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Original Research Article

IDENTIFICATION OF RISK FACTORS FOR URINARY TRACT INFECTION IN PATIENTS WITH UROLITHIASIS

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Abstract: *Urinary tract infections (UTIs) are common among patients with urolithiasis, making treatment complicated and even dangerous. This study aimed to identify risk factors associated with UTIs in urolithiasis patients. A retrospective study was conducted at Mayo Hospital Lahore, which included 300 patients with kidney stones. The patients were separated into two groups: those with UTIs and those without. Various factors were examined, including age, gender, smoking history, stone structure, alcohol use, stone location, and presence of blockages in the urinary tract. Out of the 300 patients, 73 (24.33%) had UTIs. The most common pathogens found in the urine cultures were gram-negative bacteria, followed by gram-positive bacteria and fungi. The study concluded that gender, age, blockages in the urinary tract, stone structure, and multiple stone locations could be considered independent risk factors for UTIs in urolithiasis patients. However, no statistically significant relationship was found between drinking and smoking and the incidence of UTIs. The most common organism found in UTIs among urolithiasis patients was a gram-negative bacillus.*

Keywords: Urinary Tract Infection, Risk Factors, Urolithiasis, Urine Culture Test

Introduction

The prevalence of urolithiasis varies greatly from two percent to twenty percent worldwide, depending on the geographic and socioeconomic characteristics of the population. The annual expenditure on treatment exceeds $2 billion (Pak, 1998; Pearle et al., 2005).

In recent years, urolithiasis has shown a trend toward increased prevalence among both sexes (Hesse et al., 2003; Stamatelou et al., 2003). Patients with kidney stones may suffer from urinary tract infections (UTIs). Persistent infections caused by urease-forming microorganisms will form infection stones consisting of monoammonium urate, struvite (magnesium ammonium phosphate), and carbonate apatite. This complicates efforts to cure urolithiasis (Bichler et al., 2002). Consequences of urolithiasis treatment with extracorporeal shockwave lithotripsy include asymptomatic urine bacteria, urinary tract infections (UTIs), and systemic bacterial infections (sepsis). The results of this study were published in 1997 (Bierkens et al.). Significant or many stones after percutaneous nephrolithotomy (PCNL) may cause postoperative systemic inflammatory response syndrome, with a small percentage progressing to urosepsis and potentially fatal septic shock. To wit: (Korets et al., 2011) Side effects from pyelonephritis, an infection of the urinary tract, can be severe. A study by Bichler and colleagues (2002)

There haven't been a lot of published studies on the causes of infections in those with urolithiasis. Catheters, pouches, urinary tract obstructions, neurogenic bladder, voiding abnormalities, and renal tubular acidosis are some of the risk factors for urinary tract infections (UTIs) and infection stones that Schwartz and Wong discovered in their study. In two separate studies (Schwartz and Stoller, 1999; Wong et al., 1995), Patients with diabetes and female gender were shown to be at higher risk for septic shock after PCNL treatment for urolithiasis, as found by Li and Liu. Based on the research of (Li et al., 2013; Liu et al., 2013), more factors may be involved in the production of stones that were not considered here. Patient variables such as smoking and alcohol consumption may increase the risk of UTIs in people with urolithiasis (Liu et al., 2009). The major objective of our retrospective cross-sectional study was to determine risk factors for UTI in individuals with urolithiasis. That's why we considered gender, age, smoking and drinking habits, stone position, obstruction, and shape (if staghorn stones).

Methodology

Data on all urolithiasis patients at Mayo Hospital were gathered for our study between September 2021 and February 2022. The Mayo Hospital Ethics Committee's guiding principles were followed throughout all trials. Patients with antibiotic use during the preceding three days, urinary tract instrumentation, and heart, kidney, or hepatic disorders were also excluded.

In the department of radiology, ultrasound imaging, X-ray, computed tomography (CT), and IV pyelography were used to identify and categorize the location of the stones, the existence of a blockage, and the stone morphology (if staghorn stones), and standard analysis of urine and urine culture test were carried out to identify a UTI. UTI was defined as having at least one of the following indications or symptoms: a temperature of more than 37.8 °C, painful urination, excessive voiding, and suprapubic discomfort, together with a growth of more than 105 colony-forming units (CFUs)/mL in a correctly taken midstream "clean-catch" urine specimen.(Trautner et al., 2009) . If a subject

consumed more than ten cigarettes every week for at least six months or routinely drank any alcohol at least once weekly, they were considered frequent drinkers and smokers. (Lee et al., 2007). All of the participants in our research were split into two groups: those with Urinary tract infections and those without. In our research, risk factors, including gender, years of age, smoking, drinking, stone location, blockage presence, and stone form (if staghorn stones) were all considered.

SPSS version 21 was used for all assessments. All information is presented as mean ± SD. Univariate evaluations were conducted by applying the Student's t-test for parametric data and the Kruskal-Wallis test for nonparametric data to identify contributing factors for urinary tract infection. Ratios were compared using Fisher's exact test and the chi-squared test. Three age-related subgroups were compared using a post hoc statistical technique. Statistics were deemed significant at $P < 0.05$.

Results

In our study, 300 individuals were enrolled; 73 (24.33%) had UTIs. Figure 1 presents the site of the stones. The most frequent ailment was the presence of stones in the ureters, followed by calculi in the kidneys, bladder calculi, and urethral stones.

The findings of the urine cultures are displayed in Table 1. The most prevalent pathogens were gram-negative bacteria isolates, gram-positive bacteria isolates, and fungi strains (90.41%, 5.47%, and 4.10%, respectively). Escherichia coli was the most prevalent among the gram-negative bacilli, followed by Pseudomonas aeruginosa, Klebsiella pneumoniae, Proteus mirabilis, and "other" (53.42%, 15.06%, 12.32%, 4.10%, and 5.47%, respectively).

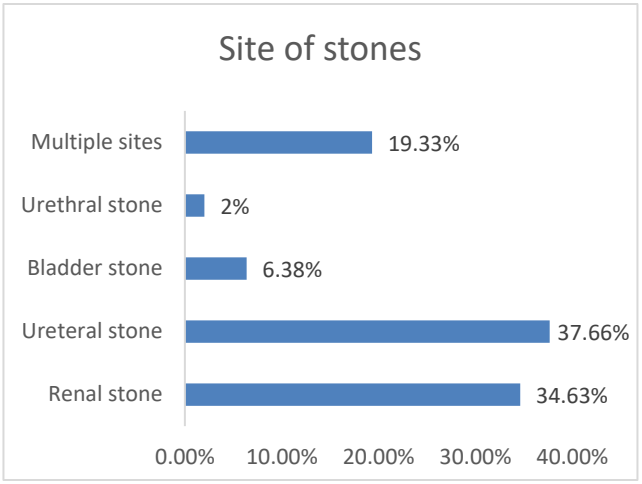

Figure 1: Different sites of urolithiasis

Table 1: Types of microbes in urine culture

Bacterial species	Isolates count	Percentage %
Gram-negative bacteria	66	90.41
Escherichia coli	39	53.42
Pseudomonas aeruginosa	11	15.06
Klebsiella pneumoniae	9	12.32
Proteus mirabilis	3	4.10
Others	4	5.47
Gram-positive bacteria	4	5.47
Fungus	3	4.10

Table 2 Demographic and Various risk factors for urinary tract infection

Risk Factors	Number	Without Infection		With Infection		χ 2	P
	N=300	N =227	%	N=73	%		
Sex						29.66	**<0.0001**
Male	165	143	86.66	22	13.33		
Female	135	84	62.22	51	37.77		
Age groups						8.96	**0.0087**
<40	117	89	76.06	28	23.93		
40-60	80	65	81.25	15	18.75		
>60	103	73	70.87	30	29.12		
Stone site						55.86	**<0.0001**
Single stone	242	201	83.05	41	16.94		
Multiple sites	58	26	44.82	32	55.17		
Obstruction						8.46	**0.0065**
Yes	215	155	72.09	60	27.90		
No	85	72	84.70	13	15.29		
Staghorn calculi						27.88	**<0.0001**
Yes	39	20	51.28	19	48.71		
No	261	207	79.31	54	20.68		
Smoking						4.06	**0.0878**
Yes	97	72	74.22	25	25.77		
No	203	155	76.35	48	23.64		

Age group: <40 versus 40-60, X2=2.97,P= 0.0786 , <40 versus >60, X2=2.22,P= 0.1548, 40-60 versus >60, X2=8.45,P= 0.0013

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Table 3 shows various risk factors for urinary tract infection in Staghorn stones

Risk Factors	Number	Without Infection		With Infection		χ 2	P
	N=39	N =20	%	N=19	%		
Sex						36.16	<.0001
Male	25	20	80	5	20		
Female	14	1	7.14	13	92.85		
Age group						3.58	0.3170
<40	11	5	45.45	6	55.55		
40-60	16	8	50	8	50		
>60	12	4	33.33	8	66.66		
Smoking						0.05	0.8764
Yes	26	12	46.15	14	53.84		
No	13	7	53.84	6	46.15		

Female patients developed the infection at a rate that was greater than those of males (37.77% vs. 13.33%, P < 0.001), and patients > 60 years old were more likely to be infected, followed by those < 40 and 40-60 years old (29.12% vs 23.93% vs 18.75%, correspondingly). Those with the obstruction were more likely to become infected than those lacking it (27.90% vs 15.29%; P = 0.0065). Patients with several stones were more likely to become infected than those with just one stone (55.17 vs 16.94%, P <0.0001). Patients who smoked had a greater infection rate than those who did not (25.77 vs 23.64%, P = 0.0878). Patients who consumed alcohol had a higher rate of infection than those who didn't (25.27 vs 23.92%, P = 0.7807). Participants with staghorn calculi showed a greater infection rate than those without (48.71 vs 20.68%,p< 0.001)(Table 2).

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Discussion

In our retrospective study, we analyzed the effect of each risk factor on the occurrence of UTI separately. Individuals with urolithiasis were found to have different risk factors for UTI based on gender, age, blockages, stone type, and multiple stone locations. Females have been observed to have a higher prevalence of infectious stones than males. To wit: (Daudon et al., 2004; Knoll et al., 2011). Females with urolithiasis were shown to be at increased risk for septic shock after PCNL therapy in the study by Li and Liu. For example, (Li et al., 2013; Liu et al., 2013). Similarities existed between these results and ours. Women may be more prone to ascending infections since their urethras are shorter than men's. Ten percent of women develop cystitis or pyelonephritis after a year of PCNL treatment (Nicolle, 2008), and up to twenty-six percent of UTIs recur within six months (Foxman, 1990).

Patients under 40 and over 60 were shown to be significantly at risk for infection in our study. Thomas found that infection stones were most common between the ages of 60 and 69 in both sexes, which is consistent with our findings but later in life. As reported by (Knoll et al., 2011). However, Daudon found that the frequency of ammonium urate stones was highest in the 0-9-year-old age group, whereas the prevalence of struvite was lowest in the 40-49-year-old age group. After that point, there was a precipitous drop in the percentage. (Daudon, 2004; Daudon, 2004a). Patients between 40 and 60 had the lowest infection rate in our study.

Obstruction in the urinary tract has been shown to increase the risk of urinary tract infections and infection stones. In addition, an infected ureter may result from irritation or injury to the ureter caused by passing stones. Similar to the preceding research, we found that obstructions could be confirmed using CT imaging and IV pyelography and that 27.90% of participants with obstructions were at risk of infection compared to 15.29% of persons without obstructions (Bichler et al., 2002). A correlation exists between the number of stones a person has and their vulnerability to infection. This may be because the risk of a urinary tract infection (UTI) increases considerably when many stones are present. The collecting system is dominated by staghorn calculi, which are branching stones. Typically, they are located in the renal pelvis and spread to several or all of the calyces. A staghorn stone extends into many collecting system segments, such as a renal pelvic stone with multiple caliceal projections. To wit: (Preminger et al., 2005). Staghorn stones have traditionally been thought to be contagious. Urinary tract infections (UTIs) brought on by urease-producing bacteria often lead to the formation of branching stones that include the kidneys and calyces. This was published in 1982 by Vargas and colleagues. Staghorn calculi comprised the majority of infectious components in 59%-68% of cases, indicating that those with staghorn stones are more susceptible to infection. Preminger and coworkers (2005). Our findings confirmed the increased infection risk in previous studies of people with staghorn calculi.

Due to the lack of statistical significance, alcohol and tobacco use should not be considered independent risk factors for UTI in patients with urolithiasis. However, it has only recently been recognized that smoking cigarettes is a

major contributor to the development of urolithiasis. Liu et al. (2009). Reduced urine flow and higher serum cadmium levels, both associated with tobacco use and alcohol consumption, may contribute to urolithiasis. (Mooser et al., 1989, Scott et al., 1982). While Hamano and coworkers did find a correlation between cigarette smoking and calcium urolithiasis, they did not find a correlation between cigarette smoking and UTIs. According to research (Hamano et al., 2005), gram-negative bacteria, especially E. coli, are typical causes of urinary tract infections. Several researchers (Zhanel et al., 2010) and Lu et al. report that Escherichia coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa are the top three most common pathogen species found in UTIs. "(Lu et al., 2012). Based on our findings, gram-negative bacteria predominated, followed by gram-positive bacteria and fungi. The most common gram-negative pathogen was Escherichia coli, followed by Pseudomonas aeruginosa, Klebsiella pneumoniae, and Proteus mirabilis.
There are some caveats to our study. First, we lacked knowledge about stone composition, which could be relevant to studying contaminated stones. Second, we didn't know what tests were available to check for bacteria's antibiotic resistance. Therefore, the link between bacterial proliferation and stone composition piqued our curiosity and may form the basis of our future research.

Conclusion

Based on the results, we can conclude that gender, age, blockage, the number of stone locations, and the type of stone (such as staghorn stones) are independent risk factors for UTI in patients with urolithiasis. The most common microorganisms found in the UTIs of kidney stone patients are gram-negative bacteria.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned.
Consent for publication
Approved
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Conflict of interest

The authors declared the absence of a conflict of interest.

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