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ORIGINAL PAPER

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The presence of microscopic hematuria detected by urine dipstick test in the evaluation of patients with renal colic

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Abstract Urolithiasis is a common diagnosis in patients presenting at our hospital with flank pain. One of the most important steps in the diagnostic algorithm of renal colic is the presence of hematuria, but this fact has been challenged by authors reporting a negative urinalysis for microscopic hematuria in about 9–18% of such patients. Our aim was to investigate whether the same results are obtained when a sample of urine is tested with a urine dipstick test (UDT) at the time of the initial examination. Data from patients with the clinical diagnosis of renal colic examined at the emergency department of our hospital were reviewed, and the sensitivity of hematuria in urine samples tested by UDT was recorded in a group consisting of patients for whom imaging showed evidence of a stone >3 mm in size. In cases in which UDT was negative, or showed only traces of red blood cells (RBCs), a formal urinalysis was performed. A total of 609 patients were finally included in the study, with a mean age of 49.2 years. Average stone size was 5.8 mm, located mainly in the lower part of the ureter. Dipstick analysis was positive for hematuria in 92.9%. A urinalysis, with a cut-off point of less than three red blood cells per high power field, was used as a means to verify the results of the UDT in 17.8% of cases: in 7.1% of UDT negative patients and 10.7% of patients with traces of blood. The urinalysis was negative in 5.1% of patients, adding only 2% to the diagnostic accuracy of UDT. Therefore, our findings suggest that the sensitivity of a UDT for hematuria in cases of suspected renal colic has a high degree of accuracy when performed at the emergency department, and can be used as a first-line, low cost examination. A microscopic analysis may be useful when the UDT is negative or not clear enough, to verify the results.

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Introduction

Nephrolithiasis is a common condition that leads patients to the emergency department of a hospital seeking medical treatment. This is especially important for high-incidence areas, like the Mediterranean countries [1, 2]. The estimated lifetime risk of renal colic ranges from 5 to 12.5%, depending on the author [2, 3]. Despite this incidence, only a limited number of studies have examined the characteristics of this population [4]. At the initial examination, the presence of hematuria (micro- or macroscopic) in urinalysis has traditionally been mentioned as one of the hallmark signs of lithiasis. Most patients undergo a series of imaging studies, such as a KUB film, an ultrasound (US), and lately unenhanced helical computed tomography (UHCT), which is considered by many as an examination of equal diagnostic ability to the 'gold standard' of intravenous urography (IVU) [5, 6].

Several historical studies state that patients with lithiasis almost always present with hematuria, but this fact has recently been challenged by authors reporting that a significant number of patients, ranging from 9 to 18%, have a negative urinalysis [3, 7, 8]. The present study was conducted in order to evaluate the sensitivity of a modified urine testing protocol, with the use of the urine dipstick test (UDT), and urinalysis in selected cases, for the detection of hematuria in the initial examination of patients with renal colic.

Materials and methods

A retrospective review of all available data from patients who presented with renal colic at the emergency department of our hospital and were afterwards referred to our urolithiasis unit, over a period of 1 year (September 1 2001–August 31 2002), was performed.

Urine testing

After taking a brief history and the initial physical examination, a urine sample was collected from each patient. This was immediately tested with a UDT (Multistix 10G, Bayer), and read by a resident or attending physician. The analysis was considered positive when at least traces of blood were noticed. The UDT results were categorized into five groups: negative, trace, 1+, 2+ and 3+. When the results of the test were either negative or showed only traces of blood, a formal urinalysis was performed on the same sample by the microbiological laboratory, which was blinded to our results. The urinalysis was classified as positive for hematuria when more than three erythrocytes per high power field (RBCs/HPF) were detected.

Imaging studies

All patients underwent an evaluation with a KUB film to detect radiopaque stones, and an ultrasound was performed by a radiologist, classifying the degree of obstruction as small, medium or severe. The size and location of the stone was recorded, if one was visualized. Only patients exhibiting at least one visible ureteral or renal stone of more than 3 mm in diameter were included in our study.

Exclusion criteria

We excluded all patients with negative imaging, those who reported the use of bowel evacuants, phenolphthalein or rifampicin (drugs that affect the UDT results), and also female patients with menstrual blood flow (Table 1).

Results

A positive UDT was found in 566 patients (92.9%), while 43 (7.1%) had a negative dipstick analysis. In 66 out of the 566 positive patients, the UDT showed only traces of blood. These patients, along with the 43 with a negative UDT, had a subsequent formal urinalysis, which proved positive in 78, leaving 31 patients with renal colic (5.1%) without any evidence of hematuria in any investigation. All of the patients with at least traces of blood in the UDT demonstrated a positive urinalysis as well.

From the 564 patients with ureteral stones, 539 had a positive UDT and 25 had a negative UDT. The proportion of severe obstruction in these two groups of patients was 10/539 and 1/25, respectively. Thus, no significant correlation was discovered between the presence of hematuria and the degree of obstruction. In the group of patients with renal stones, only 27/45 (60%) had a positive UDT.

From the 564 patients with ureteral stones, 324 had stone(s) less than 6 mm in size, and the remaining 240 had stone(s) more than 6 mm. When the patients were separated into two groups using this cut-off point, the absence of hematuria was evident in 13/324 and 12/240, respectively. No correlation was noted between the size of the stone and the degree of hematuria. Table 2 shows the results of the UDT compared to the degree of obstruction and the size of the stone(s).

Table 1 Characteristics of patients with lithiasis. A total of 609 patients who met the criteria were included in the analysis, most of them male. The majority had a lower ureteral stone (38.9%), with a mean stone size was 5.8 mm. A significant number (32%) had a previous stone history

Male/female (%)	385 (63.2)/224 (36.8)
Mean age ± SD(years)	49.2 ± 15.9
Stone location	
Renal (%)	45 (7.4)
Upper 1/3 (%)	145 (23.8)
Mid 1/3 (%)	182 (29.9)
Lower 1/3 (%)	237 (38.9)
Position of the stone (left/right)	300/309
Mean stone size, mm (range)	5.8 (3–11)
No. of stones (range)	1–4
Microscopic hematuria in UDT (%)	566 (92.9)
Urinalysis performed	109 (17.8)
Negative UDT (%)	43 (7.1)
Traces in UDT (%)	66 (10.7)
Negative urinalysis (%)	31 (5.1)

Discussion

When a patient presents at the emergency department with flank pain, one of the most common diagnoses that comes to mind is renal colic. The estimated lifetime risk of an episode varies between 5% and 12.5%, and the prevalence of upper urinary tract stone disease is estimated to be 2–5% [2]. Our hospital covers, on a rotational basis every 4 days, the greater area of Athens with around four million people, sharing the emergencies with two other hospitals. During this study, around 4,600 patients were examined, about 1/3 of whom suffered from lithiasis-related medical problems.

Due to the extremely high cost for the health system, algorithms for the correct identification of such patients, combined with strategies for minimizing cost, should be the primary goal of every health professional. Such efforts are already under way, and researchers, as of 1998, have proposed a diagnostic scoring method for renal colic, combining factors such as acute abdominal pain with normal appetite, short duration of pain, loin or renal tenderness, and hematuria [9].

Table 2 Association between the UDT results and the degree of obstruction and size of stones

Patients with ureteral stones	564
Positive UDT	539
Negative UDT	25
Patients with renal stones	45
Positive UDT	27
Negative UDT	18
Patients with high grade obstruction	11/564
Positive UDT	10/539
Negative UDT	1/25
Stone size < 6 mm	324
Positive UDT	13
Stone size > 6 mm	240
Positive UDT	12

In the differential diagnosis of such patients, hematuria (micro- or macroscopic) has always been considered as one of the characteristic signs. This, however, seems to be under reconsideration. Press and Smith, in a study of 140 patients using IVU as the reference standard, reported the presence of microscopic hematuria in 85.5% of patients, but excluded 22% (31/140) due to insufficient data [3]. Furthermore, the sensitivity of UDT in their study was calculated by the results of 55 patients who had a positive IVU. By combining UDT with a microscopic examination, the sensitivity rose to 94.5%, suggesting an improved performance with a combination of these tests. Luchs et al. used UHCT as a reference standard, and found that lithiasis was present in 62% of 950 patients, and hematuria in 84% of patients with lithiasis, but reported no data from UDT, since these were not recorded [7]. Bove at al. in another study of 267 patients with flank pain, found a negative incidence for hematuria in 19%, using the presence of more than one RBC in urinalysis, and 20% using the UDT [8].

The presence or absence of hematuria is affected by the definition used in each study. As the normal secretion of RBCs in the urinary tract is difficult to define, different cut-off points have been used as a limit of 'normal' excretion of erythrocytes. We defined microscopic hematuria as greater than three RBCs/HPF in urinalysis, and the presence of at least traces of blood in the UDT, in order to exclude patients with minimal degrees of hematuria.

Other pitfalls that influence the results of UDT, and may lead to false positive results, are the use of drugs or substances contained in bowel evacuants. Such patients were excluded from our study. Female patients with menstrual blood flow were also excluded. The study group consisted of patients later referred to our urolithiasis unit for follow-up.

Our aim was to examine the sensitivity of our urine testing protocol in combination with the imaging studies usually performed in the emergency setting, in cases of suspected renal colic. In most studies, the results from the UDT are not available. As Kiel and Moskowitz noticed in a review of urinalysis, the method for measuring hematuria by HPF is very imprecise, since technical factors can lead to the loss of erythrocytes [10]. Additionally, others have showed that the interval between the collection and examination of urine can lead to haemolysis of RBCs, thus allowing a difference in the results between UDT and urinalysis [11].

UDT positivity for the presence of hematuria was found in 92.9% of UDTs performed on the 609 patients in our study, which is higher than reported previously. This fact may be attributed to the method of urine examination used in our hospital: after the results of the UDT were recorded by a member of the medical staff, a microscopic analysis of the same sample followed, if necessary, in the microbiological laboratory by a trained member of the staff, blinded to the results of the UDT. The urinalysis results were recorded in cases with small or no hematuria, for verification reasons. The results of the urinalysis verified the presence of hematuria in an additional 2% of patients with negative UDT, providing only a modest improvement compared to the dipstick test. In support of our findings, a recent study by Kobayashi et al. concluded that the sensitivity of the dipstick test was higher than that of microscopic urinalysis, and also that the overall hematuria sensitivity on day 0 from the onset of colic was 95% [12]. The observation that only 7.4% of patients had renal stone(s) may explain, in part, these results. It must be pointed out that in this group only 60% had a positive UDT, compared to the 95.5% in the group with ureteral stones.

No significant correlation was discovered between the degree of obstruction and the results of the UDT. With high-grade obstruction, it would seem reasonable to expect fewer patients with hematuria. This fact is in accordance with previous studies [3], which failed to identify such a relation, if one exists. No significant correlation was found between the results of the dipstick test and the size of the stones. By separating two groups of patients, using the 6 mm as a cut-off size, the analysis showed no significant difference in the degree of hematuria. Bearing in mind that most patients in the study group had a stone size of less than 6 mm, a larger series of patients with stones >6 mm may be needed to prove a difference in the degree of hematuria.

No special characteristics in terms of age or sex were identified in the negative UDT group. The only factor associated with a negative result was the presence of renal stones: only 60% of these patients produced positive UDT results, as one would expect.

A potential limitation of our study was the reference standard used for the detection of stones. IVU has been traditionally used as the definitive test to show stones in the urinary tract, nevertheless, this is an invasive procedure with known limitations and risks [13, 14]. UHCT seems to be most promising [5,14, 15, 16], but the increased cost and the technical equipment required prevent its widespread use in the emergency department setting. On the other hand, a KUB film and an ultrasound are the easiest, fastest, and cheapest examinations. Both, and especially the ultrasound, carry a minimal risk for the patient in terms of radiation exposure, and are easily performed in the emergency department. The development of modern US technology, involving the detection of ureteric jets and the measurement of the resistive index, might aid in increasing the sensitivity of the examination. Unfortunately, such data were not available in our study group.

Henderson et al. showed that the combination of a KUB and US produced comparable results to those obtained by IVU, detecting 97.1% of patients with positive IVU [17]. Yilmaz et al., in 1998, reported that the combination of KUB and US reaches a sensitivity comparable to UHCT [18]. Furthermore, Ghali et al., in an effort to develop a cost-effective plan for the diagnosis of patients with stone disease, discovered that the combination of KUB and US had a sensitivity of 94% compared to emergency IVU [19].

Therefore, the detection of the presence of a stone in a KUB film, and of obstruction in US, seems to be justified in the emergency setting.

In conclusion, our results suggest that UDT as a screening test for hematuria has a high degree of sensitivity in the evaluation of patients with a high clinical suspicion of renal colic. Our purpose was to demonstrate that no microscopic examination of urine is necessary when the UDT is positive. Furthermore, it became evident that urinalysis provides only a modest improvement compared to the UDT, and should be used only when the UDT is negative or doubtful. In the future, clinical factors and laboratory results may be used in diagnostic algorithms during the initial examination of patients, providing accurate results in terms of the diagnosis and prognosis of urinary lithiasis. The value of imaging studies in such patients remains unchanged.

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