

ORIGINAL PAPER

UROLOGY

The use of computed tomography as the first imaging modality in patients with renal colic and microscopic haematuria

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Abstract

Objective: We aimed to evaluate the use of computed tomography (CT) as the first imaging modality in patients with renal colic and microscopic haematuria.

Methodology: The patients that presented to the emergency service of six health centers with renal colic between January 2017 and January 2018 and were found to have microscopic hematuria on urinalysis were retrospectively evaluated. Only patients for whom non-contrast CT was used as the first imaging modality were included in the study. Patients were divided into two groups according to the stone presence (stone +, stone -) and the groups were compared in terms of demographics and clinical characteristics of patients.

Results: A total of 834 patients were included in the study and 711 (85.3%) were diagnosed with urolithiasis. CT also revealed additional pathology in 26 (3.1%) patients. The male patients had a significantly higher rate of stones than female patients (89.5% vs 75.2%; $P < .001$) and the BMI values were also significantly higher in the male patients compared with the females (27.0 ± 2.1 vs 25.0 ± 4.0 , $P < .001$). Right renal colic was more common in female patients and the rate of left renal colic was significantly higher in male patients. The male patients diagnosed with stone disease required treatment at a higher rate than the female patients ($P = .005$).

Conclusions: Because of its high sensitivity and specificity values in the diagnosis of stone disease, easy applicability and fast results, CT can be safely used as the first imaging modality for the diagnosis of renal colic and microscopic haematuria.

1 | INTRODUCTION

Renal colic is a common urologic emergency, which often develops because of renal stone disease, presents with severe pain and is diagnosed and treated in emergency departments. In the United States of America, more than one million patients are admitted to emergency clinics per year because of renal colic.¹ In Europe, 7%-9% of emergency ambulance service calls because of the pain caused by renal colic.^{2,3} In patients admitted to the emergency service with renal colic, urinalysis is usually performed and the patients are referred to urology polyclinics after the pain is taken under control. In this patient group, the kidney-ureter-bladder graphy (KUB),

ultrasonography (USG) or non-contrast tomography can be used as imaging techniques. Previous studies reported KUB sensitivity as 18.6 to 53.6%, while the sensitivity of USG was found to be 81% for the diagnosis of kidney stones but much lower for ureteral stones at 46%.⁴⁻⁶

Microscopic haematuria can be seen in various conditions, such as urological cancers, renal parenchymal and tubular diseases, urinary system stone disease and urinary tract infection.⁷ The percentage of urinary system stone disease detection was reported to vary between 4% and 20% in patients that underwent USG because of asymptomatic microscopic haematuria.^{8,9} Compared with USG, KUB and intravenous pyelography; non-contrast computed tomography

(CT), with its high sensitivity, is considered to be the best method and gold standard for the diagnosis of stones in patients with renal colic and microscopic haematuria.^{10,11} However, despite its high sensitivity in the diagnosis of urinary stone disease, CT is not used as the first choice in most health centres and is usually undertaken after USG and KUB. Considering that there is a high probability of a stone disease especially in the presence of renal colic and microscopic haematuria, CT not being adopted as the first choice can lead to delayed diagnosis and treatment.¹² In the current study, we performed non-contrast CT as the first imaging modality in patients, who presented or were referred to our emergency service within the last year and were found to have microscopic haematuria, and we aimed to evaluate the efficacy of this method in the first-step diagnosis and detecting pathologies other than those of the urinary system.

2 | METHODS

Following the approval of the local ethics committee, the patients that presented to the emergency service of six health centres with renal colic between January 2017 and January 2018 and were found to have microscopic haematuria (three or more red blood cells per high-power field on microscopic evaluation of urinary sediment) on urinalysis were retrospectively evaluated. Only patients for whom non-contrast CT was used as the first imaging modality were included in the study. The patients' demographic data, smoking status, comorbidities, renal colic side, history of stone disease and urinalysis results were recorded. The patients with leukocytes in the urine, those under 18 years of age and female patients in the menstrual period were excluded from the study. The patients were scanned from the lower thorax to the pubic bone and the images were reconstructed following the CT protocol at 1 mm intervals. The CT report included the presence/absence of a stone, the location of the stone if present (upper calyx, renal pelvis, lower calyx, proximal ureter, distal ureter, multifocal), stone size and any additional pathology. Patients were divided into two groups according to the stone presence (stone +, stone -) and the groups were compared in terms of demographics and clinical characteristics of patients.

2.1 | Statistical analysis

The data were analysed using the Statistical Package for Social Sciences (SPSS, Inc, Chicago IL) version 22 and presented as mean \pm standard deviation, number (n) and percentages (%). The chi-square test and Student's *t* test were used to compare the groups in terms of categorical and continuous variables, respectively. *P* values of $<.05$ were considered statistically significant.

3 | RESULTS

A total of 834 patients, 588 (70.5%) male and 246 (29.5%) female, from six centres were included in the study between January 2017 and

What's known

- CT is the gold standard for the diagnosis of urolithiasis; however, it is not used as a first choice in many centres.

What's new

- We aimed to present that CT can be safely used as the first imaging modality for the diagnosis of renal colic and microscopic haematuria in this study.

January 2018. The mean age of the patients was 38.7 ± 13.1 years and the mean body mass index (BMI) was 26.4 ± 2.9 . Renal colic was present on the right side for 423 patients (50.7%), on the left side for 405 patients (48.6%) and bilateral for six patients (0.7%). Of the 834 patients, 711 (85.3%) were diagnosed with urinary system stone disease using the CT images taken because of renal colic and microscopic haematuria. CT also revealed additional pathology in 26 (3.1%) patients and all of these patients were redirected to relevant clinics (inguinal hernia in seven patients, cholelithiasis in five patients, liver cyst in four patients, ovarian cyst in four patients, lower lobe pathologies of the lung in three patients, abdominal aortic aneurysm in two patients and appendicitis in one patient). The patients' demographic characteristics and stone dimensions and localisations according to the CT results are given in Table 1. Patients were divided into two groups according to the stone presence (stone +, stone -) and no significant differences were detected between the groups in terms of age, BMI, smoking status and comorbidities; however, the male patients had a significantly higher rate of stones than the female patients (89.5% vs 75.2%; $P < .001$) (Table 2). The BMI values were also significantly higher in male patients compared with the females (27.0 ± 2.1 vs 25.0 ± 4.0 , $P < .001$). Right renal colic was more common in female patients and the rate of left renal colic was significantly higher in male patients (Table 3). The male patients diagnosed with stone disease required treatment at a higher rate than female patients ($P = .005$).

4 | DISCUSSION

Renal colic is the most common symptom of urinary system stone disease and is also the most common urological cause of admission to the emergency department.¹³ The possibility of a person experiencing renal colic in their lifetime is reported to be between 1% and 10%.¹⁴ Renal and ureteral stone disease are the most frequent differential diagnosis of side pain, while the same symptoms and indications can also be seen in other urinary system diseases such as pyelonephritis, ureteropelvic junction obstruction; gastrointestinal, gynaecological, pancreatic, hepatobiliary, vascular and musculoskeletal disorders.^{15,16} In order to make an accurate differential diagnosis, imaging techniques and laboratory tests are utilised. The most adopted imaging modalities for renal colic are KUB, USG and CT.

TABLE 1 Demographic characteristics and CT results of patients (n = 834)

Age (y)	38.7 ± 13.1
BMI (kg/m ²)	26.4 ± 2.9
Stone size (mm)	7.1 ± 4.7
Gender (n, %)	
Male	588 (70.5%)
Female	246 (29.5%)
Smoking (n, %)	
Yes	341(40.9%)
No	493 (59.1%)
Co-morbidity (n, %)	
Yes	73 (8.8%)
No	761(91.2%)
Previous urological surgery (n, %)	
Yes	57 (6.8%)
No	777 (93.2%)
The side of renal colic (n, %)	
Right	423 (50.7%)
Left	405 (48.6%)
Bilateral	6 (0.7%)
Stone presence in CT (n, %)	
Yes	711 (85.3%)
No	123 (14.7%)
Stone localisation (n, %)	
None:	123 (14.7%)
Upper calyx	22 (2.6%)
Renal pelvis	70 (8.4%)
Lower calyx	48 (5.8%)
Proximal ureter	164 (19.7%)
Distal ureter	387 (46.4%)
Multifocal	20 (2.4%)
Treatment modality (n, %)	
Observation	517 (62.0%)
Medical expulsive therapy	105 (12.6%)
Surgery (URS or PNL)	122 (14.6%)
SWL	90 (10.8%)

Abbreviations: BMI, body mass index; PNL, percutaneous nephrolithotomy; SWL, shock wave lithotripsy; URS, ureterorenoscopy.

According to the 2018 European Urology Guidelines, the sensitivity and specificity of USG is 45% and 94%, respectively, for the diagnosis of ureteral stones and 45% and 88%, respectively, for the diagnosis of kidney stones.¹⁷ For KUB, the sensitivity and specificity values for the diagnosis of renal stones range from 44% to 77%; however, this method is not recommended in cases where CT is indicated.¹⁷ In recent years, non-contrast CT has replaced intravenous urography as the gold standard for the diagnosis of acute renal colic.¹⁸ Obtaining data that are important for the decision-making process, such as the density and internal structure of stones, skin-stone distance and the

TABLE 2 Comparison of the characteristics of patients according to the stone presence in CT

	Stone (-) (n = 123)	Stone (+) (n = 711)	P
Age (y)	37.8 ± 13.1	38.9 ± 13.1	.386
BMI (kg/m ²)	26.0 ± 3.2	26.4 ± 2.9	.397
Gender (n, %)			.000
Male (n = 588)	62 (10.5%)	526 (89.5%)	
Female (n = 246)	61 (24.8%)	185 (75.2%)	
Smoking (n, %)			.234
Yes	44 (5.3%)	297 (35.6%)	
No	79 (9.5%)	414 (49.6%)	
Co-morbidity (n, %)			.102
Yes	15 (1.8%)	58 (7.0%)	
No	108 (12.9%)	653 (78.3%)	

Abbreviation: BMI, body mass index.

anatomy of neighbouring organs, non-contrast CT is recommended to be undertaken before the planning of treatment.¹⁹

One of the first examinations to be performed in renal colic assessment is a complete urinalysis, which should also involve the evaluation of the presence of infection and microscopic haematuria. The American Urological Association (AUA) defines clinically significant microscopic haematuria as three or more red blood cells per high-power field on the microscopic evaluation of urinary sediment from two of the three properly collected urinalysis specimens and the prevalence of microscopic haematuria in adults was reported to be 0.18% to 33% in population-based studies.^{20,21} Microscopic haematuria can be seen in various diseases and conditions, including urological cancers, renal parenchymal and tubular diseases, urinary system stone disease and urinary tract infection.⁷ In the evaluation of patients with microscopic haematuria in addition to the imaging modalities of intravenous urography (IVU), USG, CT and MRI, invasive procedures, such as cystoscopy can also be performed.⁷ Compared with other imaging modalities, CT is the gold standard method for the diagnosis of stone disease and with its high sensitivity and specificity, this method has also been increasingly used and has even been recommended as a first-step imaging modality in certain guidelines for the evaluation of patients with microscopic haematuria.²² In a study investigating the sensitivity of microscopic haematuria in the diagnosis of urinary stone disease in patients that presented to the emergency service with acute renal colic, 88.6% of patients diagnosed with stone disease on CT were found to have microscopic haematuria.²³ In the same study, 79.6% of the patients were diagnosed with urinary stone disease accompanied by acute renal colic and microscopic haematuria based on non-contrast CT findings.²³ In another study conducted with 950 patients who underwent a CT scan and urinalysis because of renal colic, Luchs et al examined the sensitivity, specificity and negative and positive predictive values of microscopic haematuria in the diagnosis of urinary stone disease.¹¹ Compared with the gold standard CT method, the results of microscopic haematuria were found to be truly

TABLE 3 Comparison of patients' demographics and clinical characteristics according to gender

	Male (n = 588)	Female (n = 246)	P
Age (y)	39.0 ± 12.7	38.1 ± 14.0	.389
BMI (kg/m ²)	27.0 ± 2.1	25.0 ± 4.0	.000
Co-morbidity (n, %)			.503
Yes	52 (8.8%)	21 (8.5%)	
No	596 (91.2%)	225 (91.5%)	
Stone size (mm)	7.0 ± 4.4	7.4 ± 5.5	.360
Stone presence in CT (n, %)			.000
Yes	526 (89.5%)	185 (75.2%)	
No	62 (10.5%)	61 (24.8%)	
Stone localisation (n, %)			.000
None	62 (10.5%)	61 (24.8%)	
Upper calyx	12 (2.0%)	10 (4.1%)	
Renal pelvis	48 (8.3%)	21 (8.1%)	
Lower calyx	29 (4.9%)	19 (7.7%)	
Proximal ureter	137 (23.3%)	27 (11.0%)	
Distal ureter	284 (48.3%)	103 (41.9%)	
Multifocal	15 (2.6%)	5 (2.0%)	
The side of renal colic (n, %)			.003
Right	277 (47.1%)	146 (59.3%)	
Left	308 (52.4%)	97 (39.4%)	
Bilateral	3 (0.5%)	3 (1.2%)	
Treatment modality (n, %)			.005
Observation	344 (58.5%)	173 (70.3%)	
Medical expulsive therapy	82 (13.9%)	23 (9.3%)	
Surgery (URS or PNL)	92 (15.6%)	30 (12.2%)	
SWL	70 (11.9%)	20 (8.1%)	

positive in 492 (52%) patients, true negative in 174 (18%) patients, false positive in 189 (20%) patients and false negative in 95 (10%) patients. According to these results; the sensitivity, specificity and positive and negative predictive values of microscopic haematuria for the diagnosis of stones in patients with renal colic were calculated as 84%, 48%, 72% and 65%, respectively.¹¹ In our, only patients with renal colic who had microscopic haematuria were evaluated and 85.3% were diagnosed with urinary system stone disease, which is consistent with the percentages reported in the literature. When we compared stone detection rate according to gender in our subgroup analysis, we observed it to be significantly lower in female patients (75.2% vs 89.5%). For false positivity, this difference may be because of possible vaginal pathologies in women (menstrual irregularities, etc) contaminating the urine with blood. In addition, trauma to the

urethral and bladder structures adjacent to the vagina during sexual intercourse may also play a role in microscopic haematuria in female patients.^{24,25} In this regard, Hosseini et al investigated the role of sexual intercourse in haematuria and proteinuria and found significantly higher rates of microscopic haematuria in women after sexual intercourse compared with men (73.3% vs 22.2%).²⁴ In another study, Harris et al reported that approximately 1/4 of women developed microscopic haematuria because of direct sexual intercourse and emphasised the need for taking into account the recent history of sexual intercourse when evaluating clinically significant microscopic haematuria in women.²⁵

Our study has some limitations. For example, the recent history of sexual intercourse was not considered in the evaluation of patients with microscopic haematuria. In addition, the study included patients with renal colic and microscopic haematuria who only underwent CT. Future comparative studies using USG and CT will provide more objective results concerning the efficacy of CT in the evaluation of the coexistence of microscopic haematuria and renal colic.

5 | CONCLUSIONS

Because of its high sensitivity and specificity values in the diagnosis of stone disease, easy applicability and fast results, CT can be safely used as the first imaging modality for the diagnosis of renal colic and microscopic haematuria.

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DISCLOSURE

The authors have declared no conflicts of interest for this article.

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