insulin resistance was necessary besides treating hypertension, in order to minimize the risk of cardiovascular disorders.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Murray CJL, Lopez AD. Global health statistics: global burden of disease and injury series. Harvard School of Public Health, Boston. 1996:23-6.
2. The World Health Organization. Study group on diabetes mellitus making a difference. World Health Organi-zation, Geneva; 1999.
3. Reaven GM. Role of insulin resistance in human disease (Syndrome X): an expanded definition. Annu Rev Med. 1993;44:121-31.
4. Ferrannini E, Buzzigoli G, Bonadonna R, Giorico MA, Oleggini M, Graziadei L. Insulin resistance in essential hypertension. N Engl J Med. 1987;317:350-7.
5. Mbanya JC, Thomas TH, Wilkinson R, Alberti KG, Taylor R. Hypertension and hyperinsulinemia: a relation in diabetes but not essential hypertension. Lancet. 1988;1:733-4.
6. Saad MF, Lillioja S, Nyomba BL, Castillo C, Ferraro R, De Gregorio M. Racial differences in the relation between blood pressure and insulin resistance. N Engl J Med. 1991;324:733-9.
7. Reddy KS. Hypertension control in developing countries. Generic issues. J Hum Hypertens. 1996;10:33-8.
8. Stern MP, Knapp JA, Hazuda HP, Haffner SM, Patterson JK, Mitchell BD. Genetic and environmental determinants of type II diabetes in Mexican Americans. Is there a "descending limb" to the modernization / diabetes relation-ship? Diabetes Care. 1991;14:649-54.
9. King H, Aubert RE, Herman WH. Global burden of diabetes, 1995-2025. Prevalence, numerical estimates and projections. Diabetes Care. 1998;21:1414-31.
10. Fuller JH, Shipley MJ, Rose G, Jarrett RJ, Keen H. Coronary-heart-disease risk and impaired glucose tolerance. The Whitehall study. Lancet. 1980;1:1373-6.
11. The DECODE study group on behalf of the European Diabetes Epidemiology Group. Glucose tolerance and mortality: comparison of WHO and American Diabetic Association diagnostic criteria. Lancet. 1999;354:617-21.
12. Hanefeld M, Fischer S, Julius U, Schulze J, Schwanebeck U, Schmechel H. Risk factors for myocardial infarction and death in newly detected NIDDM: the diabetes intervention study, 11-years follow-up. Diabetologia. 1996;39:1577-83.
13. Ford ES, Gile WH, Dietz WH. Prevalence of the metabolic syndrome among US adults: findings from the third National Health and Nutrition Examination Survey. JAMA. 2002;287:356-9.
14. Sicree R, Shaw J, Zimmet P. Diabetes and impaired glucose tolerance. In: Gan D, editor. Diabetes Atlas. International Diabetes Federation. 3rd ed. Belgium: International Diabetes Federation; 2006:15-103.
15. Haffner SM, Valdez RA, Hazuda HP, Mitchell BD, Morales PA, Stern MP. Prospective analysis of the insulin-resistance syndrome (syndrome X). Diabetes. 1992;41(6):715-22.
16. Sinha S, Akhter QS, Banik S, Islam MK, Haque M. Correlation Study of Insulin Resistance and Essential Hypertension among Bangladeshi Male Volunteers. JYP. 2015;7(3):200-5.
17. Garcia-Puig J, Ruilope LM, Luque M, Fernandez J, Ortega R, Dal-Re R. AVANT Study Group Investigators. Glucose metabolism in patients with essential hypertension. Am J Med. 2006;119(4):318-26.

Cite this article as: Hussain Z, Tripathi VD. A study to find out the relationship between insulin resistance and hypertension. Int J Adv Med 2017;4:1299-1303.