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ORIGINAL ARTICLE

Relationship Between Serum Uric Acid Levels and Severity of Hypertension in Adult Patients

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ABSTRACT

Objective: To establish the correlation between serum uric acid and the level of hypertension in adult patients who report to a tertiary care hospital.

Study Design: Descriptive cross sectional study.

Place and Duration of Study: Tertiary care Teaching Hospital (Department of Cardiology and Medicine, Bolan Medical College Hospital, Quetta), between February 2023 to August 2023.

Methodology: Non-probability consecutive sampling was used to enroll 369 adult patients who had diagnosed essential hypertension. Blood pressure was measured by means of standardized protocol and hypertension was diagnosed into stage 1 and stage 2 by using standardized protocols. Estimation of serum uric acid through enzymatic colorimetric technique was done on venous blood samples. Hyperuricemia was considered to be the serum uric acid level exceeding 7.0 mg/dL in men and 6.0 mg/dl in women. The SPSS version 25 was used to analyze data. Quantitative variables have been presented in the form of mean, SD and qualitative variables have been presented in the form of frequencies and percentages. Appropriate statistical tests were used to determine the relationship between levels of serum uric acid and the level of hypertension with a p-value of 0.05 taken as a statistically significant value.

Results: The average age of the participants was 52.611.4. Sixty-one point five percent of the patients had hypertension 2 in stage 2. Stage 2 hypertensive patients had significantly high levels of mean serum uric acid level when compared to patients with stage 1 hypertension (7.3 ± 1.5 mg/dL vs 6.1 ± 1.3mg/dl; p<0.001). Hyperuricemia was high in patients with hypertension of stage 2.

Conclusion: High serum uric acid is closely related with intense hypertension. Serum Uric acid could be an easy and affordable indicator of high-risk patients in resource-constrained environments with regard to severe hypertension.

Keywords: High blood pressure; Urine level; Overuricemia; Blood pressure intensity.

INTRODUCTION

Hypertension is highly widespread non-communicable disease in the world and a major factor in cardiovascular morbidity and mortality. With improved diagnosis and treatment, however, a significant percentage of adult patients remain poorly managed in blood pressure, placing them at risk of stroke, ischemic heart disease, heart failure, and chronic kidney disease. It is thus important to understand some factors that relate to the intensity of hypertension in order to enhance better risk stratification and dictate preventive measures especially in resource-constrained environments[1].

The end product of the purine metabolism in humans is serum uric acid, which has been traditionally perceived primarily as an indicator of gout and kidney problems. Nevertheless, there is growing evidence of possible involvement of hyperuricemia in the etiology and pathogenesis of hypertension. Epidemiological research has revealed that high levels of serum uric acid are common among hypertensive individuals and could be the antecedent of hypertension especially in the younger adult population[2].

Various pathophysiological mechanisms have been put forward to describe the connection between the serum uric acid and hypertension. It is postulated that uric acid causes endothelial dysfunction by decreasing the bioavailability of nitric oxide which causes a defect in vasodilation. Also, hyperuricemia can stimulate the renin-angiotensin-aldosterone system, as well as lead to the development of oxidative stress and inflammation, which subsequently cause the increase in vascular resistance and the prolonged elevation of blood pressure[3].

Both experimental and clinical research has gone further to show that increased levels of uric acid not only can be related to the presence of hypertension, but also its relative severity. The presence of increased serum uric acid levels has been linked to an increase in systolic and diastolic blood pressure results, an increase in arterial rigidity, and an advancement in the stages of hypertension. This correlation does not seem to be dependent on the conventional cardiovascular risk factors in various groups of people[4].

The correlation between serum uric acid and hypertension is of great interest in the study of adults with metabolic comorbidities like obesity, insulin resistance and dyslipidemia. These conditions tend to co-occur with hyperuricemia and can have a synergistic effect in terms of the blood pressure control. In addition, the most frequent antihypertensive drugs, including diuretics, may elevate the serum uric acid level, which makes the disease even more complicated[5].

In the developing nations such as the Pakistani nation, hypertension is commonly diagnosed at late stages and patients usually come with moderate to severe cases. Clinically, therefore, simple and low cost laboratory markers that can be used to identify patients who are at the danger of severe hypertension are of high value. Uric acid estimation in serum is cheap, universally accessible and can be done on a regular basis thus serum uric acid could be a potentially valuable tool in the daily clinical routine[6].

Although the international evidence is increasing, local data and evidence examining the correlation between serum uric acid levels and the extent of hypertension in adult patients is scarce. Differences in genetics, nutrition, and access to health care can create an association, which is why region-specific research should be conducted to produce applicable evidence and make clinical decisions[7,8].

Objective: The purpose was to establish the correlation between the level of serum uric acid and the extent of hypertension among the adult patients.

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MATERIALS AND METHODS

Study Design: The research was carried out as a descriptive cross-sectional research to assess the association between serum uric acid concentrations and the degree of hypertension among adult patients.

Study Setting: The research was conducted in the Department of Cardiology and Medicine, Bolan Medical College Hospital, Quetta, one of the tertiary care teaching hospitals in Quetta, Pakistan. The hospital is a big referral centre of Blouchistan and its hypertensive patients are large in number both urban and rural.

Study Duration: The experiment intended lasted six months between February 2023 and to 2023.

Study Population: The study comprised adult patients, who have a confirmed diagnosis of primary hypertension and presented to the outpatient department or were admitted to the medical wards during the study period.

Sample Size: The WHO sample size calculator was used in calculating the sample size. Assuming a prevalence of hyperuricemia among hypertensive patients of 40, a 95-percent confidence level, and also margin of error of 5 percent, the sample size obtained was 369 patients. All patients with 369 patients who met the inclusion criteria were recruited in the study.

Sampling Technique: Eligible patients were recruited through the non-probability consecutive sampling until the needed sample size was reached.

Inclusion Criteria: They were patients aged 18 years and above of any gender who were diagnosed with essential hypertension regardless of the length of disease and status of using antihypertensives.

Exclusion Criteria: Patients having secondary hypertension, known gout, chronic kidney disease, chronic liver disease, malignancy, acute inflammatory or infectious disease, those taking uric acid-lowering medications were not allowed. Pregnant women and those who did not give consent to take part were also locked out.

Data Collection Procedure: The demographic and clinical information such as age, gender, duration of hypertension, smoking history, body mass index, and antihypertensive medication history was taken at the time of informed written consent using a structured proforma. The calibrated mercury sphygmomanometer was used in measurement of blood pressure as per the standard guidelines. The position of sitting was measured after five minutes of rest, and the average of two measurements made five minutes apart recorded. The diastolic and systolic levels of blood pressure were used to identify hypertension severity as stage 1 and stage 2.

Aseptic venous blood samples were also collected, and then were forwarded to the hospital laboratory where the serum uric acid levels were estimated using an enzyme colorimetric assay. To be consistent, the study used the same laboratory equipment and standardized procedures.

Operational Definitions: Hyperuricemia was considered to be serum uric acid levels of above 7.0 mg/dL in males and above 6.0mg/dl in females. And the severity of hypertension was divided based on international blood pressure staging criteria.

Data Analysis: Statistical Package of Social Sciences (SPSS) version 25 has been used to enter and analyze the data. The age, systolic and diastolic blood pressure, serum uric acid were quantitative variables, which were expressed as a mean with standard deviation. Qualitative variables were given in the form of frequencies and percentages. The chi-square test and independent sample t-test were applied to determine the relationship between the level of serum uric acid and the severity of hypertension where necessary. A p-value of 0.05 or less was taken as significant.

Ethical Considerations: The study was started after getting ethical approval of the Institutional Ethical Review Committee of the hospital. All subjects signed an informed consent. Patient data was kept secret and the participants were assured that nonparticipation would not be noted to influence their healthcare.

RESULTS

The study had a total of 369 adult hypertensive patients. The population of the study consisted of 52.6 years of mean age with a majority of males. Majority of the patients had a long history of hypertension and were taking antihypertensive drugs one or more. Table 1 provides a summary of baseline demographic and clinical characteristics of the study participants.

In the term of severity of hypertension, the proportion of patients with stage 2 hypertension was more than those with stage 1 hypertension. The older patients and those patients who have had more disease years were more likely to have stage 2 hypertension. Table 2 represents the distribution of patients based on the severity of hypertension.

The average serum uric acid of the participants was 6.88 gm/dl. A significant percentage of the patients had hyperuricemia. In stratification by the severity of hypertension, stage 2 hypertension patients had a very high mean serum uric acid level than the stage 1 hypertension patients. Table 3 elaborates on this association between the level of hypertension and serum uric acid levels.

The statistically significant correlation between stage 2 hypertension and hyperuricemia was observed. Patients having high level of serum uric acid were prone to severe hypertension as opposed to patients with normal level of serum uric acid. Table 4 reflects the relationship between the status of hyperuricemia and hypertension severity.

To show the relationship between rising serum uric acid concentration and worsening of hypertension graphical representation was made using grouped mean serum uric acid values at various stages of hypertension. The figures that have been used in this graphical representation are the data in Table 5 which is equal to bar graph to visualize the increasing means of serum uric acid levels with the increasing level of hypertension.

Table 1: Demographic and Clinical Characteristics of Study Participants (n = 369)

Variable	Value
Mean age (years)	52.6 ± 11.4
Gender (Male/Female)	214 (58.0%) / 155 (42.0%)
Mean duration of hypertension (years)	6.9 ± 4.2
Smokers	121 (32.8%)

Table 2: Distribution of Patients According to Severity of Hypertension

Hypertension Severity	Frequency	Percentage
Stage 1 Hypertension	142	38.5%
Stage 2 Hypertension	227	61.5%
Total	369	100%

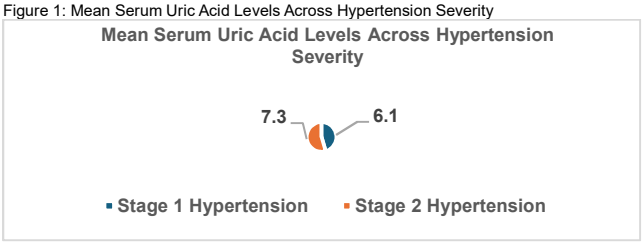
Table 3: Comparison of Mean Serum Uric Acid Levels According to Hypertension Severity

Hypertension Severity	Mean Serum Uric Acid (mg/dL)	Standard Deviation	p-value
Stage 1	6.1	± 1.3	
Stage 2	7.3	± 1.5	<0.001

Table 4: Association Between Hyperuricemia and Severity of Hypertension

Serum Uric Acid Status	Stage 1 Hypertension	Stage 2 Hypertension	Total	p-value
Normal	96 (67.6%)	92 (40.5%)	188	
Hyperuricemia	46 (32.4%)	135 (59.5%)	181	<0.001
Total	142	227	369	

Figure 1: Mean Serum Uric Acid Levels Across Hypertension Severity



DISCUSSION

The current research shows that there is a strong relationship between serum uric acid levels and the level of hypertension in the adult patients. The mean serum uric acid levels were significantly

elevated in patients with stage 2 hypertension than in patients with stage 1 hypertension and hyperuricemia was significantly more widespread in people with serious disease. The findings are in line with the increasing number of evidence that uric acid in serum is not just an incidental abnormality of biochemical importance but could be a significant factor in the progression and severity of hypertension[9].

Other epidemiologic studies have also indicated comparable relationships between high levels of serum uric acid and increased blood pressure measurements. Longitudinal evidence indicates that hyperuricemia could be an antecedent of developing hypertension and could be relevant in developing higher blood pressure control over the years. The relationship that was observed in the present study corresponds to the reports that suggest that high uric acid levels are associated with elevated systolic and diastolic blood pressure and later stages of hypertension[10,11].

The pathophysiological processes of the association are complex. Uric acid has been reported to cause impairment of the endothelial functioning by lowering the bioavailability of nitric oxide, causing vasoconstriction and raising the peripheral resistance. Moreover, hyperuricemia facilitates oxidative stress, vascular smooth muscle cell growth and inflammation, which leads to long term increase in blood pressure and vascular remodeling[12,13]. The severity of hypertension is worsened further by the activation of renin-angiotensin-aldosterone system by uric acid.

The greater correlation found in this investigation with stage 2 hypertension is an indication that serum uric acid may be especially applicable in patients with more advanced disease. This observation agrees with earlier research findings that have also revealed the high concentration of uric acid in poorly managed or resistant hypertension patients. These patients might experience increased endothelial dysfunction and arterial stiffness which might be the reason why a higher level of uric acid was found[14].

Metabolism can also contribute significantly in the relationship between hyperuricemia and intense hypertension. Obesity, insulin resistance, and dyslipidemia are usually linked with high levels of serum uric acid and can have a synergistic effect on the level of hypertension. Though these factors were not specifically examined in an in-depth manner, their co-occurrence in hypertensive populations might be the reason of the observed association partly[15,16].

Clinically, the results of the present research may be used to point out the possible use of serum uric acid as an inexpensive and a simple test to evaluate hypertensive patients at risk of severe disease. In resource-constrained conditions, when sophisticated testing might not be easily accessible, systematic testing of serum uric acid might help clinicians in risk-stratification and in more closely monitoring high-level patients[17,18].

In addition, there is also new evidence that the reduction of serum uric acid level can affect blood pressure positively, especially in early or mild hypertension. Whereas the uric acid - lowering therapy is yet to be recommended in the management of hypertension, the high degree of association herein and in other studies points to the need to conduct additional studies with an aim of exploring the therapeutic possibilities[19,20].

Limitations: This researched work has some limitations. Its cross-sectional format does not allow the causal correlation between the level of serum uric acid and the severity of hypertension. The possible confounding variables like diet, alcohol consumption, insulin resistance and use of certain antihypertensive drugs especially diuretics were not studied in detail. Moreover, the study was single-centered, and this does not necessarily imply that the results can be applied to all the populations. It is suggested that future multicenter/prospective studies should be carried out further to explain the causal relationship of serum uric acid in the development and the intensities of hypertension.

CONCLUSION

This paper concludes that an abnormal level of serum uric acid is strongly linked to a higher intensity of hypertension among adult patients. Patients who had reached stage 2 hypertension showed elevated mean and prevalence of hyperuricemia as opposed to patients with stage 1 disease. The results indicate that serum uric acid can be a valuable, inexpensive biochemical indicator of the presence of hypertensive patients that are at risk of more serious illness, especially in resource constrained environments. Regular evaluations of the serum uric acid in hypertensive patients could contribute to the early identification of risk by predicting the treatment strategies and ensuring their timely optimization, although additional prospective studies are required to prove causality and determine the possible advantages of uric acid-reducing interventions in the management of hypertension.

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