Prevalence of Hypertension in Patients with Nephrolithiasis

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Introduction: Kidney stone disease, also known as nephrolithiasis, is a prevalent illness that affects people of all ages and genders. Hypertension is defined as persistent elevation of systemic arterial blood pressure (systolic pressure ≥ 140 mmHg and/or diastolic pressure ≥ 90 mmHg).

Methodology: This was a prospective study conducted over a period of 3 months between February 2021 and April 2021 at the Department of General Medicine in our tertiary care center. A total of 280 patients who came to the outpatient department (OPD) were included in the study as study participants. After recording blood pressure, participants were classified as normotensives (218) and hypertensives (62). The study participants were examined for the development of kidney stone disease. In those study participants who had clinical features suggesting nephrolithiasis, the diagnosis was confirmed by Ultrasonography.

Results: It was observed that 25 of 62 hypertensives and 47 of 218 normotensives developed nephrolithiasis. And there were 43 men and 29 women among the 72 stone formers.

Conclusion: Our study showed a male preponderance for stone formers. And it is also evident that nephrolithiasis is more prevalent among hypertensives than normotensives though not statistically significant.

Keywords: Blood pressure; hypertension; nephrolithiasis; normotension.

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1. INTRODUCTION

Kidney stone disease, also known as nephrolithiasis, is a common and painful condition. While a stone may develop in the upper urinary system due to the crystallization of lithogenic substances, it can then travel into the ureter causing renal colic. Although nephrolithiasis is rarely fatal, many who have had renal colic say it is the most excruciating agony they have ever felt. Nephrolithiasis is a prevalent illness that affects people of all ages and genders. Kidney stones are of a variety of types. The most frequent kind of stone is calcium oxalate (~75 percent), followed by calcium phosphate (~15 percent), uric acid (~8 percent), struvite (~1 percent) and cystine (<1 percent) stones. Many stones have a combination of crystal kinds (for example, calcium oxalate and calcium phosphate) as well as protein in the matrix. Medications including acyclovir, indinavir, and triamterene are rarely encountered in stones. On estimation, it is expected that 12-15% of the population will develop kidney stones during their lifetime [1][2]. Moreover, stone-formers have a substantially higher recurrence rate of as high as 80% [1].

Hypertension (or HTN) or high blood pressure is defined as abnormally high arterial blood pressure. Hypertension is defined as systolic BP level of ≥140 mmHg and/or diastolic BP level ≥ 90 mmHg [3].

For many years, the epidemiological link between nephrolithiasis and hypertension has been documented. Much research has gone into this topic since Tibblin first discovered the link between arterial hypertension and nephrolithiasis in 1965 [4]. Urinary stone disease is more prevalent in those who have high blood pressure [5][6]. Many other studies also suggest a positive association that those with hypertension have increased risk of developing nephrolithiasis.

2. METHODOLOGY

This was a prospective study conducted over a period of 3 months between February 2021 and April 2021 at the Department of General Medicine in our tertiary care center. A total of 280 patients who came to the outpatient department (OPD) were included in the study as study participants. After the participants had been sitting erect for at least 10 minutes, blood pressure was taken between 8 and 11 am with an aneroid sphygmomanometer, systolic and diastolic blood pressures were recorded three times, two minutes apart by trained medical doctors. First recorded blood pressure reading was discarded and the average of the next two blood pressure readings was recorded as the blood pressure of that study participant. Participants were classified as normotensive if their systolic blood pressure was less than 140 mm Hg and their diastolic blood pressure was less than 90 mm Hg and as hypertensive if their systolic blood pressure was greater than 140 mm Hg and their diastolic blood pressure was greater than 90 mm Hg (untreated hypertensive) or if they were taking any regular blood pressure medication (treated hypertensive i.e., they were put on regular medication to control blood pressure with drugs such as Angiotensin converting enzyme inhibitors, Angiotensin-II receptor blockers, Calcium channel blockers, Diuretics, α-blockers, β-blockers, vasodilators, either alone or in combination therapy). The study participants were examined for the development of kidney stone disease. In those study participants who had clinical features suggesting nephrolithiasis (such as loin pain, fever, hematuria, dysuria, increased frequency of nausea and vomiting), the diagnosis was confirmed by Ultrasonography by the same doctor.

3. RESULTS

A total of 280 patients participated in the study. The age of the study participants ranged from 28 to 65 years and the mean age of the study participants was found to be 48.8±2.4 years. At baseline, among 280 study participants, 62 were hypertensives (22.14%) and 218 were normotensives (77.85%). Distribution of stone formers between Hypertensives and Normotensives as shown in Table 1. There were 39 males and 23 females among the 62 hypertensive subjects. There were 116 males and 102 females among 218 normotensives. It was found that 25 of the hypertensives and 47 of the normotensives developed nephrolithiasis as shown in Table 2. The percentage of hypertensives and normotensives developing nephrolithiasis are 40.32% (25/62) and 21.55% (47/218) respectively. Chi-square was calculated as 0.2206 and p-value was calculated as 0.638. Since p-value is greater than 0.05, the difference is not statistically significant. Sex distribution of the stone formers is depicted in Fig. 1. It was observed that there were 43 men (59.72%) and 29 women (40.27%) among the total stone formers. Further it was found that there were 14
males and 11 females among 25 hypertensive stone formers and there were 29 males and 18 females among 47 normotensive stone formers. Our study showed a male preponderance and from the data, it is also evident that nephrolithiasis is more prevalent among hypertensives than normotensives though not statistically significant.

4. DISCUSSION

Nephrolithiasis is an acutely painful, recurring illness that affects people of all ages, ethnicities, and genders. Ancient Indian, Chinese, and Greek literature all have descriptions of nephrolithiasis[7]. The health-care system continues to be burdened by kidney stone illness. Over the last several decades, epidemiological investigations of nephrolithiasis have revealed an increase in the disease’s frequency and incidence. The link between hypertension and nephrolithiasis has been studied extensively in recent years. Although urolithiasis occurs seldom in animals, spontaneously hypertensive rats are more likely to develop kidney stones [8]. Over the last few decades, the lifetime risk of having a systemic stone event has continued to rise [9]. Prospective studies are needed to determine whether hypertension occurs before the onset of kidney stones and, thus, may be regarded as a probable risk of this condition.

![Sex distribution of the stone formers](image)

**Fig. 1. Sex distribution of the stone formers**

|                      | N     | Nephrolithiasis |
|----------------------|-------|-----------------|
| Hypertensive stone    | 62    | 25/62           |
| Hypertensive stone    | 218   | 47/218          |
| Hypertensive stone    | 280   | 72/280          |

**Table 1. Distribution of stone formers between Hypertensives and Normotensives**

|                      | Males | Females | Total | Chi-Square (X²) | p-value |
|----------------------|-------|---------|-------|-----------------|---------|
| Hypertensive stone    | 14    | 11      | 25    | 0.2206          | 0.638   |
| Normotensive stone    | 29    | 18      | 47    |                 |         |
| Total                | 43    | 29      | 72    |                 |         |

**Table 2. Comparison of nephrolithiasis development between hypertensives and normotensives**
In this study, 43 males (which includes 14 hypertensives and 29 normotensives) had kidney stone disease and 29 females (which includes 11 hypertensives and 18 normotensives) had kidney stone disease among the 72 total stone formers (Male:Female ratio=1.48:1). This showed that the incidence of nephrolithiasis is higher among males than females. The condition generally affects males with a global prevalence incidence of 1.7 to 8.8% [10][11]. Fan et al suggested that nephrolithiasis has higher prevalence in males than females which can be attributed to the effect of sex hormones on some lithogenic risk factors, such as androgens increasing excretion of urinary oxalate and kidney deposition of calcium oxalate, and estrogen decreasing excretion of urinary oxalate and kidney deposition of calcium oxalate, according to experimental data [12].

In our study, 25 of 62 hypertensives and 47 of 218 normotensives developed kidney stone disease accounting for 72 of the total stone formers [25/62 (40.32%) versus 47/218 (21.55%); \(\chi^2=0.2206; \text{p-value}=0.638\)]. As per the data, hypertensives are more likely than normotensives to develop nephrolithiasis. Our study is also consistent with other studies. In a study by Cappuccio on a group of middle-aged males, kidney stone disease was found to be more common in hypertensive men than in normotensive men [19/114 (16.7%) versus 33/389 (8.5%)]. Males with hypertension had a higher incidence of kidney stones than men with normal blood pressure (RR 1.96; 95% confidence interval 1.16-3.32). That study also showed that exclusion of treated hypertensives had no effect on the risk [5]. Borghi et al conducted a study in which they found that 19 out of 132 hypertension patients and 4 out of 135 normotensive patients experienced renal stone events over the course of at least 5 years of follow-up and concluded that by significant percentage, renal stone disease development is more common in hypertensive patients than in normotensive patients [6]. Cirillo and Laurenzi also noted that, when compared to normotensives, hypertensives had a significantly higher prevalence of urinary stone disease (5.22% versus 3.36%, \(\chi^2=6.81, \text{p}=0.009\)). Male hypertensives had a higher proportion of stone history than normotensive males. Females with hypertension and normotension also showed a similar comparable difference [13]. Cappuccio, Strazzullo and Mancini showed that study participants with hypertension (both treated and untreated) had a higher prevalence than participants with normal blood pressure as history of urolithiasis was found in 13.4% (68/509) of normotensive patients, 20.3% (24/118) of untreated hypertensives, and 32.8% (20/61) of treated hypertensives (p value is less than 0.001). They also showed when the impacts of body mass index, serum creatinine, urate, and total calcium concentrations were taken into consideration, the pattern remained unchanged [14]. Other studies by Robertson et al., and Soucie et al., also found that there exist a positive association between hypertension and kidney stone disease [15][16].

5. CONCLUSION
Our study revealed a male preponderance, and the data also revealed that nephrolithiasis is more common in hypertensives than in normotensives, while the difference is not statistically significant. It is possible, but as of yet not proved, that increased and sustained loss of calcium in urine of the persons with high blood pressure are the pathophysiological relationship. These findings may have substantial implications for the early detection and prevention of kidney stone disease in hypertensive patients. In conclusion, hypertension and male gender could be a risk factor for nephrolithiasis but further studies are required.

DISCLAIMER
The products used for this research are commonly and predominantly used in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT
The study participants gave their written informed consent when the research details were explained to them.

ETHICAL APPROVAL
The Institutional Ethics Committee granted approval for the study.

COMPETING INTERESTS
Authors have declared that no competing interests exist.
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