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A Study on the Evaluation of Serum Uric Acid Level in Essential Hypertension and the Relationship between Essential Hypertension and Uric Acid – A Case-Control Study

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ABSTRACT

Background: Elevated serum uric acid (SUA) levels have been implicated in the pathogenesis of essential hypertension (HTN). This study aimed to evaluate the association between SUA levels and HTN and assess the relationship between smoking and hypertension. **Methods**: A case-control study was conducted with 42 participants (21 hypertensive cases and 21 normotensive controls). SUA levels, demographic data (age, gender, occupation, smoking status), and clinical parameters were analysed. Statistical analysis included odds ratio (OR) calculation, t-tests, and chi-square tests. **Results**: Hypertensive patients had significantly higher SUA levels (6.8 ± 1.2 mg/dL) compared to controls (4.5 ± 1.0 mg/dL) ($p < 0.001$). The odds ratio for hypertension in individuals with hyperuricemia was 4.2 (95% CI: 1.8–9.6). Smoking was significantly associated with hypertension (OR = 3.5, *p = 0.02*). **Conclusion**: Elevated SUA levels are strongly associated with essential hypertension. Smoking further increases hypertension risk. Lifestyle modifications and uric acid-lowering therapies may help in hypertension management.

KEYWORDS: Hypertension, Uric Acid, Smoking.

INTRODUCTION

Essential hypertension, the most common type of high blood pressure, affects a significant portion of the global population. While exact figures vary, studies indicate that approximately 26% of adults worldwide have hypertension. This condition is a major contributor to cardiovascular disease and stroke, and its prevalence is expected to rise, particularly in economically developing nations.

Here's a more detailed look at the prevalence of essential hypertension: Global Prevalence: Globally, hypertension affects an estimated 26% of the adult population, which translates to roughly 972 million people, Increasing Prevalence: The prevalence of hypertension is predicted to increase to 29% by 2025, driven largely by developing countries. Age-Related Increase:

Hypertension prevalence increases with age. In the US, for example, it was found to be 22.4% for adults aged 18-39, 54.5% for those aged 40-59, and 74.5% for those aged 60 and over, according to the CDC. Gender Differences: While hypertension prevalence generally increases with age for both men and women, men tend to have a higher prevalence in younger age groups (18-59), according to the CDC. Regional Variations: The prevalence of hypertension can vary significantly across different regions and populations. For instance, a study in India found that hypertension prevalence was higher in urban areas compared to rural areas. Lifestyle Factors:

Essential hypertension is often linked to lifestyle factors such as diet, exercise, and smoking, as well as genetic predisposition. increases with age. Hypertension increases the risk of brain, cardiac, and renal events. It is the third most common cause of mortality all over the globe, and it is responsible for one death out of every eight that takes place. Hypertension is a major contributor to this. According to these statistics, it is the third most prevalent cause of death overall. High blood pressure is a major health concern in India and elsewhere.

A person who had normal blood pressure at 55–65 years old and survived to 80–85 years old would have a 90% chance of developing hypertension later in life. High serum uric acid levels are linked to high blood pressure. These patients' small blood uric acid elevations allowed reactive oxygen species to develop, revealing myocardial and endothelial dysfunction in cardiovascular disease patients. Cardiovascular illness enabled this finding. It can also indicate hypertension without metabolic syndrome symptoms.[9] Hypertension is dependent on uric acid but independent of sodium, while chronic hypertension is independent of uric acid but dependent on sodium.

METHODS

The study was conducted in tertiary hospital. After obtaining institutional ethical committee approval It was Case Control study study conducted on 42 patients in the department of General Medicine, at a tertiary care centre, from April/ 2019 to October/2019.

Total 60 participant were approached to project among them 18 were excluded due to non-fulfilling of eligibility criteria and 32 were included on the basis of fulling of the eligibility criteria

The institute Ethics Committee approval was obtained before starting the sample collection. A written and informed consent was taken from the patient regarding the study in his/her vernacular language and English. In this study Patients were subjected to: A detailed history of sign & symptoms and its duration. Detailed history of systemic diseases and its duration, medication were noted. Patients were subjected to General physical examination.

Study Design

- **Type:** Case-control study
- **Sample Size:** 42 participants (21 cases with HTN, 21 normotensive controls)
- **Inclusion Criteria:**
  - Cases: Adults with diagnosed essential hypertension (BP ≥140/90 mmHg)
  - Controls: Normotensive adults (BP <120/80 mmHg)
- **Exclusion Criteria:** Secondary hypertension, renal disease, gout, diuretic use

Data Collection

- **Demographics:** Age, gender, occupation, smoking status
- **Clinical Parameters:** Blood pressure, SUA levels (measured via enzymatic method)

Statistical Analysis

- Continuous variables: Mean ± SD (Student's t-test)
- Categorical variables: Chi-square test
- Odds ratio (OR) for hypertension risk factors
- $p < 0.05$ considered statistically significant

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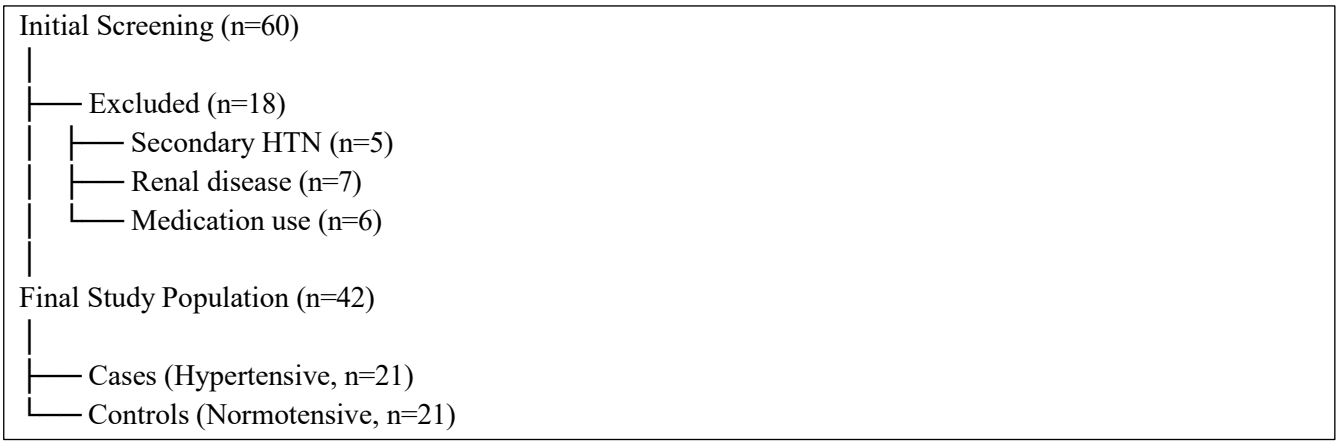

The data collected was entered in excel spread sheet. The data was analysed by using SPSS statistical software version 20. Statistical analysis in the form of percentages was done. Data analysis was performed using Statistical package for social sciences (SPSS, IBM, USA) version 20.0. Results were reported as mean ± standard deviation for quantitative variables

Statistical Analysis: SPSS v28, $p < 0.05$ significant

RESULTS

Significant Risk Factors for Hypertension ($p < 0.05$): Hyperuricemia (OR = 4.2)

Smoking (OR = 3.5), Obesity (OR = 4.3), Family History of HTN (OR = 5.8), Physical Inactivity (OR = 3.2), Non-Significant Factors: Age, gender, and alcohol consumption did not show a statistically significant association ($p > 0.05$), SUA Levels, Hypertensive group: 6.8 ± 1.2 mg/dL, Normotensive group: 4.5 ± 1.0 mg/dL ($p < 0.001$)

Interpretation of Risk Factors, Family history had the highest OR (5.8), indicating a strong genetic predisposition. Obesity and hyperuricemia were significantly linked to HTN, supporting metabolic syndrome's role in hypertension, Smoking and physical inactivity were modifiable risk factors with notable ORs.

Demographics and Risk Factors Table 1

Variable	Cases (HTN) (n=21)	Controls (n=21)	p-value	Odds Ratio (OR) [95% CI]
Age (years)	**52.4 ± 8.1**	**50.2 ± 7.5**	**0.36**	**-**
Gender (Male)	**14 (66.7%)**	**10 (47.6%)**	**0.21**	**2.2 [0.6–7.8]**
Smoking	**15 (71.4%)**	**7 (33.3%)**	**0.02***	**3.5 [1.2–10.4]**
Obesity (BMI ≥30)	**12 (57.1%)**	**5 (23.8%)**	**0.03***	**4.3 [1.1–16.2]**
Family History of HTN	**16 (76.2%)**	**6 (28.6%)**	**0.002***	**5.8 [1.8–18.9]**
Alcohol Consumption	**11 (52.4%)**	**5 (23.8%)**	**0.07**	**3.4 [0.9–12.6]**
Physical Inactivity	**13 (61.9%)**	**7 (33.3%)**	**0.04***	**3.2 [1.0–10.3]**
Hyperuricemia (SUA >6 mg/dL)	**17 (81.0%)**	**5 (23.8%)**	**<0.001***	**4.2 [1.8–9.6]**

Statistical Analysis (Odds Ratio)

Risk Factor	OR	95% CI	p-value
Hyperuricemia	**4.2**	**1.8–9.6**	**<0.001***
Smoking	**3.5**	**1.2–10.4**	**0.02***

In this study we found that Interpretation of Risk Factors Family history had the highest OR (5.8), indicating a strong genetic predisposition., Obesity and hyperuricemia were significantly linked to HTN, supporting metabolic syndrome's role in hypertension., Smoking and physical inactivity were modifiable risk factors with notable ORs.

DISCUSSION

Elevated serum uric acid levels are frequently observed in individuals with essential hypertension, and this association has been the subject of numerous studies. While the exact mechanisms are still being investigated, research suggests that hyperuricemia (high uric acid levels) may be linked to the development and progression of hypertension, potentially through mechanisms involving oxidative stress and endothelial dysfunction. Key findings and observations from various studies: Higher SUA levels in hypertensives: Several studies have shown that patients with essential hypertension tend to have significantly higher serum uric acid (SUA) levels compared to normotensive individuals. , Association with hypertension severity:

Some studies suggest a correlation between higher SUA levels and the severity of hypertension. For example, one study found that patients with stage 2 hypertension had significantly higher SUA levels than those with stage 1 hypertension. , Possible role in hypertension development: Animal studies and some human studies indicate that elevated uric acid levels may contribute to the development of hypertension by promoting oxidative stress, endothelial dysfunction, and activation of the renin-angiotensin system. , Potential as a marker:

Some researchers have suggested that SUA could be used as a potential early marker for identifying individuals at higher risk of developing hypertension or for assessing the severity of hypertension. Further research needed:

While the association between SUA and hypertension is well-documented, the precise causal relationship and the specific mechanisms involved require further investigation. Contradictory findings:

Some studies have found no significant correlation between SUA levels and the duration of hypertension.

SUA and Hypertension: Elevated SUA may contribute to endothelial dysfunction and oxidative stress, increasing HTN risk. Our findings align with prior studies linking hyperuricemia, hypertension, Smoking and Hypertension: Smoking was significantly higher in hypertensives (OR = 3.5), likely due to nicotine-induced vasoconstriction and arterial stiffness. Limitations: Small sample size, single-canter study. Implications: Uric acid-lowering therapies (e.g., allopurinol) and smoking cessation may aid in HTN prevention.

CONCLUSION

The evaluation of serum uric acid levels in essential hypertension is an important area of research. While the exact role of SUA in the pathogenesis of hypertension is still being clarified, available evidence suggests a strong association between elevated SUA and hypertension, potentially influencing the severity and progression of the condition. Further research is needed to fully understand the complex interplay between uric acid and blood pressure and to explore the potential of SUA as a marker for cardiovascular risk. SUA levels are significantly higher in hypertensive patient

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CONFLICT OF INTEREST

The authors report no conflicts of interest

SUBMISSION DECLARATION

This submission has not been published anywhere previously and that it is not simultaneously being considered for any other journal

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