

An Association between Urolithiasis and Urinary Tract Infection

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ABSTRACT

Urolithiasis is one of the most common chronic kidney conditions. Bacteria have long been recognized to contribute to urinary stones. Several findings indicate a definitive association between urinary stones and bacteria, including the high rate of urinary tract infections in urinary stone patients. The presence of bacteria is associated with increased clumping of crystals, and that they stimulate incorporation of proteins into the stone matrix. The purpose of this study is to discuss the association between urinary tract infections to urolithiasis. 155 patients who presented with flank pain at the surgical outpatient department at a peripheral hospital in Nasik, Maharashtra, India over a period of 2 years between Jan 2017 to Oct 2018 were included in the study that underwent Ultrasonography studies to detect the side and site of the stone in the urinary system and urine culture test. The study concluded that Urolithiasis affects males more commonly as compared to females. The most frequent age group affected is between 31-40 years. Right sided urolithiasis is commoner although a significant number of patients revealed bilateral urolithiasis on Ultrasound examination. Renal stones were commonest followed by lower ureteric stones. 40% of urolithiasis is associated with urinary tract infection and this association is stronger in females (21 patients (56.75%) out of 37 female patients revealed positive urine culture reports) as compared to males (41 patients (34.74%) out of 118 male patients were found to have positive urine culture tests). *E. coli* (51.61%) followed by *Pseudomonas* (20.96%) are the common pathogens in urolithiasis found to be associated urinary tract infection.

Key words: Urolithiasis, Renal calculus, Urinary tract infection

INTRODUCTION

Nephrolithiasis is the most ancient and common chronic kidney condition after hypertension. Stones are more common in men than in women. Calcium oxalate stones are commoner in males whereas Calcium phosphate stones are more common in females. Calcium oxalate is the predominant component of most stones. Approximately 10% of people will have a urinary stone during their lifetime [1]. An important factor in urinary stone formation is super saturation, a process by which the concentration of substances in urine, such as calcium and oxalate, exceed the limits of their solubility [2]. The bacterial contribution to urolithiasis has long been recognized.

Magnesium-ammonium-phosphate (struvite) stones (a conglomeration of bacteria, crystals and protein matrix) form due to urinary tract infection (UTI) with urease-producing bacteria [3] However, struvite accounts for only 4% of urinary stones. In contrast, calcium oxalate contributes to about 60% of urolithiasis whereas calcium phosphate stones contribute to around 40% [4]. The purpose of this study is to discuss the association between urinary tract infection and urolithiasis.

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MATERIALS AND METHODS

A total of 155 patients who presented with flank pain at the

surgical outpatient department at peripheral hospital in Nasik, Maharashtra, India, over a period of 2 years between Jan 2017 to Nov 2018 were included in the study. All of them underwent ultrasonography of the kidney, ureter, bladder and prostate to detect the side, site and size of the stone in the urinary system. A urinary culture test was performed in all cases.

Ethical Approval: Approval for the study was granted by Military Hospital Devlali Ethics Committee, and permission to analyze the urine culture and Ultrasonography reports was taken from the Pathologist and Sonologist of the hospital.

RESULTS

A total of 155 patients were included in the study. 118 patients (76.12%) were males and 37 patients (23.87%) were females. 76 patients (49.03%) had right sided urolithiasis whereas 57 patients (36.77%) had Left sided urolithiasis. 22 patients (14.19%) had bilateral stones. 90 patients (58.06%) had Renal stones, 30 patients (19.35%) had Ureteric stones, 20 patients (12.90%) had Vesico-ureteric junction calculus, 11 patients (7.09%) had micro concretions and 4 patients (2.58%) had Pelvi-ureteric junction calculus. 31-40 years was the most commonly affected age bracket wherein 56 patients (36.12%) were affected by urolithiasis followed closely by age group of 21-30 years in which 45 patients (29.03%) were affected (Table 1).

Table 1: The different age groups affected by urolithiasis is as follows

Age group	Number of patients affected	Percentage
11-20 years	19	12.25%
21-30 years	45	29.03%
31-40 years	56	36.12%
41-50 years	16	10.32%
51-60 years	9	5.80%
61-70 years	7	4.51%
71-80 years	3	1.93%

Urine culture tests in 155 patients with urolithiasis revealed that bacteria were grown in 62 cases (40%) while 93 tests (60%) for urinary culture showed no evidence of any bacterial growth (Figure 1). 41 patients (34.74%) out of 118 male patients were found to have positive urine culture tests and showed growth of some bacteria. 21 patients (56.75%) out of 37 female patients revealed positive urine culture reports (Figure 2).

Urine culture test

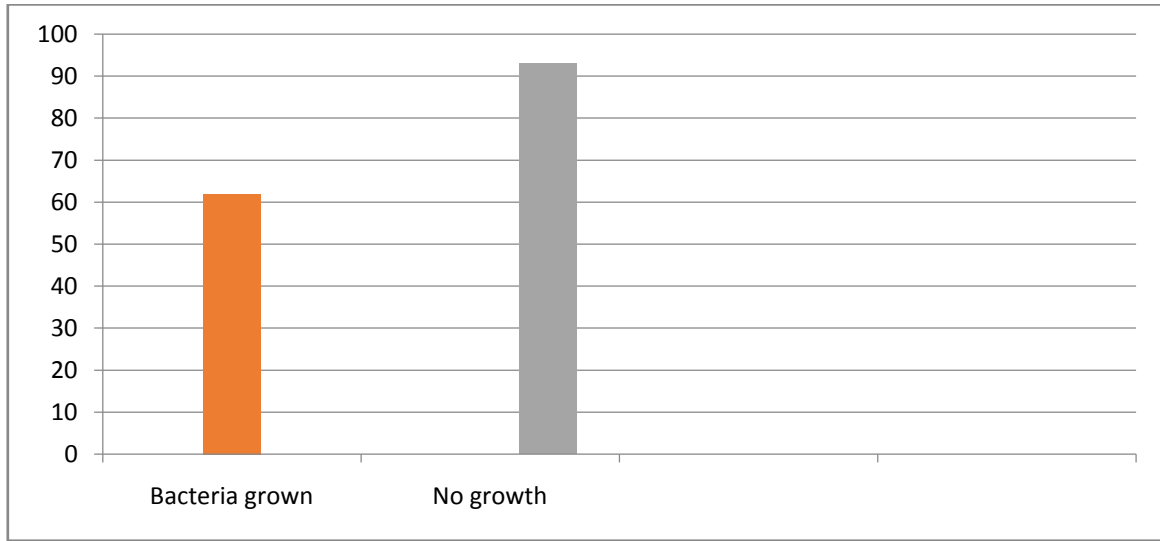


Figure 1: Results of Urine culture in patients presenting with urolithiasis

Urine culture results in both sexes

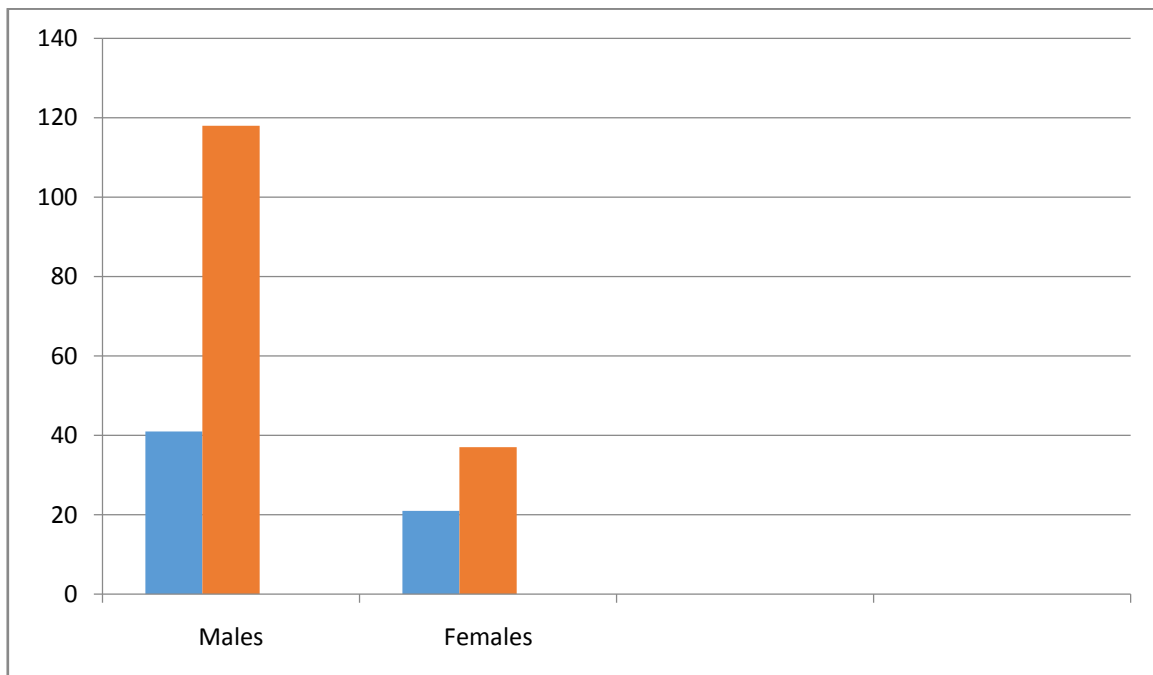


Figure 2: Positive urine culture representation in both sexes

Bacilli cultured from culture positive urine samples: Of the 62 positive urine culture tests which showed some bacterial growth, urine culture tests from 32 patients (51.61%) showed growth of *E. coli*, 13 (20.96%) showed *Pseudomonas*, 9 (14.51%) showed *Proteus* and 8 (12.90%) urine samples showed growth of *Klebsiella* (Figure 3).

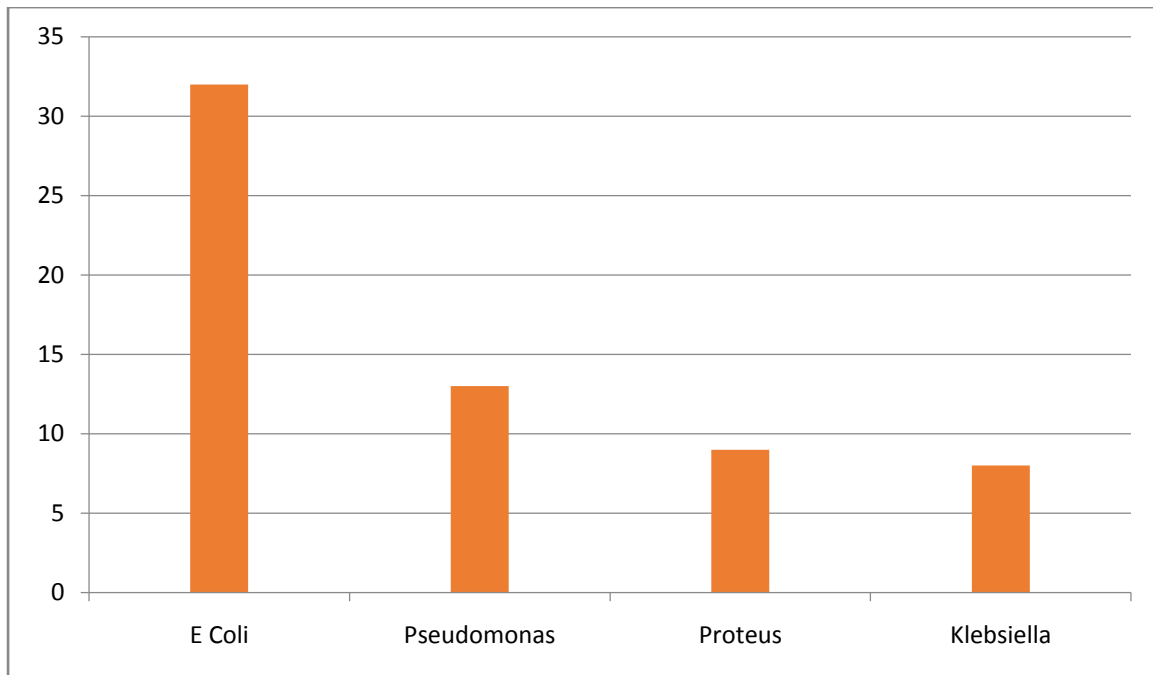


Figure 3: The figure depicts the various bacilli and their prevalence in urine culture tests

DISCUSSION

Urinary tract infection (UTI) is very common in patients with urolithiasis, which makes the treatment of urolithiasis complicated, even dangerous. Whereas stones were once treated with invasive open surgical techniques, in the present day almost all urinary calculi are treated either in a completely noninvasive fashion with shockwave lithotripsy or in a minimally invasive endoscopic fashion with ureteroscopy or percutaneous nephrolithotomy.

Site and size: Urinary stones are polycrystalline concretions occurring in the urinary tract and their formation is governed by patho-anatomical and physicochemical factors [5]. Around 97% of urinary stones are found in the kidneys and ureters (kidney stones), the remaining 3% in the urinary bladder and urethra [6]. Urinary stones can range in size from micrometers to several centimetres in diameter. They frequently remain unnoticed for long periods before manifesting themselves- often very painfully- or being discovered incidentally on radiography or ultrasound

Composition and risk factors: Calcium oxalate (82%), calcium phosphate (8%), uric acid (8%), cysteine (1%) and struvite (1%) are the commonly occurring renal stones. Changes in lifestyle and improvements in diagnosis have led to growing prevalence and incidence of urinary stones. Fifty percent of patients suffer at least one recurrence, and 10 to 20% experience three or more further episodes of urolithiasis [7]. Affluence-related urolithiasis is also on the rise in the emerging economies, due to high calorie diet combined with reduced physical exercise. A co-relation between rich meals, wine, and urinary stones has been established [8]. In the past two decades the incidence has risen predominantly between the ages of 40 and 49 years [9]. Occupation can be a risk factor; the risk is increased in physicians- particularly surgeons [10]. Poor fluid balance is an important factor responsible for formation of stones in the renal system.

Presentation: Nephrolithiasis often presents with renal colic, pain usually starts in the flank and radiates down and anteriorly into the genital region. The pain is not usually aggravated or alleviated by change of position, and may be accompanied by nausea, vomiting and haematuria.

Evaluation: History revealing classical pain of renal or ureteric colic describes as flank pain radiating to groin or tip of penis associated with nausea, vomiting and some form of urinary symptom like burning micturition, increased frequency, and haematuria points towards the diagnosis of urolithiasis. Urine examination reveals presence of RBCs. X Ray KUB may show presence of stones if the stone is radio-opaque and most stones of the renal system show their presence on plain radiographs. An X Ray KUB can often visualize calcium-containing stones in the kidney or ureter, including struvite stones, but uric acid and cystine stones are radio-lucent and are visualized poorly. Ultrasonography is an imaging modality in the diagnosis of urolithiasis which is portable and poses no risk of radiation exposure. Its use in stone management is limited by decreased sensitivity, specificity, user dependence, and inaccurate stone sizing [11]. In the United States, CT is the most common imaging modality for renal colic and the diagnostic standard for the initial imaging of patients with suspected nephrolithiasis [12] but is associated with ionizing radiation exposure and higher cost. Non-contrast helical CT can accurately visualize the size and location of stones in the urinary tract.

Management: Stones less than 5 mm in diameter will usually pass spontaneously, although it may require several weeks of conservative management, while about 50% of stones larger than 5 mm require urologic intervention for removal, and those above 10 mm are very unlikely to pass unaided [13]. Initial management of stones less than 5 mm in patients without anatomic abnormalities of the urinary tract is watchful waiting, to allow time for stone passage. Pain can be controlled with use of NSAIDs [14]. Presence of any signs of urinary tract infection, persistent vomiting and inability to accept oral fluids, or obstruction of a single functioning kidney requires hospitalization and active management in the form of antibiotics and anti-emetics. Use of an α -(1)-adrenoreceptor antagonist such as tamsulosin may hasten the time to stone passage in some patients [15].

Surgical treatment is recommended for 10–20% of symptomatic stones that fail to pass spontaneously or with medical management. Extra-corporeal shock wave lithotripsy (ESWL) uses sound waves to fragment stones that can be easily passed per urethrally, is an effective treatment modality for most stones less than 2 cm in size. Cystine and phosphate stones being hard stones may be resistant to fragmentation by ESWL. Larger stones, particularly those composed of cystine or struvite, can be approached via percutaneous access through a small flank incision, allowing direct visualization and intracorporeal lithotripsy for stone disruption, and removal of fragments. This technique is called as Percutaneous nephrolithotomy (PCNL). Ureteroscopy (URS) is becoming increasingly useful for removal of stones in the lower ureter.

CONCLUSION

Urolithiasis affects males more commonly as compared to females and the most frequent age group affected is between 31-40 years [16]. Right sided urolithiasis is commoner as compared to left sided stones [17] although a significant number of patients revealed bilateral urolithiasis on ultrasound examination. Renal stones were commonest followed by lower ureteric stones. 40% of urolithiasis is associated with urinary tract infection and this association is stronger in females (21 patients (56.75%) out of 37 female patients revealed positive urine culture reports) as compared to males (41 patients (34.74%) out of 118 male patients were found to have positive urine culture tests). *E. coli* (51.61%) followed by *Pseudomonas* (20.96%) are the commonly associated pathogens in urolithiasis found to have associated urinary tract infection [18-19].

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