

Hematuria: Is it useful in predicting renal or ureteral stones in patient presenting to emergency department with flank pain?

Mansour Alnazari, Abdulaziz Bakhsh, Hatem Ahmed Shaqroon, Emad S. Rajih, Nizar Abdulaziz Al-Nakshabandi¹, Danny M. Rabah^{2,3}

Department of Urology, College of Medicine, Taibah University, Madinah, ¹Department of Radiology, College of Medicine, King Saud University, ²The Cancer Research Chair, Department of Surgery, College of Medicine, King Saud University, ³Department of Urology, King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia

Abstract

Objectives: The objective of the study was to evaluate hematuria as a diagnostic test for renal and ureteral stones compared with a noncontrast-enhanced computed tomography (CT) scan (gold standard test) in emergency room patients with acute flank pain.

Patients and Methods: In total, 604 patients treated in our emergency department from 2006 to 2011, with a history of flank pain and suspected urolithiasis were included in a retrospective review. All patients were evaluated with a noncontrast-enhanced CT scan and urine analysis. Using the noncontrast CT scan as the gold standard for the evaluation of the presence, number, size, and site (renal or ureteral [upper, middle, and lower]) of the stones, we calculated the sensitivity, specificity, and positive and negative predictive values of hematuria for diagnosing both renal and ureteral stones.

Results: Urolithiasis was diagnosed in 388 patients (64%) and 216 patients (36%) had no stones on a noncontrast-enhanced CT scan. The sensitivity, specificity, positive predictive value, and negative predictive value for microhematuria were 77%, 33%, 67%, and 45%, respectively. Microhematuria was more common in patients with ureteral stones only (139 patients) and had a sensitivity of 85% compared to patients with renal stones only (32 patients), with a sensitivity of 55% ($P < 0.001$). There were no significant differences in the specificity or positive or negative predictive values.

Conclusion: Although microhematuria is more sensitive to ureteral stones, the absence of microhematuria does not exclude the possibility of urolithiasis and a noncontrast-enhanced CT scan should be the gold standard diagnostic tool.

Keywords: Hematuria, renal colic, urine analysis, urolithiasis

Address for correspondence: Dr. Mansour Alnazari, Department of Urology, College of Medicine, Taibah University, Madinah, Saudi Arabia.
E-mail: dr.mansouralnazari@hotmail.com

Received: 23.06.2023, **Revised:** 16.08.2023, **Accepted:** 12.09.2023, **Published:** 15.11.2023.

INTRODUCTION

Urolithiasis is a common disease and has a lifetime prevalence of 12% in men and 7% in women in the US, with

an annual cost of 2 billion dollars.^[1] The overall prevalence rate in Saudi Arabia is 8.1% in men and 4.0% in women, and the prevalence increases with age.^[2] Urolithiasis is the most

Access this article online	
Quick Response Code:	Website: www.urologyannals.com
	DOI: 10.4103/ua.ua_66_23

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Alnazari M, Bakhsh A, Shaqroon HA, Rajih ES, Al-Nakshabandi NA, Rabah DM. Hematuria: Is it useful in predicting renal or ureteral stones in patient presenting to emergency department with flank pain? Urol Ann 2024;16:71-4.

common diagnosis for patients with colicky and flank pain seeking emergency room care.^[3] Noncontrast-enhanced computed tomography (CT) scanning has become the gold standard method for diagnosing acute flank pain and has replaced intravenous urography (IVU). A noncontrast-enhanced CT scan can identify the presence of the stone, its location, and diameter.^[4-8] Hematuria and flank pain are considered hallmark signs of urolithiasis.^[9] Many studies have evaluated hematuria as a diagnostic test for urolithiasis compared with noncontrast-enhanced CT, and a few studies have focused on its relationship to ureteral stones.^[9-12] The purpose of this study was to examine the diagnostic value of hematuria for both renal and ureteral stones in comparison to the gold standard test, which is noncontrast-enhanced CT.

PATIENTS AND METHODS

In total, 604 patients who presented to the emergency department from 2006 to 2011 complaining of acute flank pain were included in a retrospective review. All patients had a urine analysis done within 48 h of the presentation; a noncontrast-enhanced CT scan was performed due to the suspicion of urolithiasis. The urine sample was collected by a midstream, clean-catch technique and was analyzed by a specialist. Microhematuria was defined as >5 red blood cells (RBC)/high-power field (HPF). The stone characteristics (number, size, and site) were documented with a noncontrast-enhanced CT scan, and the ureteral stones were subdivided into upper, middle, and lower based on the radiology report, which was approved by the radiology consultant. The sensitivity, specificity, and positive and negative predictive values of hematuria for the diagnosis of urolithiasis were compared with CT scanning. All values were calculated initially for all patients. Then, the values were reevaluated for patients with only renal stones and with only ureteral stones. The incidence of hematuria in patients with stone disease was also analyzed in relation to age, gender, side, and number of stones. For patients with only one stone, the incidence of hematuria was characterized in relation to the site and the size.

RESULTS

A total of 604 patients were included in the study. With CT scan, 388 (64%) patients were diagnosed with urolithiasis and 216 (36%) patients had no stones. Hematuria (>5 RBC/HPF) was found in 455 (75%) patients and 159 (25%) patients were negative. For patients diagnosed with stones, the incidence of hematuria was greater in males 249 (80%) than in females 52 (67%) ($P = 0.022$). There

was no difference in the incidence of hematuria related to age [Table 1].

Among the patients diagnosed with stones, 223 patients had one stone, 71 patients had two stones, and 94 patients had three or more stones, and the incidence of hematuria was 78%, 74%, and 82%, respectively. In addition, microhematuria was positive in 78% ($n = 153$) of patients with stones on the right side, 78% ($n = 145$) of patients with stones on the left side, and 74% ($n = 87$) of patients with bilateral stones. No significant difference was found in the incidence of microhematuria in relation to the number or side of the stones.

For the 223 patients with only one stone, the size of the stone did not show any significant difference in relation to the incidence of microhematuria [Table 2].

The stone location was subdivided into renal and ureteral (upper, middle, or lower). Three patients had stones within the bladder [Table 3]. Patients with only one stone in the ureter were found to have more incidence of hematuria compared to patients with renal stones ($P < 0.0001$).

The sensitivity, specificity, and positive and negative predictive values of hematuria for diagnosing urolithiasis compared to CT scans were initially calculated for all

Table 1: Incidence of microhematuria according to age in patients with urolithiasis

Age groups (years)	Number of patients	Incidence of microhematuria, n (%)
<29	9	8 (89)
20-39	178	138 (77)
40-59	162	121 (75)
60-79	36	30 (83)
>80	3	3 (100)

Table 2: Incidence of microhematuria, according to stone size in patients with only one stone

Stone size (mm)	Number of patients	Incidence of hematuria, n (%)
<5	126	100 (79)
5-7.9	68	51 (75)
8-10	10	8 (80)
>10	16	14 (78)

Table 3: Incidence of microhematuria according to the location in patients with only one stone

Location of the stone	Number of patients	Incidence of hematuria, n (%)
Kidney	58	32 (55)
Ureter	162	139 (86)
Upper	36	31 (86)
Middle	20	16 (80)
Lower	106	92 (86)
Bladder	3	3 (100)

patients. Then, the predictive values were reevaluated for patients with only renal stone and for patients with only ureteral stones [Table 4]. Hematuria was more sensitive to ureteral stones (86%) compared to renal stones (55%) or the general sample (77%). There were no significant differences in other parameters.

DISCUSSION

Renal colic is one of the most common diagnoses treated in the emergency department.^[3] Almost all patients treated in our emergency department had a history of acute flank pain. The patients were generally tested with a urine analysis and a spiral CT scan. The CT scan has replaced the intravenous urogram (IVU) for the diagnosis of renal stones and gives more details about the stone size and location, in addition to its ability to diagnose other causes of hematuria.^[4-8] Although a noncontrast-enhanced CT scan involves a higher dose of radiation compared with IVU, it has an advantage of faster diagnosis, avoidance of further diagnostic imaging tests with similar imaging cost makes it the study of choice for patients with acute flank pain.^[13] Ultrasound is a useful initial study for patient with acute flank pain particularly pregnant patient and children; it is very effective in the detection of hydronephrosis a result of possible obstructing ureteric stone, but it has a limited role detecting small renal (<5 mm) or ureteric stones.^[14] There has been a prolonged debate about the role of hematuria in clinical diagnoses, and many studies have conflicting conclusions about the sensitivity of microhematuria for diagnosing urolithiasis in patients presenting with acute flank pain. However, most of those studies concluded that hematuria can be misleading, and the presence or absence of hematuria cannot reliably determine which patients actually have urolithiasis.^[3,9-12]

In a study by Li *et al.*, 397 patients with proven ureterolithiasis, only 9% did not have hematuria (sensitivity 91%),^[9] whereas Xafis *et al.* found that microhematuria for diagnosing urolithiasis has (67%) sensitivity which is the lowest ever reported for such a number of patients using low-dose unenhanced CT scan as the gold standard test.^[12]

A retrospective study by Bove *et al.* compared the presence of hematuria with Unenhanced helical computed tomography (UHCT) results in 195 patients with suspected

renal colic. Out of 95 patients with ureteral stones, 30% had one or no RBC/HPF on urinalysis, whereas 51% of the 100 patients without ureteral stones had >1 RBC/HPF. Furthermore, in his study, using CT as the gold standard defining hematuria as >1 RBC per HPF, the sensitivity of hematuria for ureterolithiasis was only 81%.^[10]

One of the largest series done on 950 patients reported only 48% specificity and 65% negative predictive value of microhematuria as a diagnostic test for renal colic, with 54% of the 69 patients with a significant alternative diagnosis had a positive urinalysis for hematuria. And concluded that hematuria testing cannot be used to exclude the diagnosis of ureterolithiasis and should not preclude additional diagnostic testing.^[11]

In our study, we reexamined the diagnostic value of hematuria for urolithiasis. We compared the sensitivity of hematuria for ureteral versus renal versus all patients, and the results indicate a higher sensitivity (86%) for ureteral stones only and a lower sensitivity (55%) for renal stones only compared to the general sensitivity of the whole sample (77%). There was no difference in the specificity or negative or positive predictive values among the three groups. However, even with a high sensitivity in patients with ureteral stones, 14% of patients have normal urine samples (no blood), despite having ureteral stones. Therefore, patients can have ureteral stones with an absence of microhematuria, which supports the conclusions of many previous studies.

Mefford *et al.* observed high rate of moderate-to-severe hydronephrosis (42%) in patients with confirmed ureteric stone and absent microhematuria by urine analysis, in addition to high incidence of moderate-to-severe hydronephrosis among patients with single ureteric stone measuring 5 mm or more, concluding that patients presenting to the emergency department with a single ureteral stone on noncontrast CT with no microscopic hematuria could be at increased risk of having moderate-to-severe hydronephrosis.^[15]

Although the incidence of hydronephrosis was not reported in our series, we found no correlation between the size, side, or number of stones and the incidence of microhematuria.

Table 4: The value of hematuria as a diagnostic test among patients with ureteral versus renal stones versus all patients with stones

Group	Number of patients	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
All patients with stones	388	77	33	67	45
Patients with only one ureteral stone	162	86	33	49	75
Patients with only one renal stone	52	55	33	18	73

Up to our knowledge, this is the first study in the literature comparing the incidence of microhematuria in patients with ureteric stone to patients with renal stones at the same population.

Because there are limitations in retrospective studies, we suggest prospective studies with larger patient sample sizes to evaluate the accuracy and sensitivity of microhematuria for the diagnosis of ureteral stones.

CONCLUSION

Urolithiasis is one of the most common causes of patients to seek emergency care, and noncontrast-enhanced CT scans should be the gold standard for the diagnosis of urolithiasis. Although hematuria was associated more with ureteral stones, its absence cannot exclude the presence of stones. Hematuria should not be used as a diagnostic tool to determine which patients should be referred for CT scanning.

Declaration

This is a retrospective Research involving Human Participants done in a University Hospital where all patients signed an informed consent for their data to be used for research purposes.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Pearle MS, Calhoun EA, Curhan GC, Urologic Diseases of America Project. Urologic diseases in America project: Urolithiasis. *J Urol* 2005;173:848-57.
- Abdel-Halim RE, Al-Hadramy MS, Hussein M, Baghlaf AO, Sibaa AA, Noorwali AW. Urolithiasis in the Western Region of Saudi Arabia: A Clinical, Biochemical and Epidemiological Study. Riyadh (KSA): King Abdul-Aziz City for Science and Technology; 1996.
- Press SM, Smith AD. Incidence of negative hematuria in patients with acute urinary lithiasis presenting to the emergency room with flank pain. *Urology* 1995;45:753-7.
- Sourtzis S, Thibeau JF, Damry N, Raslan A, Vandendris M, Bellemans M. Radiologic investigation of renal colic: Unenhanced helical CT compared with excretory urography. *AJR Am J Roentgenol* 1999;172:1491-4.
- Miller OF, Rineer SK, Reichard SR, Buckley RG, Donovan MS, Graham IR, *et al.* Prospective comparison of unenhanced spiral computed tomography and intravenous urogram in the evaluation of acute flank pain. *Urology* 1998;52:982-7.
- Yilmaz S, Sindel T, Arslan G, Ozkaynak C, Karaali K, Kabaalioglu A, *et al.* Renal colic: Comparison of spiral CT, US and IVU in the detection of ureteral calculi. *Eur Radiol* 1998;8:212-7.
- Niall O, Russell J, MacGregor R, Duncan H, Mullins J. A comparison of noncontrast computerized tomography with excretory urography in the assessment of acute flank pain. *J Urol* 1999;161:534-7.
- Wang JH, Shen SH, Huang SS, Chang CY. Prospective comparison of unenhanced spiral computed tomography and intravenous urography in the evaluation of acute renal colic. *J Chin Med Assoc* 2008;71:30-6.
- Li J, Kennedy D, Levine M, Kumar A, Mullen J. Absent hematuria and expensive computerized tomography: Case characteristics of emergency urolithiasis. *J Urol* 2001;165:782-4.
- Bove P, Kaplan D, Dalrymple N, Rosenfield AT, Verga M, Anderson K, *et al.* Reexamining the value of hematuria testing in patients with acute flank pain. *J Urol* 1999;162:685-7.
- Luchs JS, Katz DS, Lane MJ, Mellinger BC, Lumerman JH, Stillman CA, *et al.* Utility of hematuria testing in patients with suspected renal colic: Correlation with unenhanced helical CT results. *Urology* 2002;59:839-42.
- Xafis K, Thalmann G, Benneker LM, Stoupis C, Buggy DJ, Zimmermann H, *et al.* Forget the blood, not the stone! Microhaematuria in acute urolithiasis and the role of early CT scanning. *Emerg Med J* 2008;25:640-4.
- Thomson JM, Glocher J, Abbott C, Maling TM, Mark S. Computed tomography versus intravenous urography in diagnosis of acute flank pain from urolithiasis: A randomized study comparing imaging costs and radiation dose. *Australas Radiol* 2001;45:291-7.
- McCarthy CJ, Baliyan V, Kordbacheh H, Sajjad Z, Sahani D, Kambadakone A. Radiology of renal stone disease. *Int J Surg* 2016;36:638-46.
- Mefford JM, Tungate RM, Amini L, Suh D, Anderson CL, Rudkin SE, *et al.* A comparison of urolithiasis in the presence and absence of microscopic hematuria in the emergency department. *West J Emerg Med* 2017;18:775-9.