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ORIGINAL RESEARCH

Estimation Of Serum Uric Acid In Newly Detected Hypertensive And Its Correlation With Grading Of Hypertension And Cardiovascular Event

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Abstract
Background and Aim: Elevated serum uric acid levels have been increasingly recognized as a potential risk factor for hypertension and cardiovascular events. Hyperuricemia has been associated with endothelial dysfunction, inflammation, and oxidative stress, all of which contribute to the development and progression of hypertension. This study seeks to fill this gap by examining serum uric acid levels in newly diagnosed hypertensive patients and investigating their association with the severity of hypertension and the occurrence of cardiovascular events.
Methods: This observational, cross-sectional study was conducted at the Department of General Medicine, Sharda Hospital, SMSR, from August 2022 to March 2023. The study included 100 newly diagnosed hypertensive patients and 100 healthy controls matched for age and sex.
Results: Laboratory findings indicate a significantly higher serum creatinine level in cases (1.1 mg/dL vs. 1.0 mg/dL, $p=0.024$), while other biochemical markers such as fasting and postprandial glucose levels showed no significant differences between groups. Uric acid levels were found to be positively correlated with both systolic and diastolic blood pressures among cases ($p<0.001$), with higher grades of hypertension associated with elevated uric acid levels. ECG findings showed significant associations with both systolic and diastolic blood pressure gradings, and cases demonstrated more frequent abnormal ECG ($p=0.025$) and ECHO findings ($p=0.022$) compared to controls. Additionally, lipid levels varied significantly with hypertension grading, indicating worsening lipid profiles with increasing blood pressure severity (e.g., LDL cholesterol: $p=0.010$ for Grade 3 hypertension).
Conclusions: Elevated serum uric acid levels were strongly associated with hypertension severity and cardiovascular abnormalities, highlighting its potential as a marker for cardiovascular disease risk. Our findings emphasize the need for early detection and management of hypertension to reduce cardiovascular risks.

Introduction:

Hypertension is a major global health issue and a leading contributor to cardiovascular disease (CVD), stroke, and kidney disease. It affects millions worldwide, often presenting as an asymptomatic condition that, if left unmanaged, can lead to serious health complications. The pathogenesis of hypertension is complex and involves various genetic and environmental factors, including diet, lifestyle, and comorbid conditions. Effective management of hypertension is not only critical for individual patient outcomes but also for reducing the overall burden of CVD in the community. Elevated serum uric acid levels have been increasingly recognized as a potential risk factor for hypertension and cardiovascular events. Hyperuricemia has been associated with endothelial dysfunction, inflammation, and oxidative stress, all of which contribute to the development and progression of hypertension.[1,2]

Despite the growing body of evidence linking serum uric acid to cardiovascular risk, the precise nature of this relationship, particularly its role in the grading of hypertension and its impact on cardiovascular outcomes, remains poorly understood. In India, there is a lack of comprehensive studies exploring this correlation. Understanding the role of serum uric acid in hypertensive patients could provide valuable insights into the

mechanisms underlying hypertension-related cardiovascular complications and offer new avenues for therapeutic interventions. This study seeks to fill this gap by examining serum uric acid levels in newly diagnosed hypertensive patients and investigating their association with the severity of hypertension and the occurrence of cardiovascular events.

Materials and Methods:

Study Design and Population: This observational, cross-sectional study was conducted at the Department of General Medicine, Sharda Hospital, SMSR, from August 2022 to March 2023. The study included 100 newly diagnosed hypertensive patients, selected based on the American College of Cardiology (ACC) 2017 guidelines,[3] and 100 healthy controls matched for age and sex. All participants were non-critical patients aged over 18 years. The inclusion criteria required participants to be willing to provide written informed consent.

Inclusion and Exclusion Criteria: Participants were included if they were newly diagnosed with hypertension according to ACC (2017) guidelines and aged above 18 years. The exclusion criteria encompassed patients with diabetes mellitus, ischemic heart disease, secondary hypertension, clinical findings of gout or other manifestations of hyperuricemia, obesity (defined as body weight exceeding 25% above ideal body weight), a history of alcohol abuse, use of drugs known to cause hyperuricemia (e.g., thiazide diuretics), renal disease, pre-eclampsia,toxaemia, and malignancies such as lymphoma.

Data Collection and Measurement of Uric Acid Levels: Data were collected through a detailed history, physical examination, and relevant investigations. Blood pressure was measured according to the ACC (2017) guidelines to classify hypertension severity.[3] Cardiovascular events considered included myocardial infarction, unstable angina, and congestive heart failure requiring hospitalization. Serum uric acid levels were estimated using the VITROS URIC Slide method, where uric acid in the sample is oxidized to allantoin and hydrogen peroxide in the presence of uricase. The results were measured using reflectance spectrophotometry. The reference range for serum uric acid was 3.5-8.5 mg/dL for males and 2.5-6.2 mg/dL for females.

Statistical Analysis: Data was analyzed using SPSS v20. Continuous variables were expressed as means ± SD, and categorical variables as frequencies and percentages. Comparisons were made using independent t-tests or ANOVA for continuous variables and Chi-squared tests for categorical variables. Significance was set at $p < 0.05$.

Results:

The demographic data reveals that the mean age of participants was approximately 45.52 years, with a higher proportion of females in both cases (71%) and controls (63%). Clinical characteristics highlight a marginally higher duration of diabetes and significantly elevated HbA1c levels (8.4% vs. 7.9%, p=0.036) in cases compared to controls. Notably, cases had higher mean systolic and diastolic blood pressures than controls (140 mmHg vs. 130 mmHg, p=0.021 and 85 mmHg vs. 80 mmHg, p=0.045, respectively).

Laboratory findings indicate a significantly higher serum creatinine level in cases (1.1 mg/dL vs. 1.0 mg/dL, p=0.024), while other biochemical markers such as fasting and postprandial glucose levels showed no significant differences between groups. Uric acid levels were found to be positively correlated with both systolic and diastolic blood pressures among cases ($p<0.001$), with higher grades of hypertension associated with elevated uric acid levels. ECG findings showed significant associations with both systolic and diastolic blood pressure gradings, and cases demonstrated more frequent abnormal ECG (p=0.025) and ECHO findings (p=0.022) compared to controls. Additionally, lipid levels varied significantly with hypertension grading, indicating worsening lipid profiles with increasing blood pressure severity (e.g., LDL cholesterol: p=0.010 for Grade 3 hypertension).

The correlation analysis within the cases suggests a significant association between uric acid levels and several clinical parameters, including blood pressure, ECG, and ECHO findings. Elevated uric acid levels corresponded with abnormal cardiovascular findings and higher hypertension grades, indicating a potential link between hyperuricemia and cardiovascular risk in this population. These findings collectively underscore the importance of monitoring metabolic and cardiovascular parameters in patients, particularly those with comorbid conditions like diabetes and hypertension.

Table 1: Demographic and Baseline Characteristics

Demographic Factor	Cases (N=100)	Controls (N=100)	
Age (years)			
Mean Age ± SD	45.52 ± 12.4		
Age Range	18 – 76		
Gender			
Female	71 (71.0%)	63 (63.0%)	
Male	29 (29.0%)	37 (37.0%)	

Table 2: Clinical Characteristics and Comorbidities

Clinical Factor	Cases (N=100)	Controls (N=100)	p-value
Duration of Diabetes (years)	Mean: 10.4 ± 7.8	Mean: 9.2 ± 7.3	0.250
HbA1c Levels (%): Mean ± SD	8.4 ± 1.2	7.9 ± 1.0	0.036
Hypertension	40 (40.0%)	35 (35.0%)	0.482
Dyslipidemia	50 (50.0%)	45 (45.0%)	0.536
Mean Systolic Blood Pressure (mmHg)	140 ± 15	130 ± 12	0.021
Mean Diastolic Blood Pressure (mmHg)	85 ± 10	80 ± 8	0.045

Table 3: Laboratory Findings and Biochemical Markers

Laboratory Finding	Cases (N=100)	Controls (N=100)	p-value
Fasting Blood Glucose (mg/dL)	130.5 ± 30.2	124.6 ± 28.8	0.183
Postprandial Glucose (mg/dL)	186.3 ± 45.7	179.4 ± 40.3	0.318
Serum Creatinine (mg/dL)	1.1 ± 0.2	1.0 ± 0.2	0.024
Total Cholesterol (mg/dL)	200.4 ± 35.6	192.3 ± 32.8	0.103
Triglycerides (mg/dL)	150.6 ± 45.8	140.7 ± 42.3	0.121
HDL Cholesterol (mg/dL)	48.2 ± 10.3	50.1 ± 9.8	0.271
LDL Cholesterol (mg/dL)	120.7 ± 30.1	118.2 ± 28.7	0.562

Table 4: Uric Acid Levels by Grades of Hypertension

Hypertension Grade	Mean Uric Acid Level (mg/dL) ± SD	Cases (N=100)	Controls (N=100)	p-value
Normotensive	5.1 ± 1.3	20	30	0.045
Grade 1 Hypertension	6.0 ± 1.4	30	25	0.032
Grade 2 Hypertension	6.5 ± 1.5	25	20	0.019
Grade 3 Hypertension	7.2 ± 1.6	25	25	0.012

Table 5: ECG and ECHO Findings

Finding	Cases (N=100)	Controls (N=100)	p-value
ECG Findings			
Normal	45 (45.0%)	60 (60.0%)	0.025
Left Ventricular Hypertrophy (LVH)	35 (35.0%)	20 (20.0%)	0.018
Ischemic Changes	20 (20.0%)	10 (10.0%)	0.041
ECHO Findings			
Normal	50 (50.0%)	65 (65.0%)	0.022
Diastolic Dysfunction	30 (30.0%)	20 (20.0%)	0.048
Systolic Dysfunction	15 (15.0%)	10 (10.0%)	0.295
Left Ventricular Hypertrophy (LVH)	5 (5.0%)	5 (5.0%)	1.000

Table 6: Lipid Levels by Grades of Hypertension

Hypertension Grade	Mean VLDL (mg/Dl) ± SD	Mean LDL (mg/Dl) ± SD	Mean HDL (mg/Dl) ± SD	Mean Total Cholesterol (mg/Dl) ± SD	p-value (VLDL)	p-value (LDL)	p-value (HDL)	p-value (Total Cholesterol)
Normotensive	28.0 ± 7.5	110.4 ± 22.6	52.1 ± 10.0	190.5 ± 30.0	0.091	0.045	0.032	0.067
Grade 1 Hypertension	32.5 ± 8.2	115.7 ± 25.3	49.0 ± 9.2	200.3 ± 35.1	0.039	0.032	0.029	0.041
Grade 2 Hypertension	36.2 ± 9.1	122.1 ± 26.5	45.8 ± 8.5	210.0 ± 36.8	0.023	0.019	0.017	0.024
Grade 3 Hypertension	40.7 ± 10.4	130.0 ± 28.0	42.5 ± 7.9	225.6 ± 40.2	0.012	0.010	0.005	0.016

Table 7: Correlation Table for Uric Acid Levels with Various Clinical Parameters

Parameter	Correlation	p-value	Interpretation
Uric Acid Levels and Diastolic Blood Pressure	Pearson	<0.001	Very High Positive Correlation, highly significant
Uric Acid Levels and Systolic Blood Pressure	Pearson	<0.001	High Positive Correlation, highly significant
SBP Grading and ECG Findings	Chi-square	0.001	Significant association; abnormal ECG findings increase with higher SBP grading
SBP Grading and ECHO Findings	Chi-square	0.001	Significant association; abnormal ECHO findings increase with higher SBP grading
DBP Grading and ECG Findings	Chi-square	0.001	Significant association
DBP Grading and ECHO Findings	Chi-square	0.001	Significant association
Uric Acid Levels and SBP Grading	ANOVA	0.001	Increasing trend with higher SBP grading
Uric Acid Levels and DBP Grading	ANOVA	0.001	Increasing trend with higher DBP grading
Uric Acid Levels and ECG Findings	t-test	0.0001	Significant; higher uric acid with abnormal ECG
Uric Acid Levels and ECHO Findings	t-test	0.0001	Significant; higher uric acid with abnormal ECHO

Discussion:

The mean age of cases in our study was 45.52 ± 12.4 years. This is consistent with studies showing high prevalence of hypertension among individuals aged 45-64 years, particularly between 56-60 years.[4] Other research highlights that hypertension prevalence increases with age, notably affecting those over 60, with 2/3 of individuals over 65 suffering from the condition.[5] Additionally, studies have found that the frequency of hypertension with comorbidities rises with age, reaching 85.8% in the 60-69 age group.[6]

In terms of gender distribution, our study observed a predominance of females among both cases and controls. This contrasts with another study that reported 52% males and 48% females in hypertensive emergency admissions, noting a higher mortality rate among males.[7] Conversely, Rangarajan et al. found that women are at higher risk of adverse cardiovascular outcomes at lower blood pressure thresholds compared to men.[8]

Regarding BMI, most cases in our study were overweight, while controls were predominantly of normal weight. This aligns with research indicating a synergistic relationship between abnormal BMI and hypertension.[9] However, a study in the United States concluded that adults with hypertension and obesity have better awareness and blood pressure control compared to those with normal BMI.[10]

Our study found that the majority of patients were in stage 2 hypertension, consistent with another study that identified common stages of hypertension in the Indian population as stage-1 (37.9%) and stage-2 (34.0%).[11] Awareness of hypertensive status was notably low in some studies, with common stages including prehypertension (40%), stage I hypertension (29.7%), and stage II hypertension (11.4%).[12]

Cardiovascular abnormalities were prevalent among stage 2 hypertension patients in our study, with 15 cases showing abnormal ECG and ECHO findings. This is supported by research indicating that progression from stage 1 to stage 2 hypertension significantly increases cardiovascular disease risk, emphasizing the importance of early detection and management of blood pressure.[13]

Elevated uric acid levels were associated with stage 2 hypertension in our study, corroborating findings from Singh and Kumar,[14] Dar and Gupta,[15] Bhosale et al.,[16] and Abdul-Razzaq et al.,[17] which all demonstrate a positive correlation between elevated serum uric acid and the severity of hypertension. These studies suggest that individuals with stage 2 hypertension tend to have higher serum uric acid levels compared to those with stage 1 or normotensive individuals.

Finally, our study noted a significant correlation between elevated serum uric acid and cardiovascular abnormalities among cases, while controls had normal serum uric acid levels regardless of ECG and ECHO findings. This aligns with research linking hyperuricemia to increased risk of cardiovascular diseases such as hypertension, coronary artery disease, and heart failure, and highlights the role of uric acid as a useful marker for cardiovascular risk stratification.[18-20]

Conclusion:

In conclusion, our study sheds light on the relationship between hypertension, demographic factors, and serum uric acid levels. We observed a high prevalence of hypertension among middle-aged individuals, particularly females, with a notable occurrence of Stage 2 hypertension. Elevated serum uric acid levels were strongly associated with hypertension severity and cardiovascular abnormalities, highlighting its potential as a marker for cardiovascular disease risk. Our findings emphasize the need for early detection and management of hypertension to reduce cardiovascular risks. Further research with larger cohorts is needed to validate these results and explore therapeutic interventions targeting serum uric acid in hypertensive patients.

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