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Study of Uric Acid Level in Newly Diagnosed Hypertensive Patients in Tertiary Care Centre, Barabanki

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Abstract: <u>Background</u>: The "quiet executioner" moniker for hypertension (HTN) comes from the fact that the condition often goes undiagnosed and unnoticed by its victims. The presence of high amounts of uric acid can cause an overexpression of both of these vasoconstrictor molecules, leading to the development of hypertension. Additionally, uric acid can mediate the onset of hypertension via a crystal - dependent mechanism. Evidence of monosodium urate deposits has been reported in various organs and tissues, including the renal medulla, heart valves, arteries, and atherosclerotic plaque. Aim: To study association between newly diagnosed hypertensive patients and their serum uric acid levels. Materials and Method: The study conducted at Dr KNS Memorial Institute of Medical Sciences, Barabanki involved patients with newly diagnosed hypertension and normotensive individuals. The research was a case - control study that lasted from August 2022 to February 2024, with a sample size of 150 (75 cases and 75 controls). Upon obtaining informed consent, The patients underwent investigations for systolic and diastolic blood pressure, as well as serum uric acid levels. Guidelines were followed for measuring blood pressure, including posture, avoidance of caffeine and smoking, and ensuring a quiet, warm setting. <u>Results</u>: Study suggestive of Grade 1 hypertension (40%) was common grade reported in our study. Apart from this; high normal (32%) and grade 2 (28%) was also reported. The mean value of lipid profile parameters like total cholesterol (195.07 v/s 171.09; p<0.001); LDL (107.40 v/s 94.69; p<0.001) and triglyceride (153.01 v/s126.36; p<0.001) was significantly higher in cases as compared to control. There was no significant difference in mean value of HDL between cases and control (46.43 v/s 44.72; p=0.407). Among hypertension cases - 25.3% had hyperuricemia and 20% participants among control group had hyperuricemia. The mean value of uric acid was significantly higher among cases as compared to control (7.82 v/s 5.02; p<0.001). the odds of occurring hyperuricemia was 2.35 times greater than control. Conclusion: We found a significant correlation between hyperuricemia and hypertension. The odds of occurring hyperuricemia was 2.35 times greater than control.

Keywords: Hypertension, Hyperuricemia, Uric Acid

1. Introduction

The "quiet executioner" moniker for hypertension (HTN) comes from the fact that the condition often goes undiagnosed and unnoticed by its victims. In rare cases, symptoms such mild headaches, nausea, vomiting, disorientation, and chronic nosebleeds may appear. When circulatory strain levels reach a critical or dangerous level, these adverse effects typically do not manifest until after the fact. Getting a man's blood pressure measured by a medical professional or other human services professional is the surest approach to diagnose hypertension. (1, 2) Approximately 970 million people across the globe are diagnosed with hypertension, according to recent evaluations (JNC8, 2015). The prevalence of hypertension among adults is projected to reach 1.56 billion by the year 2025. (2–5)

Massive damage to veins due to hypertension. (6) The impassible nature of hypertension—a man can suffer the condition for years without realizing it—is the inspiration for its moniker. The force exerted on the arterial walls by the pumped blood is known as blood pressure. The systolic blood pressure is the result of the squeezing of blood against the

corridor walls every time the heart contracts. When the heart relaxes in the pauses between beats, the force exerted on the artery wall is measured as diastolic blood pressure. A guy might have hypertension for a long time without realizing it, which is why the disease is called hypertension. It doesn't have any obvious symptoms. (7)

Uric acid is a heterocyclic molecule and a weak acid; at a specific blood pH value, it acts mostly as urate ions. As in both endogenous and exogenous purine catabolism pathways, XOR (Xanthine Oxidoreductase) catalyzes the conversion of hypoxanthine and xanthine to urate. (8)

The more common kind of xanthine oxidoreductase is oxidase, although there are two subtypes: dehydrogenase and oxidase. (9) The ability to convert uric acid into allantoin was lost by humans during the Miocene period as a result of nonsense mutations in the uricase gene. (10)

On the other hand, "uric acid can combine with oxidants, lipid radicals, nitric oxide, and peroxynitrite to indirectly metabolize a small amount of it. (11) The breakdown of nucleic acids (DNA, RNA, and ATP) and other purines causes

an increase in SUA. (12) There is evidence that aldose reductase and XO activity increases in response to ischemia, heat stress, and dehydration, which in turn raises intracellular and serum uric acid levels. Endothelial dysfunction pathophysiology may involve uric acid - induced oxidative damage and inflammation. (12–17) Uric acid - mediated vascular smooth muscle cell growth is another potential afferent arteriolopathy etiology. (15, 18–20) The up - regulation of thromboxane and endothelin - 1 may also contribute to uric acid - mediated hypertension."

The presence of high amounts of uric acid can cause an overexpression of both of these vasoconstrictor molecules, leading to the development of hypertension. (21, 22) Additionally, uric acid can mediate the onset of hypertension via a crystal - dependent mechanism. Evidence of monosodium urate deposits has been reported in various organs and tissues, including the renal medulla, heart valves, arteries, and atherosclerotic plaque. A higher risk of hypertension may result from renal damage and arterial stiffness caused by these deposits. (23, 24) Hence; this study aimed to study the association between newly diagnosed hypertensive patients and their serum uric acid levels.

Objectives of the Study

To study association between newly diagnosed hypertensive patients, their serum uric acid levels and lipid profile

2. Material and Methods

The study conducted at Dr KNS Memorial Institute of Medical Sciences, Barabanki involved patients with newly diagnosed hypertension and normotensive individuals. The research was a case - control study that lasted from August 2022 to February 2024, with a sample size of 150 (75 cases and 75 controls). The sample size calculation was based on a formula involving the statistic corresponding to the level of confidence, expected prevalence, and precision.

The patients underwent investigations for systolic and diastolic blood pressure, as well as serum uric acid levels. Guidelines were followed for measuring blood pressure, including posture, avoidance of caffeine and smoking, and ensuring a quiet, warm setting. Standard equipment like a Digital Sphygmomanometer was used, with the bladder covering 2/3rds of the arm length.

The blood pressure was measured by inflating the bladder above the systolic pressure and deflating it gradually, recording the Korotkoff phase V. Recommendations were made for multiple readings on separate occasions and for using the arm with the higher pressure if there was a difference between arms.

Additionally, guidelines were provided for estimating serum uric acid levels, which were done using the Mindray BS -240pro machine in the Biochemistry laboratory of the institute. Normal ranges considered in the study were above 6.8 mg/dl, with 2ml of blood collected in a Clot activator Plain vial. The study aimed to analyze the association between serum urate levels and hypertension in young adults. **Inclusion Criteria:** (1) Patients who are ready to give consent. (2) Newly diagnosed hypertension age 18 years to 70 years.

Exclusion Criteria: (1) Patients who are not ready to give consent. (2) Patients below 18 years. (3) Patients with diabetes mellitus. (4) Patients with renal failure. (5) Pregnancy. (6) Females on non - steroidal anti - inflammatory drugs, anti - hypertensive. (7) Patients with peripheral vascular disease.

Statistical Analysis

The data was entered in an MS - Excel 2013 worksheet. Data analysis was performed using IBM SPSS Stats 21.0 version. Chi - square test and Independent samples 't' - test were used to compare the data. A 'p' value less than 0.05 was considered as statistically significant.

3. Results

A total of 150 participants enrolled in our study - 75 cases of newly diagnosed hypertension and 75 cases of control in a ratio of 1: 1. The mean age of overall participants 52.34 ± 7.48 years. The mean age of cases were 51.62±8.01 years and 53.05±6.88 years. There was no significant difference in the mean age between cases and control. There were male preponderance in each group - 61.3% male in cases group and 62.7% male were in control group. There was no significant difference observed (p=0.174). Most of our participants belonged to rural community - 69.3% in cases group and 58.7%. There was no significant difference in area of residence between these two groups (p=0.384). Socioeconomic status had been assessed by modified kuppuswamy scale. Most of study participants belonged to lower (46.7% v/s 58.7%) and lower middle class (34.7% v/s 18.7%) of socioeconomic status. There was no significant difference in the distribution of study participant according to socioeconomic status (p=0.743). Among 75 cases of hypertensive patients; fatigue (66.7%); nausea (61.3%); shortness of breath (61.3%) and light - headedness (57.3%) were the common complaints. Other complaints were headache, excessive sweating and palpitation/irregular heart beat. The family history of hypertension was significantly associated with hypertension (cases) i. e.76% v/s 36% (control); p<0.001.

Table 1: Family history of hypertension

| | | Groups | | | | | |
|--------------|-----|--------|------------|---------|------------|--|--|
| | | | Cases | Control | | | |
| | | Count | Column N % | Count | Column N % | | |
| Family H/O | No | 18 | 24.0% | 48 | 64.0% | | |
| Hypertension | Yes | 57 | 76.0% | 27 | 36.0% | | |
| P<0.001 | | | | | | | |

The history of smoking was significantly associated with hypertension (cases) i. e.86.7% v/s 39% (control); p<0.001; but there was no significant association was found with alcohol intake and hypertension (68% v/s 66.7%; p=0.862).



Figure 1: Distribution as per personal history of smoking and alcohol intake

The mean value of anthropometric parameters like BMI (24.14 v/s 22.97; p=0.001); Waist circumference (88.71 V/S 78.83; P=0.001); hip circumference (89.05 v/s 78.92; p=0.001) and waist/hip ratio (0.88 v/s 0.68; p=0.001) was significantly higher in cases as compared to control. The mean SBP (144.14 v/s 122.97; p=0.001) and DBP (98.71 v/s 74.83; p=0.001) value was significantly higher in cases as compared controls.



Figure 2: Bar Graph for Anthropometric parameters Grade 1 hypertension (40%) was common grade reported in our study. Apart from this; high normal (32%) and grade 2 (28%) was also reported. The mean value of lipid profile parameters like total cholesterol (195.07 v/s 171.09; p<0.001); LDL (107.40 v/s 94.69; p<0.001) and triglyceride (153.01 v/s126.36; p<0.001) was significantly higher in cases as compared to control. There was no significant difference in mean value of HDL between cases and control (46.43 v/s 44.72; p=0.407).

Table 2: Lipid Profile comparison between cases and

| control | | | | | | | | |
|---------------|------|-------------------|-------|-----------|-----------|--|--|--|
| Lipid Profile | | | | | | | | |
| Grou | ıps | Total Cholesterol | HDL | LDL | TG | | | |
| C | Mean | 195.07 | 46.43 | 107.40 | 153.01 | | | |
| Cases | SD | 45.87 | 9.76 | 33.56 | 43.30 | | | |
| Control | Mean | 171.09 | 44.72 | 94.69 | 126.36 | | | |
| Control | SD | 41.17 | 12.37 | 30.38 | 47.57 | | | |
| P - V | laue | < 0.001** | 0.407 | < 0.001** | < 0.001** | | | |

Among hypertension cases - 25.3% had hyperuricemia and 20% participants among control group had hyperuricemia. The mean value of uric acid was significantly higher among cases as compared to control (7.82 v/s 5.02; p<0.001). the odds of occurring hyperuricemia was 2.35 times greater than control.

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|---------------|------|-------|--------|------|--------|--------|-----|-------|---------|
| Table. | 3: ' | Corre | lation | of h | /perur | icemia | and | hyper | tension |
| | | | | - | | | | | |

| | | Groups | | | | |
|--|-------------|--------|---------------|-------|---------------|--|
| | C | ases | Control | | | |
| | | Count | Column N % | Count | Column N % | |
| II | No | 56 | 74.7% | 60 | 80.0% | |
| Hyper - uncenna | Yes | 19 | 25.3% | 15 | 20.0% | |
| Mean Uric acid Le | 7.82 (1.13) | | 5.02 (0.23) | | | |
| P<0.001; Odds ratio: 2.35 (95%CI: 1.54 - 4.23) | | | | | | |

4. Discussion

One in four adults worldwide suffers from hypertension, making it a new and pressing issue in public health. The complicated interplay between genes and environmental variables makes it difficult to predict the etiological factors linked with hypertension. (25)

The link between hypertension and serum uric acid level has been supported by various investigations. One plausible explanation for how hyperuricemia can lead to hypertension is:

- Effect on the glomerular apparatus and stimulation of the renin - angiotensin system produced by uric acid; (26, 27)
- 2) Increased insulin resistance and hyperinsulinemia leading to reduced uric acid, salt, and potassium excretion from the kidneys; (28, 29)
- Effects of uric acid on vascular smooth muscle proliferation, endothelial dysfunction, and reduced nitric acid generation. (30–32)

Although hyperuricemia and hypertension are often associated, there are several factors that can complicate the relationship between the two, such as metabolic syndrome, diabetes, obesity, chronic renal disease, salt intake, fluid volume status, alcohol use, and salt. Consequently, we aimed to adjust for the potential confounding factors in order to determine the connection between hyperuricemia and hypertension. The main findings of this study are discussed below:

Age and Gender

In our study the mean age of hypertensive patients was 51.62 years and 61.3% were male (M: F=1.6: 1). Eisen et al. and Grayson et al. found similar mean ages for their study subjects (33, 34) Poudel et al. demonstrated that the median age of hypertension cases was 44 years (35). In one study, the gender ratio was 1.25: 1, whereas in another, Feig et al. found a ratio of 1.5: 1. (60)

Systolic and diastolic blood pressure

Our study showed SBP and DBP among hypertensive cases were 144.14 mmHg and 98.71 ± 11.40 mmHg respectively. The average values of systolic and diastolic blood pressure in patients were 143.99 ± 14.28 and 96.61 ± 7.24 respectively, according to Poudel et. al. (35). The average systolic blood

pressure (SBP) and diastolic blood pressure (DBP) of the individuals studied by Feig et al. (36) were 139 mm Hg and 83 mm Hg, respectively.

Smoking and hypertension

In our study we found smoking is strongly associated with occurrence of hypertension. According to research by Wagai et al., smoking causes a sudden increase in blood pressure by activating the sympathetic nervous system. Central blood pressure, which is more closely linked to damage to target organs than brachial blood pressure, is more negatively affected by chronic smoking's effects on arterial stiffness and wave reflection. Accelerated atherosclerosis is likely to blame for the increased risk of severe hypertension in hypertensive smokers, which includes malignant and renovascular hypertension. (37) Halperin et al. concurred in their prospective cohort analysis that smoking cigarettes may be a small but significant risk factor for hypertension. (38)

Dyslipidemia and Hypertension

In our study hypertension is significantly associated with dyslipidaemia (p<0.005). The patients with hypertension had significantly high level of total cholesterol, LDL and triglyceride. Hypertension was found to be associated with increased levels of TC, LDL - c, and non - HDL - c in a Chinese study of adult males (39), although triglycerides (TG) did not demonstrate a significant association. After controlling for body mass index (BMI), the connection between HDL - c and the risk of hypertension changed from being unrelated to a positive correlation. There is a strong relationship between diastolic blood pressure and triglycerides and between systolic blood pressure and total cholesterol, according to another research by Anika et. al. (40). Systolic and diastolic blood pressure did not show a statistically significant association with the other factors. In a recent case control study, Chandrika et. al. also discovered that hypertension cases had considerably higher mean values of LDL, TG, and cholesterol compared to the control group (p<0.001). (41)

Anthropometry and Hypertension

Our study found that anthropometric characteristics such as body mass index (BMI), waist/hip ratio, and hip/waist circumference were considerably larger in the cases compared to the control group. Patients with hypertension tended to be overweight or obese in comparison to the control group. Hypertension due to obesity is common, as demonstrated by Noor et. al. Age over 40, being unemployed, and being married were all considered common risk factors. Central obesity, extreme obesity, and advanced age are all risk factors for poorly managed blood pressure. (42)

One robust independent risk factor for hypertension, according to Amira et. al., is obesity. Health education should therefore promote dietary habits and weight growth as linked risk factors for obesity in order to control this unhealthy trend. (43)

Correlation of hyperuricemia with hypertension

We found a significant correlation between hyperuricemia and hypertension. The odds of occurring hyperuricemia was 2.35 times greater than control. Poudel et al. (35) found a robust positive correlation between hyperuricemia and hypertension in their cross - sectional case control research. Hyperuricemia in conjunction with hypertension was seen in 28.8% of patients. Thirteen percent of the patients with hypertension and hyperuricemia were identified by Garrick et al. (44). Both Eisen et al. and Grayson et al. found significantly elevated blood uric acid levels in hypertension patients (33, 34). New research establishes a correlation between hypertension and elevated uric acid (UA) levels, highlighting the need to continuously monitor UA levels in hypertensive individuals. Based on these findings, clinical practitioners can implement tailored therapies to effectively reduce cardiovascular risk. (45) A previous case - control research that found considerably greater mean serum uric acid in hypertension cases compared to controls similarly supported our findings. (41)

Additionally, the risk of cardiovascular disease decreased in hypertensive patients whose serum uric acid levels fell following BP management. The LIFE trial found that 29% of the improvement in prognosis in females was due to losartan's reducing effect on serum uric acid levels. The trial compared the levels of uric acid with the beginning of cardiovascular disease in patients receiving atenolol and losartan. (46) The risk of death from cardiovascular disease decreased significantly by 23% in the aforementioned workplace trial involving individuals who used diuretics plus anti hyperuricemic medications to get their serum uric acid levels back to normal. (46)

Additionally, despite blood pressure control, serum uric acid levels in the SHEP research's male and female participants were 6.7 and 5.7 mg/dl or higher, respectively, suggesting a considerable rise in the risk of cardiovascular disease. This study focused on elderly people with hypertension. (47)

5. Conclusion

A total of 150 participants enrolled in our study - 75 cases of newly diagnosed hypertension and 75 cases of normotensive control in a ratio of 1: 1. The main findings of this study are following:

- The mean age of hypertensive patients was 51.62 years and 61.3% were male (M: F=1.6: 1).
- The SBP and DBP among hypertensive cases were 144.14 mmHg and 98.71±11.40 mmHg respectively.
- We found smoking is strongly associated with occurrence of hypertension.
- Hypertension is significantly associated with dyslipidaemia (p<0.005).
- The patients with hypertension had significantly high level of total cholesterol, LDL and triglyceride.
- Anthropometric characteristics such as body mass index (BMI), waist/hip ratio, and hip/waist circumference were considerably larger in the cases compared to the control group.
- We found a significant correlation between hyperuricemia and hypertension. The odds of occurring hyperuricemia was 2.35 times greater than control.

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