The clinical importance of microscopic hematuria and hydronephrosis in urolithiasis

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Abstract

Aim: The aim of this study was to investigate the relationship between the degree of hydronephrosis and the presence of microscopic hematuria in patients that presented to the emergency department (ED) with ureteral stones. Methods: The records of patients who presented to our ED due to urolithiasis between January 2017 and December 2020 were retrospectively analyzed. Patients aged 18 years or older who underwent non-contrast computed tomography (CT abdomen/pelvis) and urinalysis (UA) and were diagnosed with ureteral stones were included in the study. Radiology reports were reviewed for stone size, localization, and degree of hydronephrosis. Patients with and without microscopic hematuria and the degree of hydronephrosis were compared. Results: A total of 476 patients were included, which consisted of 391 with microscopic hematuria and 85 without microscopic hematuria. The median stone size was 4.1 mm in the presence of microscopic hematuria and 5.5 mm in the absence of microscopic hematuria. Logistic regression analysis was performed to determine the factors associated with the development of hydronephrosis. Stone size [odds ratio (OR):2.15, 95% confidence interval (CI):1.12-4.16, p<0.001), presence of pyuria (OR: 2.58, 95%CI: 1.78-3.48, p<0.001), and absence of microscopic hematuria (OR: 1.31, 95%CI 1.04-2.89, p=0.017) were identified as risk factors for moderate and severe hydronephrosis. Conclusion: We consider that non-contrast CT imaging is necessary for the diagnosis and treatment of emergency cases in which microscopic hematuria is not detected in urinalysis since their stone size may be larger and degree of hydronephrosis may be more severe.

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Conclusion: We consider that non-contrast CT imaging is necessary for the diagnosis and treatment of emergency cases in which microscopic hematuria is not detected in urinalysis since their stone size may be larger and degree of hydronephrosis may be more severe.

Keywords: Hydronephrosis, Microscopic Hematuria, Ureteral Stone

What's already known about this topic?

Urolithiasis is one of the common diseases of the urinary system, manifesting with severe pain that causes patients to frequently refer to ED.

What does this article add?

Although most ureteral stones pass spontaneously without intervention, the main challenge for emergency physicians is to identify patients at high risk for complications, such as obstructive uropathy. Ureteral obstruction can result in irreversible renal damage and be associated with lifethreatening infection. The aim of the current study was to investigate the relationship between the degree of hydronephrosis and the presence of microscopic hematuria and pyuria in patients who presented to ED due to ureteral stones.

Review criteria: how did you gather, select and analyze the information you considered in your review?

The data of the study were obtained from the hospital electronic database.Clinical, biochemical and radiological imaging reports were collected and analysed.

Message for the clinic: what is the 'take-home' message for the clinician?

We determined that microscopic hematuria was associated with stone size and hydronephrosis severity. If a patient with suspected ureteral stone disease does not have microscopic hematuria, we consider that non-contrast CT imaging is necessary for diagnosis and treatment, since the size of the stone may be larger and the degree of hydronephrosis may be more severe.

1. INTRODUCTION

Urolithiasis is a common urological emergency situation encountered in emergency departments (EDs). In the United States, more than one million patients present to ED each year due to acute renal colic.[1] The probability of an individual experiencing renal colic throughout life varies between 5 and 12%.[2] Diagnostic evaluation in urolithiasis starts with a detailed medical history and continues with a physical examination and laboratory and imaging tests. A reliable imaging technique should be adopted in the diagnostic examination of all patients with symptoms related to urinary tract stones. In recent years, as a rapid and non-contrast alternative imaging modality, non-contrast computed tomography (CT) has become essential, especially in stone-induced urinary system disorders.[3] In the detection of ureteral stones, non-contrast CT has high sensitivity and specificity, as well as revealing hydronephrosis, stone size-localization, and other pathologies that can cause acute pain.[4,5]

Most patients presenting with urolithiasis have gross or microscopic hematuria. Although hematuria is a common finding in these patients, its presence alone is not sufficient to exclude other serious diagnoses. Depending on the presence or absence of microscopic hematuria, the clinical features and findings of the patients may differ. In a previous study, it was reported that the incidence of moderate and severe hydronephrosis was higher in patients without microscopic hematuria among those who underwent non-contrast abdominal CT due to ureteral stones.[6] The aim of the current study was to investigate the relationship between the degree of hydronephrosis and the presence of microscopic hematuria and pyuria in patients who presented to ED due to ureteral stones.

2. MATERIALS AND METHODS

2.1. Study Design and Participants

In this study, the records of patients that presented to our hospital with urolithiasis between January 1, 2017 and December 31, 2020 were retrospectively analyzed. The case presentations were classified using the International Classification of Disease-10 coding system (ICD-10). In the ICD-10 code system, patients assigned the N20-23 codes (kidney stone, kidney and ureteral stone, ureteral stone, kidney and ureteral stones, unidentified ureteral stone, and renal colic) were screened. Patients aged 18 years or older who had non-contrast CT of the abdomen/pelvis and urinalysis (UA) and were diagnosed with ureteral stones were included in the study. Local ethics committee approval was obtained for the study (Ethics committee number: 2021/01-83).

Incomplete records, absence of a ureteral stone in the non-contrast CT radiology report, presence of two or more ureteral stones, presence of a ureteral stent or nephrostomy tube, missing UA results, presence of any intraabdominal or pelvic mass resulting in ureteral obstruction, and $<$ 18 years of age were excluded from the study.

2.2. Data collection

Clinical data were obtained by reviewing the patients' electronic medical records. The demographic characteristics, physical examination findings, laboratory tests and radiological imaging reports of the patients were recorded. All examinations were performed with a 128-slice CT scanner (GE Revolution EVO, USA). Localization, dimensions and contours of both kidneys, and the presence of hydroureteronephrosis were noted from the CT report. In cases with ureteral stones, stone localization (proximal, mid-section and distal of the ureter) and size were obtained from the radiology reports. All CT examinations were interpreted by a radiologist.

2.3. Definitions

A ureteral stone was defined as a stone located anywhere from the ureteropelvic junction to the ureterovesical junction. The presence and severity of hydronephrosis was evaluated as absent, mild, moderate or severe according to the radiology report. Microscopic hematuria was accepted as the presence of [?]5 erythrocytes per high-power field (HPF).[7] Pyuria was defined as the presence of [?]3 leukocytes per HPF.

2.4. Outcome measures

The primary outcome measure was the relationship between the degree of hydronephrosis and the presence or absence of microscopic hematuria in patients with ureteral stones. The secondary outcome was the effect of the presence of pyuria on the development of hydronephrosis.

2.5. Statistical Analysis

Statistical analysis was performed using SPSS 17.0 program (SPSS Inc, Chicago, IL, USA). Numerical variables were expressed as mean ± standard deviation, and categorical variables as numbers and percentages. The normal distribution of the data was evaluated with the Kolmogorov-Smirnov test. When comparing numerical variables, Student's t-test was used for normally distributed data, and the Mann-Whiney U test for those that did not show a normal distribution. The chi-square and Fisher's exact tests were used in the analysis of categorical data. Univariate and multivariate logistic regression analyses were conducted to determine the relationship between hydronephrosis and possible clinical variables. The multivariate logistic regression analysis was applied to variables with a p value of $<$0.1 in the univariate logistic regression analysis. A value of $p < 0.05$ was considered statistically significant in all comparisons.

3. RESULTS

A total of 476 patients who met the inclusion criteria were included. The median age of the patients was 39.0 (33.0-50.0) years. Of the patients, 65.3% (n = 311) were male and 34.7% (n = 165) were female. There were 391 (82.1%) patients with microscopic hematuria and 85 (17.9%) without microscopic hematuria. Approximately half (55.3%) of the ureteral stones were localized in the distal part. The median stone size was 4.1 mm (3.0-6.0 mm) in the presence of microscopic hematuria and 5.5 mm (4.0-8.5 mm) in the absence of microscopic hematuria. A statistically significant difference was observed between these two groups in

terms of stone size ($p < 0.001$) (Table 1). There was also a statistically significant correlation between the degree of hydronephrosis and the absence of microscopic hematuria ($p = 0.042$). Microscopic hematuria was present in 84.1% (n = 292) of the patients with normal and mild hydronephrosis and 76.7% (n = 99) of those with moderate and severe hydronephrosis (Table 2). The relationship between the size of the stone in the ureter and the severity of hydronephrosis is shown in Table 2.

Univariate and multivariate logistic regression analyses were performed to determine the relationship between hydronephrosis and possible clinical variables. The multiple logistic regression analysis was conducted between age, stone size, pyuria, and absence of microscopic hematuria, which were determined to be statistically significant variables in the univariate analysis (Table 3). According to the results, stone size [odds ratio (OR): 2.15, 95% confidence interval (CI): 1.12-4.16, $p < 0.001$), presence of pyuria (OR: 2.58, 95% CI: 1.78-3.48, $p < 0.001$), and absence of microscopic hematuria (OR: 1.31, 95% CI: 1.04-2.89, $p = 0.017$) were correlated with moderate and severe hydronephrosis.

4. DISCUSSION

Urolithiasis is one of the common diseases of the urinary system, manifesting with severe pain that causes patients to frequently refer to ED.[8] Although most ureteral stones pass spontaneously without intervention, the main challenge for emergency physicians is to identify patients at high risk for complications, such as obstructive uropathy. In our study, we found that patients with urolithiasis and without microscopic hematuria in UA had clinically more significant ureteral stones. In addition, emergency patients without microscopic hematuria had a higher risk of moderate to severe hydronephrosis than those with microscopic hematuria.

The investigation of microscopic hematuria in UA is a good screening test in patients with suspected renal colic, but its sensitivity varies between 69% and 84%.[9] Kim et al.[10]found the sensitivity, specificity, positive predictive and negative predictive values of microscopic hematuria as 89.4%, 41.1%, 88.9% and 42.1%, respectively in the diagnosis of urolithiasis. They showed that 10.6% of the patients diagnosed with urolithiasis did not have hematuria. Luchs et al. reported that the incidence of a negative UA test was 16% in patients with renal colic caused by stones that were definitively diagnosed based on non-contrast abdominopelvic CT.[9] Similarly, Gulacti et al. determined that hematuria was not observed in 12% of patients diagnosed with urolithiasis.[11] In our study, we found renal colic due to ureteral stone without hematuria in 17.9% of the cases. Our data show that the absence of hematuria in UA does not rule out the diagnosis of urolithiasis.

Inci et al.[12] reported no relationship between stone volume and microscopic hematuria. They found that the frequency of microscopic hematuria was 42% if the stone volume was 1-10 mm^3, and 83% if 75-100 mm^3. Mefford et al.[6] determined that the presence or absence of microscopic hematuria was not related to the size of the stone and that patients without microscopic hematuria had a higher rate of moderate to severe hydronephrosis (42%) compared to those with microscopic hematuria. In addition, that study revealed that the incidence of moderate to severe hydronephrosis was 49% for ureteral stones of 5 mm or greater, while it was 14% for those smaller than 5 mm. In the current study, the incidence of moderate and severe hydronephrosis was higher in the patient group without microscopic hematuria than the patient group with microscopic hematuria. Unlike other studies, we found that pyuria and hematuria had an independent relationship.

CT has a very high diagnostic value for kidney stone disease (94-100% sensitivity and 92-99% specificity). It also provides important data in the planning of treatment by determining stone size and localization, and degree of hydronephrosis.[13,14] In a study involving 1,824 patients with urolithiasis, Chang et al.[15] reported that the severity of hydronephrosis before treatment was associated with the failure of shock wave lithotripsy. Cho et al.[16] reported that patients suffering from urolithiasis without microscopic hematuria used medication more often and were hospitalized more frequently than those with microscopic hematuria. In our study, we detected a correlation between the degree of hydronephrosis and the absence of microscopic hematuria. Therefore, we suggest that rapid diagnosis and treatment are required by promptly performing non-contrast CT in the patient group without microscopic hematuria.

Study Limitations

This study has certain limitations. The first concerns the limited number of patients that met the inclusion criteria. Second, the study had a single-center design. Third, it was conducted retrospectively, which limited the data to those that were routinely collected. There is a need for further studies on this subject with the participation of multiple centers.

5. CONCLUSION

We determined that microscopic hematuria was associated with stone size and hydronephrosis severity. Unlike other studies, we found a higher rate (17.9%) of renal colic due to ureteral stone in patients without microscopic hematuria. If a patient with suspected ureteral stone disease does not have microscopic hematuria, we consider that non-contrast CT imaging is necessary for diagnosis and treatment, since the size of the stone may be larger and the degree of hydronephrosis may be more severe.

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Declaration of conflicting interests

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Table legends

Table 1. Clinical characteristics of the patients according to the presence or absence of microscopic hematuria.

Table 2. Relationship between kidney stone size and degree of hydronephrosis

Table 3. Multivariate logistic regression analysis of factors associated with moderate to severe hydronephrosis

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