Original Article Ann Med Res 2023;30(5):576–582

Ann Med Res

Current issue list available at AnnMedRes

Annals of Medical Research

journal page: www.annalsmedres.org

Evaluation of clinical and laboratory results of patients diagnosed urinary calculi in emergency department

Abdullah Ahmet Atila[a], Mehmet Ediz Sarihan[a], Zeynep Kucukakcali[b,*], Hasan Gungor[c]

[a] *Inonu University, Faculty of Medicine, Department of Emergency Medicine, Malatya, Türkiye*
[b] *Inonu University, Faculty of Medicine, Department of Biostatistics and Medical Informatics, Malatya, Türkiye*
[c] *Inonu University, Faculty of Medicine, Department of Urology, Malatya, Türkiye*

ARTICLE INFO

Keywords:
Emergency department
Urinary stones
Laboratory results

Received: Jan 21, 2023
Accepted: Apr 26, 2023
Available Online: 26.05.2023

DOI:
10.5455/annalsmedres.2023.01.032

Abstract

Aim: In this study, we examined the factors affecting the rate of urine culture positivity and the rate of urine culture positivity in patients who were found to have kidney stones in the emergency department and were followed up by the Urology outpatient clinic. We evaluated the examinations and treatments of these patients with the results of the urology outpatient clinic until the urine culture results were obtained. We think that our study will provide useful information to emergency service workers in the evaluation of patients with urinary system stones.

Materials and Methods: In this study, patients who applied to Emergency Medicine Department of İnönü University Faculty of Medicine between January 1st, 2016 and November 1st, 2022, who were diagnosed with urinary calculi by imaging and who were followed up in the Urology outpatient clinic, were retrospectively analyzed. The age and gender of the patients, as laboratory tests, complete blood count, urinalysis, serology and urine culture results were examined. Multiple logistic regression analysis was performed with all the parameters obtained from our study and the analysis was statistically significant according to the Hosmer&Lemeshow test.

Results: In our study, there were a total of 349 patients, 99 (28.37%) female and 250 (71.63%) male, and a pathogenic microorganism growth was observed in the urine culture of 40 (11.7%) of the patients. The first two microorganisms most frequently encountered in urine culture were Escherichia Coli (24/40) and Klebsiella spp. (5/40). In the logistic regression model, nitrite positivity increased 48.8%, urinary white blood cells increased 0.2%, bacteria presence in urine 3.06%, and increased patient age increased the probability of culture positivity by 2.6%. Each 1 unit increase in hemoglobin value decreased the probability of positive urine culture by 27.8%.

Conclusion: The leukocyte count, bacteria presence, nitrite positivity, low blood hemoglobin and advancing advanced age in the complete expulsion examination of a patient with urinary system stone are the prediction of a positive ejection result. These data should be considered in the decision to take the culture of dissemination at the time of death of patients with urinary tract stones or the management of care during the time until they reach the respiratory tract.

Introduction

Kidney stones are a common disease worldwide, with an incidence of 5-20% depending on the geographical area [1]. Also, the incidence of kidney stone disease has increased in the last 20 years, especially in developed countries, and the recurrence rate of these patients might reach 50-70% in 10-year follow-ups. In some previous studies, it is reported that an average of 2 billion dollars is spent annually to treat urinary system stone diseases. For this reason, kidney stones are an essential healthcare issue with high socioeconomic costs. Several studies predicted that the incidence of kidney stones would increase dramatically in the future [2, 3]. Urinary Tract Infection (UTI) is very common in patients with urolithiasis. This makes the treatment of urolithiasis complicated and even dangerous. A previous study detected UTI in 178 (22.0%) of 806 patients with kidney stones. Gram-negative bacilli, gram-positive bacilli, and fungi were detected in the urine culture results of these patients [2].

Infective and non-infective stones might host bacteria,

*Corresponding author:
Email address: zeynep.tunc@inonu.edu.tr (Zeynep Kucukakcali)

which makes them resistant to antimicrobial therapy [4, 5]. After the first examination of a patient with a suspected kidney stone, laboratory and imaging examinations must be performed, and the patient must be evaluated holistically [6]. Kidney stones are mineral stones in the kidney calyces and pelvis and may be attached to the renal papilla or may be loose. Approximately 80% of kidney stones are calcium oxalate stones (CaOx) mixed with calcium phosphate (CaP). Stones composed of uric acid, struvite, and cystine are also common, making up approximately 9%, 10%, and 1% of kidney stones [7].

Acute renal colic presents as cramping and intermittent abdominal and flank pain as kidney stones move through the ureter from the kidney to the bladder. Pain is often accompanied by nausea, vomiting, and weakness, and fever and chills may also be present. The value of the patient's own or family history during an episode of renal colic is unknown; similarity to a previous episode of pain from a kidney stone must increase confidence in the diagnosis. The physical examination must target to exclude differential diagnoses such as UTI, musculoskeletal pain, ectopic pregnancy, testicular torsion, and cancer [5, 6]. Stones in the urinary system may cause complete urinary obstruction and result in Acute Kidney Injury (AKI) or irreversible loss of kidney function [6]. All urinary system stones constitute a risk factor for infection because they could obstruct the upper part of their locations. They may also cause hydronephrosis by causing dilation of the urinary tract proximal to the stone as a result of obstruction, and atrophy and functional losses may occur in the kidney because of the progression of hydronephrosis [8-10].

Urinary tract stones and UTIs are strongly associated. The cause of the stones is an infection, and the development of infection may complicate the treatment of preexisting stones in approximately 15% of stone formers. If left untreated, both conditions can lead to loss of kidney function and can sometimes be life-threatening [9]. Struvite stones, also known as infection stones, might obstruct the pelvicalyceal system due to the development of an infection one after another and may cause morbidity if not treated [11]. The mainstay of treatment for infectious stones is surgery targets to clear 14 stones, and there are less invasive treatment options. Systemic sepsis remains the most serious complication, and relapse may occur despite antibiotic prophylaxis. After stone removal, various strategies can be used to minimize the risk of recurrence of infection. When infection complicates pre-existing stone disease, the primary target in treatment is to treat the infectious episode and delay treatment for urinary stones until the infection clears. The most alarming situation occurs when a system already blocked by a stone becomes infected later on above the blockage level. In this scenario, drainage of the obstruction with parenteral antimicrobials will sometimes save nephron function and the patient's life. Congested and infected kidneys lose function much faster than a simple clogged kidney. In such cases where an obstruction is also present, prompt evacuation of the affected kidney is likely to prevent permanent kidney damage and may be life-saving [9].

In the present study, the factors that affect the rate of urine culture positivity and the rate of urine culture positivity in patients with urinary system stones who applied to the emergency department with urinary system complaints will be examined. Whether the antibiotic treatment started until the urine culture results of these patients were sufficient was evaluated with the results of the urology clinic.

Materials and Methods

Data collection and variables

In the study, patients who applied to the Inonu University Faculty of Medicine Turgut Özal Medical Center Emergency Medicine Department were diagnosed with kidney stones by imaging and were followed up in the urology clinic were analyzed retrospectively. The ethics committee approval was obtained with the number 2022/4010 from the Inonu University Health Sciences Non-Interventional Clinical Research Ethics Committee, and the patients admitted to our emergency department between January 1, 2016, and November 1, 2022, were included. Patients whose kidney stone diagnosis was not confirmed by any imaging, patients with missing parameters, and those whose urine culture results were evaluated as contamination were not included in the study. Applications were identified through the hospital health information management system. After the patient applications were determined, the patients' medical records were examined, and a patient follow-up form was created for the patients. The data of the patients recorded in this form were transferred to the Microsoft Office Excel® program. In the medical records of the patients, the file number of the patients, application number, name-surname, age, gender, laboratory tests [(White Blood Cell (WBC), hemoglobin (HGB), hematocrit (HCT), platelet count (PLT), C-reactive) protein (CRP), kidney function test results (Blood urea nitrogen [BUN], creatinine and uric acid), electrolyte values (Sodium, potassium), complete urinalysis (Blood, leukocyte, white blood cell count [urine WBC], red blood cell, number of [urine RBC], nitrite, bacteria) and urine culture (whether there was significant bacterial growth, the name of the microorganism growing or the family of microorganisms) were examined. When the complete urinalysis (TIT) was studied, the leukocyte, blood, and Nitrite values were considered positive +1, +2, +3; and negative or trace values were considered negative, and urine WBC and urine RBC were analyzed quantitatively in the microscopic analysis, bacterial presence was positive, and no bacteria absence was negative. When urine culture was studied, colony-forming bacterial growth of >105 hpf was accepted as culture positivity.

Power analysis/sample size

In the study, when culture positivity/negativity was the outcome variable/clinical endpoint, Type I error amount (alpha) was detected to be 0.05, test power (1-beta) was 0.8, the effect size was 0.24, distribution ratio to groups was 1, and alternative hypothesis (H1) was two-way. It was calculated with theoretical power analysis that the minimum sample size must be 321 to find a significant difference16. To increase the power of this study, a total of 349 individuals were included in the study.

Biostatistical data analysis

Qualitative variables were summarized as numbers (percentage), and numerical variables as mean ± standard deviation or median and interquartile range (CIW) according to the distribution of the data. The Kolmogorov-Smirnov test was used for the data that conformed to normal distribution. Mann Whitney U and Spearman Rho correlation tests were used where appropriate in statistical analysis. To determine the effects of WBC, HGB, HCT, PLT, CRP, creatinine, TIT RBC, TIT WBC, BUN, uric acid, Na, K, age, TIT Blood, TIT leukocytes, TIT Nitrite, TIT bacterial variables on culture result positivity/negativity, multiple logistic regression was used [13]. The significance of the relevant model was evaluated with the Hosmer & Lemeshow and Omnibus Tests. A $p<0.05$ value was considered statistically significant in the applied statistical analyzes. The American Psychological Association (APA) 6.0 style was used to report the statistical differences. All analyses were made using IBM SPSS Statistics 28.0 for Windows (New York, USA).

Results

There were a total of 349 patients in the study (99 (28.37%) female and 250 (71.63%) male). The mean age of the patients was detected to be 47.17±14.7 years. Although the mean age was 45.7±16.1 years in female patients, it was 47.5±14.2 years in male patients, and no growth was detected in 308 (88.3%) of these patients due to culture, but an increase was observed in 40 (11.7%) of them. Escherichia coli was detected in 24 (6.88%) patients, Klebsiella spp. in 5 (1.43%), Enterococcus in 4 (1.15%), Pseudomonas in 2 (0.57%) patients, fungal infections were detected in 3 (0.86%) and gram (-) bacilli in 3 (0.86%). TIT blood was negative in 131 (37.54%) patients, and TIT blood was positive in 218 (62.46%) patients. Although TIT leukocytes were negative in 223 (63.90%) patients, TIT leukocytes were positive in 126 (36.10%) patients, and TIT Nitrite was negative in 333 (95.42%) patients, it was positive in 16 (4.58%) patients. Although only 21 (6.02%) bacteria were observed in TIT, bacteria were not observed in TIT in 328 (93.98%) patients. Table 1 shows descriptive statistics for categorical variables.

Among the blood and urine variables, the WBC mean

Table 1. The descriptive statistics for the categorical variables.

Variables	Categories	Number (%)
Gender	Woman	99 (28.37)
	Male	250 (71.63)
Culture positiveness	No reproduction	308 (88.3)
	Reproduction	41 (11.7)
Result of culture	No reproduction	308 (88.25)
	Escherichia coli	24 (6.88)
	Klebsiella	5 (1.43)
	Enterococcus	4 (1.15)
	Pseudomonas	2 (0.57)
	Fungal infections	3 (0.86)
	Gram(-) bacillus	3 (0.86)
TIT Blood	Negative	131 (37.54)
	Positive	218 (62.46)
TIT Leukocyte	Negative	223 (63.90)
	Positive	126 (36.10)
TIT Nitrate	Negative	333 (95.42)
	Positive	16 (4.58)
TIT Bacteria	Negative	328 (93.98)
	Positive	21 (6.02)

TIT: Complete Urinalysis.

Table 2. The descriptive statistics for the numerical variables.

Variables	Mean±Standard Deviation
WBC	8.843±2.865
HGB	14.545±1.748
HCT	43.537±4.559
PLT	265.777±74.695
CRP	1.422±3.298
BUN	15.874±6.464
CREATININE	1.018±0.353
URIC ACID	5.463±1.512
NA	139.034±2.567
K	4.388±0.456
TIT RBC	207.556±610.461
TIT WBC	57.542±186.039
Age	47.069±14.763

TIT: Complete Urinalysis; WBC: White Blood Cell; HGB: Hemoglobin; HCT: Hematocrit; PLT: platelet count; CRP: C-reactive protein; BUN: Blood urea nitrogen.

Table 3. The results of the analysis of blood and urine variables in terms of gender.

Variables	Gender**		p*
	Woman	Male	
	Median (IQR)	Median (IQR)	
WBC	8.21 (3.29) [a]	8.32 (3.7)[a]	0.381
HGB	13.1 (1.7)[a]	15.15 (1.72) [b]	**<0.001**
HCT	40.3 (4) [a]	45.2 (4.9)[b]	**<0.001**
PLT	283 (83)[a]	247 (75) [b]	**<0.001**
CRP	0.33 (0.65)[a]	0.33 (0.45)[a]	0.962
BUN	12.6 (4.81) [a]	15.45 (5.49) [b]	**<0.001**
CREATININE	0.75 (0.12) [a]	1 (0.3)[b]	**<0.001**
URIC ACID	4.6 (1.6) [a]	5.775 (1.87) [b]	**<0.001**
NA	139 (3)[a]	139 (3) [a]	0.039
K	4.33 (0.47) [a]	4.34 (0.58)[a]	0.723
TIT RBC	10 (88) [a]	15 (97) [a]	0.351
TIT WBC	14 (33) [a]	5 (19) [b]	**<0.001**
Age	45 (23)[a]	47 (20)[a]	0.178

*:Mann Whitney U test; **: There is a statistically significant difference in group categories that do not contain the same letter; IQR: Interquartile range.
TIT: Complete Urinalysis; WBC: White Blood Cell; HGB: Hemoglobin; HCT: Hematocrit; PLT: platelet count; CRP: C-reactive protein; BUN: Blood urea nitrogen.

Table 4. The results of the analysis of blood and urine variables in terms of culture positivity.

Variables	Culture positivity**		p*
	No reproduction	Reproduction	
	Median (IQR)	Median (IQR)	
WBC	8.175 (3.71) ^{a}	9.01 (4.31) ^{b}	**0.028**
HGB	14.9 (2.175) ^{a}	13.7 (2.2) ^{b}	**<0.001**
HCT	44.20 (5.7)^{a}	41.9 (5.3) ^{b}	**<0.001**
PLT	253 (81.5) ^{a}	286 (91)^{b}	**0.010**
CRP	0.33 (0.36)^{a}	1.05 (3.87) ^{b}	**<0.001**
BUN	14.545 (5.94) ^{a}	15.52 (6.18)^{a}	0.566
CREATININE	0.92 (0.3)^{a}	0.89 (0.50)^{a}	0.693
URIC ACID	5.5 (2) ^{a}	5.03 (2.47)^{a}	0.276
NA	139 (3) ^{a}	138 (4) ^{a}	0.225
K	4.35 (0.56) ^{a}	4.27 (0.37) ^{a}	0.317
TIT RBC	11 (89) ^{a}	26 (143)^{a}	0.177
TIT WBC	6.5 (18) ^{a}	59 (188)^{b}	**<0.001**
Age	46 (21.5)^{a}	48 (14)^{a}	0.109

*:Mann Whitney U test; **: There is a statistically significant difference in group categories that do not contain the same letter; IQR: Interquartile range.
TIT: Complete Urinalysis; WBC: White Blood Cell; HGB: Hemoglobin; HCT: Hematocrit; PLT: platelet count; CRP: C-reactive protein; BUN: Blood urea nitrogen.

Table 5. The results of the analysis of blood and urine variables in terms of TIT blood.

Variables	TIT blood**		p*
	Negative	Positive	
	Median (IQR)	Median (IQR)	
WBC	8.45 (4.31)^{a}	8.285 (3.17)^{a}	0.363
HGB	14.8 (2.4)^{a}	14.7 (2.2)^{a}	0.838
HCT	44 (6.3)^{a}	43.75 (5.55)^{a}	0.822
PLT	256 (82)^{a}	256.5 (87)^{a}	0.979
CRP	0.33 (0.48)^{a}	0.33 (0.50)^{a}	0.864
BUN	15.42 (6.87)^{a}	14.38 (5.21)^{a}	0.133
CREATININE	0.92 (0.38)^{a}	0.93 (0.3)^{a}	0.926
URIC ACID	5.5 (1.94) ^{a}	5.45 (2.15) ^{a}	0.639
NA	139 (4) ^{a}	139 (3) ^{a}	0.176
K	4.42 (0.55)^{a}	4.32 (0.52)^{a}	0.067
TIT RBC	2 (6) ^{a}	57.5 (193)^{b}	**<0.001**
TIT WBC	3 (15) ^{a}	10 (29)^{b}	**<0.001**
Age	48 (20)^{a}	45.5 (21)^{a}	0.408

*:Mann Whitney U test; **: There is a statistically significant difference in group categories that do not contain the same letter; IQR: Interquartile range.
TIT: Complete Urinalysis; WBC: White Blood Cell; HGB: Hemoglobin; HCT: Hematocrit; PLT: platelet count; CRP: C-reactive protein; BUN: Blood urea nitrogen.

was detected to be 8.843±2.865, HGB mean 14.545±1.748, HCT mean 43.537±4.559, PLT mean 265.777±74.695, CRP mean 1.422±3.298, BUN mean 15.874±6.464, creatinine mean 1.018±0.353, uric acid means of Na was 5.463±1.512, mean of Na was 139.034±2.567, mean of K was 4.388±0.456, mean of TIT RBC was 207.556±610.461, mean of TIT WBC was 57.542±186.039 and mean age was 47.069±14.763 years. Descriptive statistics for numerical variables are given in Table 2.

Table 6. The results of the analysis of blood and urine variables in terms of TIT leukocytes.

Variables	TIT Leukocyte**		p*
	Negative	Positive	
	Median (IQR)	Median (IQR)	
WBC	7.98 (3.95)^{a}	7.98 (3.16)^{b}	**0.012**
HGB	14.9 (2.3)^{a}	14.9 (2.3)^{b}	**0.014**
HCT	44.3 (5.5)^{a}	43.2(5.7)^{b}	**0.025**
PLT	252 (76)^{a}	252 (97)^{b}	**0.004**
CRP	0.33 (0.33)^{a}	0.35 (0.84)^{b}	**0.034**
BUN	14.95 (6.2)^{a}	14.95 (4.68)^{a}	0.380
CREATININE	0.93 (0.37)^{a}	0.91 (0.29)^{b}	**0.036**
URIC ACID	5.4 (2.18)^{a}	5.5 (2.15)^{a}	0.726
NA	139 (3)^{a}	139 (3)^{a}	0.192
K	4.34 (0.58)^{a}	4.35 (0.47)^{a}	0.464
TIT RBC	7 (48)^{a}	7 (265)^{b}	**<0.001**
TIT WBC	3 (9)^{a}	3 (111)^{b}	**<0.001**
Age	46 (21)^{a}	46 (21)^{a}	0.279

*:Mann Whitney U test; **: There is a statistically significant difference in group categories that do not contain the same letter; IQR: Interquartile range.
TIT: Complete Urinalysis; WBC: White Blood Cell; HGB: Hemoglobin; HCT: Hematocrit; PLT: platelet count; CRP: C-reactive protein; BUN: Blood urea nitrogen.

Table 7. The findings of the logistic regression analysis.

Variables	Odds Ratio	95% Confidence Interval	p
TIT Nitrate (+)	49.882	10.945 - 315.781	<0.001
HGB	0.723	0.576 - 0.903	0.004
TIT bacteria (+)	4.06	1.039 - 13.224	0.027
TIT WBC	1.002	1.001 - 1.003	0.029
Age	1.026	1.002 - 1.05	0.031
Constant term	20.109		0.286

TIT: Complete Urinalysis; WBC: White Blood Cell.

The results of the analysis of the blood and urine variables in terms of gender are given in Table 3.

According to the results, statistically significant differences were detected in terms of gender in HGB, HCT, PLT, BUN, creatinine, uric acid, and TIT WBC variables ($p<0.05$). However, no statistically significant difference was detected in terms of gender for the other examined WBC, CRP, Na, K, TIT RBC, and age variables ($p>0.05$). The results of the analysis of blood and urine variables in terms of culture positivity are given in Table 4.

According to the results, a statistically significant difference was detected in terms of culture positivity variable for WBC, HGB, HCT, PLT, CRP, and TIT WBC variables ($p<0.05$). However, no statistically significant difference was detected in terms of culture positivity variable for BUN, creatinine, uric acid, Na, K, TIT RBC, and age variables ($p>0.05$). The results of the analyzes of blood and urine variables in terms of TIT blood are given in Table 5.

According to the results, a statistically significant difference was detected between TIT RBC, TIT WBC variables, and TIT blood variables ($p<0.05$). However, no statistically significant difference was detected in terms of TIT blood variable for other examined WBC, HGB, HCT, PLT, CRP, BUN, creatinine, uric acid, Na, K, and age variables ($p>0.05$). The descriptive statistics for blood and urine variables regarding TIT leukocytes are given in Table 6.

In this regard, statistically significant differences were detected for WBC, HGB, HCT, PLT, CRP, creatinine, TIT RBC, and TIT WBC variables regarding the TIT leukocyte variable ($p<0.05$). However, no statistically significant differences were detected regarding the TIT leukocyte variable for BUN, creatinine, uric acid, Na, K, and age variables ($p<0.05$).

To determine the effects of WBC, HGB, HCT, PLT, CRP, creatinine, TIT RBC, TIT WBC, BUN, uric acid, Na, K, age, TIT Blood, TIT leukocytes, TIT Nitrite, TIT bacteria 31 on culture result positivity/negativity, multiple logistic regression was performed. According to the analysis findings, the logistic regression model was statistically significant according to the Hosmer & Lemeshow Test (Chi-Square=7.675, SD=8, p=0.466). Also, the model coefficients in question were significant due to the Omnibus test (Chi-Square=74.2, SD=7, $p<0.001$). The logistic regression model explained 37.6% (Nagelkerke R2) of the variance in culture result positivity/negativity and correctly classified 91.4% of cases. TIT Nitrite (+) [OR=49.8, 95% CI (10.945 - 315.781)], HGB [OR=0.723, 95% CI (0.576 - 0.903)]), TIT bacteria (+) (OR=4.06, 95% CI [1.039 - 13.224], TIT WBC (OR=1.002, 95% CI [1.001 - 1.003]), and age (OR=1.026, 95% CI [1.002 - 1.05], variables were statistically significant in the model ($p<0.001$, p=0.004, p=0.027, p=0.029, and p=0.031, respectively). Table 7 shows the findings of the logistic regression analysis.

Discussion

The incidence of kidney stone disease is increasing as a significant clinical and economic problem [14]. The most common symptoms in urinary system stone patients are sudden onset and cramping flank pain, hematuria, nausea, vomiting, pain, and palpation of the costovertebral angle and/or lower quadrant. Patients may also experience dysuria and a constant sense of urination [15]. Many of these symptoms are similar to UTIs. For this reason, it may be clinically challenging to distinguish the presence of UTI in the presence of urinary stones and may occasionally cause misleading results [16]. Acute kidney injury may develop due to UTI and hydronephrosis in patients with urinary system stones [17, 18]. For this reason, when stone patients are evaluated, tests must be requested by considering the complications of the stone.

A good-quality urine sample is vital in making a diagnosis. However, if the patient's clinical manifestation strongly suggests a urinary tract infection, treatment must not be delayed. In general, if possible and appropriate, urine sampling for culture is recommended before the first antibiotic administration. Most patients with complicated UTIs will show pyuria, but the absence of pyuria does not exclude a UTI. Different urinary WBC ranges depend on the urine sample, and results must be interpreted accordingly [19]. Demonstrating the causative pathogen in a urine culture is accepted as the gold standard in diagnosing UTI [20]. However, the reproduction rate is not at the desired level even in patients whose urine culture has a very high probability of UTI, and different rates are reported in various clinics. Although urine culture, which is the gold standard in UTI, does not always detect UTI, urine culture is the gold standard despite its disadvantages in confirming the diagnosis and therapeutic management. However, urine culture from every patient is costly and might not be possible in many healthcare centers. In the present study, there were 349 patients; 308 (88.3%) of the patients did not have growth in culture, and 40 (11.7%) showed growth of a pathogenic microorganism. Different studies report a wide frequency of urine culture positivity between 7% and 36% in patients with urinary system stones [16, 21, 22]. This rate was 11.7% In the present study, which is consistent with current reported rates in the literature.

In a previous study that was conducted with 231 patients with acute kidney stones in 2021, it was reported that the incidence of kidney stones was more common in men than in women (65% in men) [23]. It was observed in the current study that male patients (71.63%) had kidney stones at a higher rate, which was consistent with the literature data. In a previous study conducted in 2020, there were 1655 patients with urolithiasis, among which 167 male and 200 female patients had positive urine cultures [24]. There were 22 culture positivities in women, and 19 in men among patients with kidney stones in the current study, and urine culture-positive female patients were higher than in male patients, which is consistent with the literature. The mean age of the patients was 47.17±14.7 years. The mean age was 45.7±16.1 years in female patients; it was 47.5±14.2 years in male patients. In a study published in 2012, it was reported that the incidence of kidney stones increased after the age of 20, peaked between the ages of 40 and 60, and then decreased with age [25]. The mean values of the age range of our patient population were consistent with this publication.

Statistically significant differences were detected in the current study in terms of gender for blood HGB, HCT, PLT, BUN, creatinine, uric acid, and TIT WBC variables ($p<0.05$). In a previous study conducted in 2020, the mean blood HGB, HCT, BUN, creatinine, and uric acid values of men in the general population were significantly higher than women, and the PLT value was substantially higher lower than the female population. These results are consistent with the results of the study.

Statistically significant differences were detected regarding culture positivity for blood WBC, HGB, HCT, PLT, CRP, and TIT WBC variables ($p<0.05$). WBC, PLT, CRP, and TIT were higher in WBC culture positives, HGB, and HCT culture negatives. However, no statistically significant difference was detected in terms of culture positivity variable for BUN, creatinine, uric acid, Na, K, TIT RBC, and age variables ($p>0.05$). PLT is, on average higher in the female population than in males, and HGB and HCT are, on average higher in males [23, 26]. A study conducted in 2020 reported that CRP, WBC, and PLT values were more elevated in patients with UTI [27]. A significant increase in WBC and CRP values and culture positivity are strong findings for UTIs, and these high values were consistent with the literature. The elevation of PLT in those with positive urine culture in our study is also compatible with the results in the literature. However, more comprehensive studies are needed on this subject. We believe the mean values did not differ because there was no significant difference between culture-positive and BUN, creatinine, uric acid, Na, K, TIT RBC, and age. After all, although AKI developing in stone patients is a significant complication, it is not a very common complication, and AKI is detected in patients with negative urine cultures.

The present study found statistically significant differences in blood WBC, HGB, HCT, PLT, CRP, creatinine values, and leukocyte positivity in TIT for TIT RBC and TIT WBC variables ($p<0.05$). However, no statistically significant differences were detected regarding the TIT leukocyte variable for BUN, creatinine, uric acid, Na, K, and age variables ($p<0.05$). We interpreted that TIT leukocyte positivity and urine culture positivity yield significantly higher results in similar parameters except for TIT RBC, as leukocyte positivity and urine culture positivity are strong evidence for UTI.

In the present study, a statistically significant difference was detected for TIT RBC and TIT WBC variables in terms of the TIT blood variable ($p<0.05$). However, no statistically significant differences were detected in terms of TIT blood variable for other examined WBC, HGB, HCT, PLT, CRP, BUN, creatinine, uric acid, Na, K, and age variables ($p>0.05$). A review study that was conducted in 2020 examined patients with urolithiasis who were found to have hematuria in the emergency departments of 8 different centers. The study reported the frequency of microhematuria between 44% and 94% [28]. In the present study, the values obtained in men and women and the hematuria ratios of the total number were compatible with the literature.

Regarding culture positivity, the Logistic Regression model explained 37.6% (Nagelkerke R2) of the variance in culture result positivity/negativity and correctly classified 91.4% of cases. TIT Nitrite (+) [OR=49.8, 95% CI (10,945 - 315.781)], HGB [OR=0.723, 95% CI (0.576 - 0.903)], TIT bacteria (+) (OR=4.06, % 95 CI [1.039 - 13.224], TIT WBC (OR=1.002, 95% CI [1.001 - 1.003]), and age (OR=1.026, 95% CI [1.002 - 1.05], variables were statistically significant in the model ($p<0.001$, $p=0.004$, $p=0.027$, $p=0.029$, and $p=0.031$, respectively). The probability of culture positivity increased at a rate of 48.8% when nitrite positivity was present, 0.2% with an increase in each urine WBC value, 3.06% for bacteria in urine microscopic examination, and 2.6% for each year increase with increasing patient age. A previous study predicted that the evaluation of leukocyte and nitrite tests determined with a strip before the culture request in patients with a preliminary diagnosis of urinary tract infection might prevent unnecessary culture tests [29]. In the current study, nitrite positivity increased the positivity of urine culture 48.8-fold and was compatible with the literature data. A study that investigated the relationship between age range and UTI in 1178 female patients with UTI symptoms in 2021 published that the prevalence of bacteriuria increases with increasing age [30]. The current study found that increasing age increased the probability of positive urine culture, and the result was consistent with the literature. A study that was conducted in 2021 reported that nitrite positivity in the urine, the presence of bacteria, and WBC count were associated with urine culture positivity [31]. The data obtained in the current study with the logistic regression model in our study were compatible with this study in the literature. We think our findings will be useful for emergency department physicians in predicting urine culture positivity in patients with urinary stones or deciding whether it is necessary to start antibiotic treatment until the urine culture results. The limitation of the study was that it had a retrospective design, and it could not question the history of the patients, the history of antibiotic use, and the presence of symptoms such as fever and dysuria.

Conclusion

Urine culture is an ineffective and time-consuming test for use in the emergency department. In patients with urinary system stones, WBC count, bacteria presence, nitrite positivity, low blood HGB, and patient age increase the likelihood of urine culture positivity in TIT. We believe the study's findings can be utilized to accurately estimate the likelihood of urine culture positivity in patients with urinary system stones, or to postpone antibiotic treatment until the urine culture results are finalized, reducing unnecessary antibiotic use.

Ethical approval

The ethics committee approval was obtained with the number 2022/4010 from the Inonu University Health Sciences Non-Interventional Clinical Research Ethics Committee.

References

1. Bauza JL, Pieras EC, Grases F, Tubau V, Guimerà J, Sabaté XA, et al. Urinary tract infection's etiopathogenic role in nephrolithiasis formation. medical hypotheses. 2018;118:34-5.
2. Yongzhi L, Shi Y, Jia L, Yili L, Xingwang Z, Xue G. Risk factors for urinary tract infection in patients with urolithiasis-primary report of a single center cohort. BMC urology. 2018;18(1):45.
3. Pearle MS, Lotan Y. Urinary lithiasis: etiology, epidemiology, and pathogenesis. Campbell-walsh urology. 2007;2:1363-92.
4. Pak CY. Kidney stones. Lancet (London, England). 1998;351(9118):1797-801.
5. Khan SR, Pearle MS, Robertson WG, Gambaro G, Canales BK, Doizi S, et al. Kidney stones. Nature reviews Disease primers. 2016;2:16008.
6. Sharma AP, Filler G. Epidemiology of pediatric urolithiasis. Indian journal of urology : IJU : journal of the Urological Society of India. 2010;26(4):516-22.
7. Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. Nature reviews Microbiology. 2015;13(5):269-84.
8. Srisubat A, Potisat S, Lojanapiwat B, Setthawong V, Laopaiboon M. Extracorporeal shock wave lithotripsy (ESWL) versus percutaneous nephrolithotomy (PCNL) or retrograde intrarenal surgery (RIRS) for kidney stones. The Cochrane database of systematic reviews. 2014(11):Cd007044.

9. Nicola R, Menias CO. Urinary obstruction, stone disease, and infection. Diseases of the Abdomen and Pelvis 2018-2021. 2018:223-8.
10. Borghi L, Schianchi T, Meschi T, Guerra A, Allegri F, Maggiore U, et al. Comparison of two diets for the prevention of recurrent stones in idiopathic hypercalciuria. The New England journal of medicine. 2002;346(2):77-84.
11. Tefekli A, Tok A, Altunrende F, Barut M, Berberoğlu Y, Muslimoğlu AY. Lifestyle and nutritional habits in urinary system stone patients. Turkish Journal of Urology/Turkish Journal of Urology. 2005;31(1):113-8.
12. Arslan AK, Yaşar Ş, Çolak C, Yoloğlu S. WSSPAS: An Interactive Web Application for Sample Size and Power Analysis with R Using Shiny. Turkiye Klinikleri Journal of Biostatistics. 2018;10(3).
13. Yaşar Ş, Arslan A, Colak C, Yoloğlu S. A developed interactive web application for statistical analysis: statistical analysis software. Middle Black Sea Journal of Health Science. 2020;6(2):227-39.
14. Romero V, Akpinar H, Assimos DG. Kidney stones: a global picture of prevalence, incidence, and associated risk factors. Reviews in urology. 2010;12(2-3):e86-96.
15. Mayans L. Nephrolithiasis. primary care. 2019;46(2):203-12.
16. Abrahamian FM, Krishnadasan A, Mower WR, Moran GJ, Talan DA. Association of pyuria and clinical characteristics with the presence of urinary tract infection among patients with acute nephrolithiasis. Annals of emergency medicine. 2013;62(5):526-33.
17. Tang X, Lieske JC. Acute and chronic kidney injury in nephrolithiasis. Current opinion in nephrology and hypertension. 2014;23(4):385-90.
18. Wang SJ, Mu XN, Zhang LY, Liu QY, Jin XB. The incidence and clinical features of acute kidney injury secondary to ureteral calculi. Urological study. 2012;40(4):345-8.
19. Gülcan A, Çelik G, Gülcan E, Cansever Z, Aladağ DM. Performance evaluation of complete urinalysis and culture results in patients with suspected urinary tract infection. Abant Medical Journal. 2012;1(2):61-4.
20. Khalili M, MK SY, Ebadi M, Sadeh M. Correlation between urine analysis and urine culture in the diagnosis of urinary tract infection in Yazd central laboratory. Tehran University Medical Journal TUMS Publications. 2007;65(9):53-8.
21. Dorfman M, Chan SB, Hayek K, Hill C. Pyuria and Urine Cultures in Patients with Acute Renal Colic. The Journal of emergency medicine. 2016;51(4):358-64.
22. Tavichakorntrakool R, Prasongwattana V, Sungkeeree S, Saisud P, Sribenjalux P, Pimratana C, et al. Extensive characterizations of bacteria isolated from catheterized urine and stone matrices in patients with nephrolithiasis. Nephrology, dialysis, transplantation : official publication of the European Dialysis and Transplant Association - European Renal Association. 2012;27(11):4125-30.
23. Down C, Malthouse T, Lobo N, Ali A, Symes A, Coker C. Gender differences in acute stone admissions - must we have a lower threshold for treatment in female patients? BJU international. 2021;128(6):697-701.
24. Wang S, Zhang Y, Zhang X, Li J. An evaluation of multidrug-resistant (MDR) bacteria in patients with urinary stone disease: data from a high-volume stone management center. World journal of urology. 2020;38(2):425-32.
25. Sakhaee K, Maalouf NM, Sinnott B. Clinical review. Kidney stones 2012: pathogenesis, diagnosis, and management. The Journal of clinical endocrinology and metabolism. 2012;97(6):1847-60.
26. Higgins V, Tahmasebi H, Bohn MK, Hall A, Adeli K. CALIPER Hematology Reference Standards (II). American journal of clinical pathology. 2020;154(3):342-52.
27. Kahraman FU, Uzuner S. Investigation of Reproduction Rates in Urine Culture and Its Relationship with Acute Phase Markers in Children with Pyuria in the Emergency Department. Van Medical Journal. 2020;27(3):287-301.
28. Ang AJS, Sharma AA, Sharma A. Nephrolithiasis: Approach to Diagnosis and Management. Indian journal of pediatrics. 2020;87(9):716-25.
29. Zorbozan N, Akarken İ, Zorbozan O. Evaluation of the performance of complete urinalysis in a secondary care center. Turkish Journal of Clinical Biochemistry. 2017;15(2):45-51.
30. Holm A, Siersma V, Cordoba GC. Diagnosis of urinary tract infection based on symptoms: how are likelihood ratios affected by age? a diagnostic accuracy study. BMJ open. 2021;11(1):e039871.
31. Liang T, Schibeci Oraa S, Rebollo Rodríguez N, Bagade T, Chao J, Sinert R. Predicting Urinary Tract Infections With Interval Likelihood Ratios. Pediatrics. 2021;147(1).