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ASSESSMENT OF ASYMPTOMATIC URINARY TRACT INFECTIONS IN UROLITHIASIS

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ABSTRACT

BACKGROUND: Genetic, metabolic, environmental, viral, socioeconomic, and nutritional factors are the multifactorial etiopathogenesis of urolithiasis, a disorder marked by the development of stones in the kidney, bladder, ureter or urethra. There is enough evidence that urolithiasis makes a substantial contribution to UTI incidence.

AIMS & OBJECTIVES: To determine the proportion of UTI (symptomatic and asymptomatic), to determine the most typical organism involved in causing Urinary Tract Infections, to determine the antibiotic susceptibility of the organisms causing Urinary Tract Infections, and to study the relationship of type and duration amongst symptomatic and asymptomatic urinary tract infection in patients with urolithiasis.

METHODS: This was a hospital based cross-sectional study of 152 patients, diagnosed radiologically to have urolithiasis who met the inclusion criteria. Clinical History of patients who have been diagnosed to have urolithiasis radiologically (i.e. USG or CT-KUB) was taken. Urine routine and urine culture were done to test for culture and sensitivity.

RESULTS: Compared to the other group, subjects under 40 years old had a low infection rate. Urine cannot move easily when stones and other causes such as BPH, prolapse, stricture, etc., cause urinary tract obstruction which is shown to be a risk factor for UTI. A significant difference was observed in the culture growth of symptomatic males with BPH.

CONCLUSION: In patients with urolithiasis, characteristics such as age, sex, blockage, multiple stone locations, and stone type (like staghorn stones) may be separate causes of UTIs. The most prevalent bacteria in UTIs in urolithiasis patients are gram-negative bacilli.

Keywords: Urolithiasis, Asymptomatic Urinary Tract Infections.

INTRODUCTION

Stones that form in the kidney, ureter, bladder, or urethra are a defining feature of urolithiasis. The primary cause of flank and abdominal pain is kidney stones. Urolithiasis is one of the most common urological diseases, the prevalence of which ranges from 12 to 20% throughout the world based on the geographic and socioeconomic characteristics of different populations with a recurrence rate of 47–60% in females and 70–80% in males. It seems that both men and women have been more prone to urolithiasis in recent years. The etiopathogenesis of urolithiasis is complex and includes immune, metabolic, environmental, infectious, socio-economic, and dietary variables. Calcium oxalate, Struvite, brushite, newberyite and apatite are the most prevalent kinds of stones. [1,2,3] Urolithiasis is typically divided into two major categories: Non-calcium stones including uric acid, cystine, unusual types (such as medications, dihydroxyadenine, and ammonium urate), and Calcium containing stones like calcium oxalate, carbonate and calcium phosphate stones. The latter are often made up of magnesium (struvite) and ammonium triphosphate. The most serious and potentially fatal complication of UTI is sepsis. Therefore, the need to treat UTI's at an early stage is essential to prevent complications, especially in high-risk individuals. This study has been undertaken to know the incidence of UTI in individuals with urolithiasis; with its various presentations, organisms causing it and antibiotic susceptibility of those organisms in patients with urolithiasis.

AIMS AND OBJECTIVES

- To determine the prevalence of UTI (symptomatic and asymptomatic) in patients with urolithiasis.
- To determine the commonest organism involved in causing Urinary Tract Infections in patients with urolithiasis.
- To determine the antibiotic susceptibility of the organisms causing Urinary Tract Infections in patients with urolithiasis.
- To study the relationship of type and duration of UTI between symptomatic and asymptomatic UTI in patients with urolithiasis.

MATERIALS & METHODS

This hospital based cross-sectional study included 152 patients who presented with radiologically diagnosed urolithiasis with or without symptoms, over a period of two years, selected by convenience sampling.

INCLUSION & EXCLUSION CRITERIA

- Patients newly diagnosed radiologically to have urolithiasis
- Patients with a previous history of urolithiasis and has a recurrent episode of urolithiasis
- Patients with urolithiasis having symptomatic or asymptomatic bacteriuria (Urinary culture showing $>10^3$CFU/ml for Males and $>10^5$CFU/ml for Females) were included.
- Those who were not willing to give consent for further investigations
- Patients less than 18 years of age were excluded.

PROCEDURE

All the patients in this study group, on an outpatient basis, were radiologically proven to have urolithiasis by various modalities, i.e. USG, X-Ray KUB, CT-KUB. These patients may or may not be symptomatic. The patients were made to fill a simple questionnaire and a sample of urine was taken for urine routine examination and culture and sensitivity, in a sterile, wide-mouthed plastic jars with tight-fitting lids and then transported to the laboratory. All specimens were processed by the laboratory within 2 hours of collection or kept refrigerated at 4 °C until delivery to the laboratory and processed no longer than 18 hours after collection.

Urinalysis was done using reagent strips. The sample was tested within a few hours of voiding for urinary constituents. Culture and sensitivity testing includes the following steps namely (1) Examination of a Gram-stained smear, (2) A screening test for significant bacteriuria, (3) A

definitive culture for urine specimens that were found to be positive in the screening test (step 2) and for all specimens obtained by cystoscopy, suprapubic bladder puncture (SBP), or catheterization (4) Susceptibility tests on clinically significant bacterial isolates.

STATISTICAL ANALYSIS

It was observed that 22% (p) of patients with urolithiasis have urinary tract infections, hence assuming a 95 % confidence interval and 5% allowable error, the sample size estimated was 274.5 approximately equal to 275. Further assuming a 10% non-response rate, the final sample size considered for the study was 302 patients who meet the inclusion criteria. Statistical analysis was done using descriptive statistics such as mean, range, percentage, and standard deviation. Chi-square test was done to test the association between type, duration, control amongst symptomatic and asymptomatic urinary tract infections in urolithiasis. p-value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.

RESULTS

The study was conducted over 2 years from January 2020 to December 2022 at A J Institute of Medical Sciences, Mangalore, India, in the Department of Urology. We selected a total of 152 patients based on the inclusion criteria for the study as opposed to 302 patients due to the COVID pandemic. It is observed that patients between the age of 21-30 years showed the highest prevalence of urolithiasis. The age-wise distribution of the 152 patients were 124 (81.5%) male patients, 28 (18.5%) female patients. Amongst the cases who have radiologically proven urolithiasis only 21(13.8%) patients were asymptomatic and the rest 131 (86.2%) had symptoms ranging from pain abdomen with colicky pain, burning micturition, fever, and haematuria. It was noted that pain abdomen was most consistent symptom amongst symptomatic patients. Based on the location of stones, highest incidence was seen in cases of renal calculi, followed by ureteric, vesicular, and vesicoureteral junction stones. In the present study of 152 patients who were included, the mean age of the patients was 42.05 ± 16.3 years with the age ranging from 18 to 80 years. Urine culture showed positive results in 46 (30.3%) patients.

Among distribution of culture results based on age (in years) of the patients, it may be noted that among patients of age >40 years, positive cultures were seen in 34(45.9%) patients; as compared to patients <=40 years of age, with culture positivity seen in 12 patients (15.4%). Hence using Chi-square test, statistically significant difference was observed in the proportion of patients with culture positivity based on age ($p<0.001$). Among symptomatic patients culture positivity was seen in 12(46.2%) of females as compared to 30(28.6%) males. However, on using Chi square test among symptomatic patients, statistically no significant difference was observed in the culture growth based on gender ($p>0.05$). Also, among asymptomatic patients, statistically no significant difference was observed in the culture growth on the basis of gender ($p>0.05$). It is also observed from the table that among symptomatic patients, culture positivity was seen among 32(50%) patients of age >40 years as compared to 10(14.9%) of patients with age <=40 years. Hence while using Chi-square test among symptomatic patients, statistically significant difference was observed in the culture growth on the basis of age ($p<0.001$). However, among asymptomatic patients, statistically no significant difference was observed in the culture growth on the basis of age ($p>0.05$).

Using Chi-square test among symptomatic as well as among asymptomatic patients statistically no significant difference was observed in the culture growth on the basis of Hydroureteronephrosis and the location of calculi ($p>0.05$). While using Chi-square test among symptomatic patients (Table-1), statistically significant difference was observed in the culture growth on the basis of abdominal pain ($p<0.01$). It is observed (Table-2) from the above table that among symptomatic patients, culture positive was seen among 20(50%) patients with fever as compared to 22(24.2%) of fever. Using Chi-square test among symptomatic patients, statistically significant difference was observed in the culture growth on the basis of presence of fever ($p<0.01$). Among symptomatic as well as

asymptomatic patients statistically no significant difference was observed in the culture growth on the basis of burning micturition (p>0.05).

Among symptomatic patients it was observed that culture growth was present among 12 (36.4%) with hematuria in comparison to 30(30.6%) without hematuria. However statistically no significant difference was observed (p>0.05). Among symptomatic as well as asymptomatic patients it may be noted that the proportion of patients with culture growth was found to be higher among diabetics as compared to non-diabetics.

However, statistically no significant difference was observed (p>0.05). Table-3 depicts that higher proportion of symptomatic patients with previous history of urolithiasis were found to have culture growth 12(38.7%) as compared to patients without previous history of urolithiasis. However, statistically no significant difference was observed (p>0.05). Table-4 depicts the culture growth on the basis of symptoms in patients who also have BPH on examination. It may be noted from the table that among symptomatic 105 male patients, culture positive was seen among 30 patients. Among them BPH Grade-1 was seen among 12 (46.2%) and BPH Grade-2 was seen among 2(100%) of male patients. Hence statistically significant difference was observed in the culture growth among symptomatic males with BPH (p<0.01). Also statistically significant difference (Table-5) was observed in the culture growth on the basis of history of instrumentation among symptomatic patients (p<0.01).

Symptoms Pain Abdomen				**Culture**		**Total**	**p**
				No Growth	**Growth**		
Absent		**Absent**	Count	17	4	21	-
			%	81.0%	19.0%	100.0%	
	Total		Count	17	4	21	
			%	81.0%	19.0%	100.0%	
Present		**Absent**	Count	15	16	31	.009
			%	48.4%	51.6%	100.0%	
		Present	Count	74	26	100	
			%	74.0%	26.0%	100.0%	
	Total		Count	89	42	131	
			%	67.9%	32.1%	100.0%	

Table 1: Pain Abdomen

Symptoms				**Culture**		**Total**	**p**
				No Growth	**Growth**		
Absent	Fever	Absent	Count	17	4	21	-
			%	81.0%	19.0%	100.0%	
	Total		Count	17	4	21	
			%	81.0%	19.0%	100.0%	
Present	Fever	Absent	Count	69	22	91	.004
			%	75.8%	24.2%	100.0%	
		Present	Count	20	20	40	
			%	50.0%	50.0%	100.0%	
	Total		Count	89	42	131	
			%	67.9%	32.1%	100.0%	

Table 2: Presence of fever

Symptoms				**Culture**		**Total**	**p**
				No Growth	**Growth**		
Absent	Previous Urolithiasis	Absent	Count	14	4	18	1.000
			%	77.8%	22.2%	100.0%	
		Present	Count	3	0	3	
			%	100.0%	.0%	100.0%	
	Total		Count	17	4	21	
			%	81.0%	19.0%	100.0%	
Present	Previous Urolithiasis	Absent	Count	70	30	100	.364
			%	70.0%	30.0%	100.0%	
		Present	Count	19	12	31	
			%	61.3%	38.7%	100.0%	
	Total		Count	89	42	131	
			%	67.9%	32.1%	100.0%	

Table 3: Previous history of urolithiasis

Symptoms				Culture		Total	p
				No Growth	Growth		
Absent	BPH in males	Absent	Count	9	0	9	.087*
			%	100.0%	.0%	100.0%	
		Grade 1	Count	4	4	8	
			%	50.0%	50.0%	100.0%	
		Grade 2	Count	2	0	2	
			%	100.0%	.0%	100.0%	
	Total		Count	15	4	19	
			%	78.9%	21.1%	100.0%	
Present	BPH in males	Absent	Count	61	16	77	.003*
			%	79.2%	20.8%	100.0%	
		Grade 1	Count	14	12	26	
			%	53.8%	46.2%	100.0%	
		Grade 2	Count	0	2	2	
			% within BPH in males	.0%	100.0%	100.0%	
	Total		Count	75	30	105	
			% within BPH in males	71.4%	28.6%	100.0%	

Table 4: BPH in males

*Cell frequencies are pooled

Symptoms				Culture		Total	p
				No Growth	Growth		
Absent	History instrumentaion	Absent	Count	15	4	19	1.000
			%	78.9%	21.1%	100.0%	
		Present	Count	2	0	2	
			%	100.0%	.0%	100.0%	
	Total		Count	17	4	21	
			%	81.0%	19.0%	100.0%	
Present	History instrumentation	Absent	Count	87	34	121	.001
			%	71.9%	28.1%	100.0%	
		Present	Count	2	8	10	
			%	20.0%	80.0%	100.0%	
	Total		Count	89	42	131	
			%	67.9%	32.1%	100.0%	

Table 5: Previous history of instrumentation

DISCUSSION

The independent impact of risk variables on the development of UTIs were examined in this study. The following independent risk factors for UTI in individuals with urolithiasis are observed in this study: sex, age, urinary outflow obstruction, type of stone and previous instrumentation. Infection due to stones were more common in females than in males, according to earlier reports. [4,5] These outcomes were similar to what we found. Following PCNL treatment, females with urolithiasis were more likely to experience septic shock, according to Li and Liu's study. [6,7] Women may be more susceptible to ascending infections due to their shorter urethras. Within a year of receiving PCNL medication, over 10% of women develop UTIs, including pyelonephritis and cystitis,[8] and up to 26% of UTIs return within 6.0 months.[9]

A staghorn calculus is any branching stone that occupies renal pelvis and has one or more caliceal extensions.[10] Infected stones and staghorn calculus have historically been used interchangeably and they develop due to UTIs containing urease-producing bacteria. Staghorn calculi were found to be the predominant infectious elements in 59–68% of cases, indicating that patients with staghorn calculi are more susceptible to infection [12] which supports earlier findings in this study. Gram-negative bacteria are typically the most prevalent cause of UTIs, with E. coli having a high frequency rate.[13] According to Lu et al. [14], the three most prevalent pathogen species identified in UTIs in Asia are E. coli, K. pneumoniae, and P. aeruginosa. Gram-negative bacteria predominated in our study, followed by gram-positive bacteria and fungi. Among gram-negative bacteria, E. coli was the most prevalent pathogen, followed by P. aeruginosa, K. pneumoniae, and P. mirabilis.

There were various restrictions on the current investigation. In order to analyse infectious stones, we needed information on the composition of the stones and stone culture, which we did not have.

CONCLUSION

This study found that in patients with urolithiasis, sex, age, urinary outflow obstruction, previous instrumentation and stone type may be independent risk factors for UTI. The most prevalent bacteria in UTIs in urolithiasis patients are gram-negative bacilli. The data on the composition of the stones and culture and sensitivity analysis of the stones were two of the study's weaknesses.

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