Original Research Article

Prevalance and clinical profile of metabolic syndrome in hypertensive patients and its correlation with insulin resistance

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ABSTRACT

Background: Metabolic syndrome (MS) is a collection of cardiometabolic risk factors that includes obesity, insulin resistance, hypertension, and dyslipidaemia. Insulin resistance lies at the heart of the metabolic syndrome. The purpose of this study is to study the prevalence, clinical attributes of metabolic syndrome in hypertensive subjects and to find out the correlation between prevalence, clinical attributes of metabolic syndrome and insulin resistance.

Methods: About 200 diagnosed cases of hypertension as per Joint national committee 8 guidelines were included in this cross sectional single centric study. All patients were examined, history enquired and laboratory tests like lipid profile, fasting plasma glucose were done and diagnosis of metabolic syndrome made as per the National Cholesterol Education Program- Adult Treatment Panel III criteria. Insulin resistance was calculated by Homeostatic model assessment method.

Results: Amongst the 200 subjects enrolled, the prevalence of metabolic syndrome in hypertensive subjects was found to be 65%. 93.07% of patients with metabolic syndrome were having blood pressure >150/90 mm hg. The prevalence of metabolic syndrome among smoker males was 54.25%. The most common co-morbidity in these subjects was raised triglycerides (96.29% in males, 90.78% in females) followed by low HDL levels (87.03% in males, 90.78% in females). Insulin resistance was found in 75 out of 130 patients who fulfilled the criteria of metabolic syndrome (57.69%), implying increased correlation of metabolic syndrome in hypertensive patients with insulin resistance (p value <0.05).

Conclusions: It was found that there is increased prevalence of metabolic syndrome in hypertensive patients and it correlates with insulin resistance.

Keywords: Insulin resistance, Metabolic syndrome, Obesity

INTRODUCTION

Metabolic syndrome (Mets) is a cluster of multiple metabolic abnormalities that increases the risk of cardiovascular morbidity and mortality.[1,2]

The cluster includes various combinations of elevated blood pressure (BP), atherogenic dyslipidemia, obesity, abnormal glucose tolerance and insulin resistance (IR) as well as such other abnormalities as pro-inflammatory and prothrombotic states.[2,3] The presence of the metabolic syndrome is associated with an approximate doubling of the risk of cardiovascular disease (CVD) and mortality.[4,5]

Hypertension is an important cardiovascular risk factor with high global prevalence.[6] It is one of the most commonly identified components of the Metabolic syndrome.[7,8] When hypertension and other metabolic risk factors co-exist in an individual, they potentiate one another leading to a synergism that increases the total Cardiovascular disease risk well above that which results from the sum of the individual risk factors.[9]

The NCEP-ATP III criteria for the diagnosis of the Metabolic syndrome were used in this study because of the ease of application in this environment when compared with most other criteria. The pathophysiological and phenotypic aspects adopted for the definition of metabolic syndrome were those defined by NCEP-ATP III and recommended by the Brazilian Guidelines for Diagnosis and Treatment of Metabolic Syndrome and minimum 3 out of 5 criteria are essential for diagnosis:

- Abdominal Circumference >90 cm for men and >80 cm for women
- Triglycerides ≥150 mg/dL
- HDL-C <40 mg/dL for men and <50 mg/dL for women
- Fasting blood glucose ≥110 mg/dL and
- Blood pressure (PA) ≥130 mmHg or ≥85 mmHg.

METHODS

Total 200 diagnosed cases of hypertension as per Joint national committee 8 guidelines as in Table 1 were included in this cross sectional single centric study over a period of one and half years considering the inclusion and exclusion criteria. The consent from all patients were taken before including them in the study. All patients were interviewed as per the proforma and detailed history regarding the hypertension was taken.

Inclusion criteria

- Age more than 18 years
- Diagnosed cases of hypertension as per JNC 8 guidelines
- All persons whether new/recent or old detected hypertensive patients on antihypertensive drugs.

Exclusion criteria

- Pregnant females
- Patients who were on long term steroidal medication or any other medication likely to cause elevated plasma glucose level
- All patients who had undergone bariatric surgery or on anti-obesity medication
- All patients with secondary hypertension (CRF, thyroid)
- All females on oral contraceptives
- Post-partum females or those with gestational hypertension
- Patient having ascites.

All diagnosed cases of hypertension were subjected to measurement of abdominal circumference using World health guidelines i.e. measurement using inelastic tape measure with increments of 0.1 cm, taken midway between iliac crest and lower costal margin in standing position. Laboratory tests like lipid profile, fasting

plasma glucose as per NCEP-ATP III criteria for metabolic syndrome were taken into account.

The DRG Insulin ELISA Kit is a solid phase enzyme-linked immunosorbent assay (ELISA) based on the sandwich principle. The microtiter wells are coated with a monoclonal antibody directed towards a unique antigenic site on the Insulin molecule. An aliquot of patient sample containing endogenous Insulin is incubated in the coated well with enzyme conjugate, which is an anti-Insulin antibody conjugated with Biotin. After incubation the unbound conjugate is washed off. During the second incubation step Streptavidin Peroxidase Enzyme Complex binds to the biotin-anti-Insulin antibody. The amount of bound HRP complex is proportional to the concentration of Insulin in the sample. Having added the substrate solution, the intensity of colour developed is proportional to the concentration of insulin in the patient sample.

Insulin resistance can be estimated using several techniques. The euglycemic insulin clamp is currently the best available standard technique. However, this method is complex and expensive. HOMA can be reliably used in large-scale or epidemiological studies in which only a fasting blood sample is available to assess insulin sensitivity. HOMA model is derived from a mathematical assessment of the interaction between beta cell function and insulin resistance in an idealized model that is then used to compute steady state insulin and glucose concentration. An advantage of the HOMA method is that only a single venepuncture is required so it is simple and easy to use. After obtaining insulin value, insulin resistance was calculated by HOMA-IR formula. Fasting insulin (mIU/L) x Fasting glucose (mg/dL)/405 OR Fasting insulin (micro U/L) x fasting glucose (nmol/L)/22.5 and categorized as in Table 2.

Results were analyzed with appropriate statistical methods done by SPSS software version 18 by using Pearson's Chi-square test and unpaired t-test. P-value of less than 0.05 was considered significant.

RESULTS

Among the 200 hypertensive subjects enrolled as per JNC 8 guidelines 22 as in Table 1, 108 were males and 92 females. The prevalence of metabolic syndrome in hypertension was found to be 65% (130 subjects) with a slight female preponderance (82.6%, 76 females as compared to 50%, 54 males, 1.40:1). Maximum number of these patients were in the fifth decade of life and belonged to the lower socioeconomic strata. The metabolic syndrome score was 3/5, 4/5 and 5/5 in 51 (39.23%), 73 (56.15%) and 6 (5%) of the subjects respectively. Demographics, characteristics and frequency distribution of study population has been described in Table 3 and 4. The most common comorbidity in hypertensive subjects with metabolic syndrome was elevated triglycerides (93.07%) followed

by low HDL levels (89.23%), followed by abnormal waist circumference (75.38%) followed by fasting plasma glucose (8.46%) in both genders.

Table 1: According to JNC 8 guidelines, hypertension may be defined as.

Patient characteristics	Blood pressure
Age <60 yrs	>140/90
Diabetes	>140/90
CKD	>140/90
Age >60 yrs	>150/90

Table 2: Insulin resistance categorised.

Category	Homa score
Normal insulin resistance	<3
Moderate insulin resistance	3-5
Severe insulin resistance	>5

Table 3: Demographics and characteristics of the study population.

	Total	Males	Females
No. of subjects	200	108	92
Age (mean)	56.21±9.9	56.25±10.8	56.16±8.2
Metabolic syndrome (%)	65	50	82.6
Abdominal obesity (%)	75.38	55.55	89.47
High triglycerides (%)	93.07	96.29	90.78
Low HDL (%)	89.23	87.03	90.78
High FBS or treated diabetes (%)	8.46	9.2	7.8
Number of subjects with insulin resistance	98	50	48

Metabolic syndrome was found to be more common in patients residing in urban areas (70 patients, 53.84%), as compared to patients residing in rural areas (60 patients, 46.15%) and found to significant correlation with the severity of hypertension (97 patients, 74.61%) and smoking (51 male patients, 54.25%).
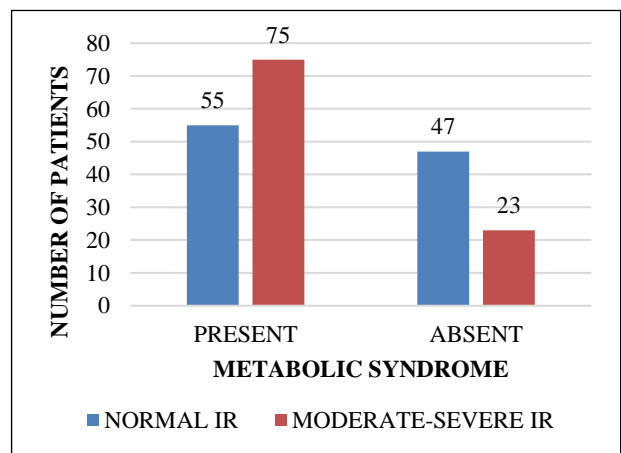
Metabolic syndrome correlation was done with respect to age, demographic profile, hypertension and smoking as described in Table 5. Insulin resistance as categorised in Table 2 was found in 98 patients (Moderate insulin resistance in 58 patients, 29% and severe insulin resistance in 40 patients, 20%).

Table 4: Frequency distribution of various parameters in patients selected for study.

	No. of patients (present)	No. of patients (absent)
Alcoholics	54	146
Smokers	92	108
Hypertensive retinopathy on fundus examination	65	135
LVH on ECG	117	83
LVH on Echocardiography	152	48
Skin tags	52	148
Albuminuria	118	82

Table 5: Comparison of the profile of hypertensive metabolic syndrome patients with those without metabolic syndrome.

	Metabolic syndrome present	Metabolic syndrome absent	P value
Age (in years)			
<50	42	27	0.37
>50	88	43	
Demographic profile			
Urban	70	50	0.01
Rural	60	20	
Hypertension			
>140/90-150/90 mm hg	9	12	0.04
>150/90mm hg and above	121	58	
Smoking			
Present	51	43	0.02
Absent	3	11	

Figure 1: Correlation between metabolic syndrome and insulin resistance.

Insulin resistance had positive correlation with hypertension retinopathy and left ventricular hypertrophy on echocardiography. Insulin resistance had positive correlation with all components of Metabolic syndrome i.e. waist circumference, raised triglycerides levels, low HDL levels along with severity of hypertension as described in table 4. Metabolic syndrome was found to be significantly associated with Insulin resistance (as in Figure 1) with 75 patients out of 130 (57.69%) with p value less than 0.05.

Table 6: Comparison of the profile of insulin resistance patients with those without insulin resistance and correlation with metabolic syndrome.

	Insulin resistance present	Insulin resistance absent	P value
Hypertensive retinopathy			
Absent	53	82	<0.001
Present	45	20	
LVH on Echocardiography			
Present	85	67	0.03
Absent	13	35	
Metabolic syndrome			
Present	75	55	<0.001
Absent	23	47	

DISCUSSION

The study population consisted of 200 hypertensive individuals, there were 108 (54%) males and 92 (46%) females. The mean age of the study population was 56.21±9.9 years. The prevalence of metabolic syndrome calculated according to NCEP ATP III criteria was 65 % that is 130 patients out of 200 hypertensive people. The prevalence of metabolic syndrome studied in newly detected hypertensive people conducted by Anusha Govindula et al, at outpatient department of Mahatma Gandhi Memorial Hospital in Warangal, Telangana, India, among 120 hypertensives patients (75 male, 45 female) with mean age of 53.28±12.98 years, according to NCEP ATP III, showed that 82.5% were falling in this criterion.[10] Similar studies conducted in a tertiary care hospital in the northern hilly state of Himachal Pradesh, India, by Surendhar Thakur et al, showed that the prevalence among 118 hypertensive patients were 68.6%.[11]

The prevalence of metabolic syndrome among male were 50% and among female was 82.6%. The prevalence among female is higher than that of male. In a study conducted in West Ethiopia showed that the prevalence of metabolic syndrome in female according to NCEP ATP III criteria was 46.5% higher, when compared to male which is 31.3%.[12]

The newly detected hypertensive individual in thisstudy were divided into two groups as people <50 years and >50 years of age. The prevalence of metabolic syndrome in these age group on analysis showed that there was no statistical difference in the prevalence based on age group. Similarly, study conducted by Apurva Sawant, Ranjit Mankeshwar et al, in Mumbai, India among 560 subjects showed there was no significant difference in the prevalence of metabolic syndrome among different age groups.[13]

The prevalence of metabolic syndrome belonging to various socioeconomic class according to modified Kuppuswamy scale (2018) was 54.83% among class II and 69.56% among class III. Studies conducted by Zhan Y, Yu J, Chen R et al, in china and by Matthews KA, Räikkönen K et al, showed that prevalence of metabolic syndrome was high in people with low socioeconomic status.[14,15]

In this study, the prevalence of metabolic syndrome among smoker male was 54.25% and the prevalence among non-smoker male was 45.7%, implying increased prevalence of metabolic syndrome in smokers. A study conducted by Sandra N Slagter, Jana V van Vliet-Ostaptchouk et al, showed that increased metabolic syndrome in smokers independent of sex and body mass index.[16]

A similar study conducted by Sang Woo Oh, Yeong Sook Yoon et al, among 24,389 men and 35,078 women showed that current smoking is associated with increased prevalence of metabolic syndrome.[17]

The hypertensive patients divided as (140-150/90) mm hg and (>150/90) mmhg as per JNC 8 guidelines shows that 9 patients (6.92%) have metabolic syndrome in range between (140-150/90) mmhg and 121 patients (93.07%) have metabolic syndrome in patients with blood pressure (>150/90) mmhg, implying increased prevalence of metabolic syndrome in patients with higher blood pressure.

In this study, metabolic syndrome was found to be more common in urban patients (53.84%) as compared to rural patients (46.15%). A similar study by Anoop Misra showed a high prevalence of the metabolic syndrome and associated cardiovascular risk factors has not only in urban South Asian/Asian Indian adults and children but also in economically disadvantaged people residing in urban slums and rural areas.[18]

In this study, the frequency of each component of metabolic syndrome was studied in all 130 patients who fulfilled metabolic syndrome out of 200 hypertensive individuals. The analysis shows that the elevated triglycerides were the most frequent abnormality of all the other components of metabolic syndrome in both gender that is 96.29% in males and 90. 78% in females. In females then it was followed by low High-density lipoprotein (90.78%), abnormal waist circumference (89.47%) impaired fasting blood glucose (7.8%).

In males following elevated triglycerides, low high-density lipoprotein (87.03%), abnormal waist circumference (55.55%), then impaired fasting blood glucose (9.2%). Elevated triglycerides were the most frequent component of metabolic syndrome found among men in this study. In a study conducted in Telengana by Govindula A et al, showed that elevated triglycerides to the most common abnormality among all 5 components according to NCEP ATP III criteria. It is followed by abnormal waist circumference and low high-density lipoprotein.[10]

In the present study, after obtaining fasting plasma insulin value, Insulin resistance was calculated by HOMA-IR formula, as blood pressure increase, insulin resistance increases. A study conducted by Lind L et al, showed that when insulin resistance was defined as an M-value at clamp of <4.4 mg/kg per min, based on calculations from a healthy control sample, about 25% of a sample of hypertensive subjects, taking no antihypertensive treatment and with no history of diabetes mellitus or hyperglycemia was found to be insulin resistant. This group of insulin-resistant hypertensives also displayed a high degree of clustering of other metabolic impairments.[19]

In this study, authors found that the hypertensive subjects who had end organ damage in the form of hypertensive retinopathy had higher insulin resistance (39.25%, 68.62%, 71.42%) as retinopathy progresses.

In this study, authors found out that the hypertensive subjects who had end organ damage in the form of LVH on echocardiography had higher insulin resistance (86.73%) as compared to those with no LVH on echocardiography (13.26%).

A study conducted by Aydin tunckale et al, also found that hypertensive individuals with end organ damage in the form of retinopathy or LVH or both had higher insulin resistance 4.2±1.7 while the subjects who are hypertensive but without end organ damage had insulin resistance 2.6±1.8. The difference was statistically significant (p <0.001).[20]

In this study, authors found out that there is increased correlation of metabolic syndrome in hypertensive patients with insulin resistance. A similar study to find out the correlation between metabolic syndrome and insulin resistance by Karen L. Cheal et al, showed that Insulin resistance and the metabolic syndrome were significantly associated (p <0.001), and the odds of being insulin resistant increased 10-fold for those individuals meeting the criteria for having the metabolic syndrome.[21]

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