

## Original Research Article

# A prospective study of cases of urolithiasis with reference to risk factors, surgery and outcomes

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### ABSTRACT

**Background:** Urinary stone disease or Urolithiasis is on a surge of increase with an incidence of 6.3% among men and 4.1% among women. The site of development of the calculi is variable and dependable on various factors. The aim of study was to identify the various predisposing and causative factors, with clinical presentations and complications and to identify identifying various modalities of treatment.

**Methods:** A prospective observational study was conducted for a period of one year after ethical committee approval. All the cases of Urolithiasis confirmed by ultra-sonogram was included and socio demographic data, clinical and laboratory investigations were performed on all the cases and the data was entered in Microsoft excel and analyzed. Surgical approach to all the cases were recorded.

**Results:** 150 cases with 64% males and 36% females were included in the study and mean age was 38.21 years. Pain abdomen was the most common symptom. Calculus was most common on right side with upper pole of the kidney being most common site of calculus in the study. Mean size of calculus in the study was 12.5mm. Statistically significant association was found with Diabetes mellitus, Obesity and low water intake (P value <0.05) in the study. Ureteroscopy (URS) was performed in 36 cases (24%), PCNL in 22 cases (14.67%), ECSWL in 46 (30.67%), cystolithotomy in 34 (22.67%) and urethral extraction in 12 cases (8%).

**Conclusions:** For renal calculi, PCNL is the best treatment modality as of now, but it is associated with greater post-operative morbidity. For stone less than 1cm size, ECSWL is a good alternative to PCNL, but has poor clearance rate and thus greater need for auxiliary procedure. For ureteral calculi, both ECSWL and ureteroscopy have given good results but ECSWL is better tolerated by the patients.

**Keywords:** Cystolithotomy, ECSWL, PCNL, Ureteroscopy, Urolithiasis

### INTRODUCTION

Urinary stone disease or Urolithiasis is on a surge of increase with an incidence of 6.3% among men and 4.1% among women in 1994 to a rapid hike of 10.6% among men and 7.1% of women by 2014 according to national health and nutrition examination Survey.<sup>1</sup> One of the new trends observed presently is a sharp increase among the females and has outpaced men. Although Urolithiasis

appears to be common among men, the incidence rate ratio of men to women has reduced from 3.1 to 1.3% which is based on the data of various national studies, hospital admissions and outpatient care.<sup>2</sup> The site of development of the calculi is variable and dependable on various factors which may be age, dietary habits, place of study etc. However, the aetiology related to the development of the calculi is multifactorial as documented by various studies universally. The

composition of the calculi is also variable and dependable upon the pathophysiological mechanism involved in development of the calculus. The primary objective of approach in stone management differs from that of the medical and surgical practices.

Vast advances in the surgical management of Urolithiasis are observed in the last two decades. Open surgeries have given way to minimal invasive procedures like extra corporeal shock wave lithotripsy, percutaneous nephrolithotomy and ureteroscopy. In spite of removal of the stone, recurrence is quite a common feature and this is prevented by medical approach.<sup>3</sup> As quoted by famous lithotomist Frere Jacques, "I have removed the stone, but god will cure the patient". The prevention of stone recurrence requires better understanding of the pathophysiology involved in stone formation. Urolithiasis is associated with 2-3% of end stage renal cases if associated with nephrocalcinosis.<sup>4</sup>

The present study was undertaken with an aim to identify the various predisposing and causative factors, with clinical presentations and complications. This is also supported by identifying various modalities of treatment so that appropriate treatment regimen can be instituted for the patient and for prevention of complications.

## METHODS

A prospective observational study was conducted for a period of one year from January 2017 to December 2017 at a tertiary care hospital of south India. The study was approved by the institutional ethical committee and all the guidelines of the committee were followed strictly. The study was performed by Department of general surgery. All the cases attending the outpatient section of general surgery department with history of flank pain and signs and symptoms suggestive of urolithiasis were included in the present study and confirmed by a thorough clinical examination by a senior resident of the department. The cases were further confirmed by performing ultra-sonogram of the abdomen to localize the site of the renal calculus. Cases of confirmed urolithiasis by ultra-sonogram were included in the present study after fulfilling the inclusion criteria. A detailed history of the cases which includes socio demographic profile, age, sex, clinical history, signs and symptoms with duration, family history, diet, history of medications, calculation of body mass index, daily water intake were noted in separate predesigned proforma.

Routine laboratory investigations which include estimation of urine albumin, sugar, pH, urine microscopy, culture and sensitivity was performed on all the included cases after collection of mid-stream urine specimen. Serum calcium, uric acid and phosphates were estimated. USG was performed to localize the site of the renal calculus and the management of the cases either medical or surgical was decided based on the standard treatment protocol of the institution.

Surgical management was done performed by extracorporeal shock wave lithotripsy (ECSWL), percutaneous nephrolithotomy (PCNL), therapeutic ureteroscopy and Cystoscopic removal of bladder calculi. ECSWL: Non-lower pole renal calculi <1cm in size, Proximal ureteral calculi <1cm in size. PCNL: Non-lower pole renal calculi >1cm in size, lower pole renal calculus irrespective of size; Ureteroscopy: For proximal ureteral calculi >1cm in size, for distal ureteral calculi; Vesical calculi: Cystoscopic removal. Calculi recovered from the cases were noted for physical characteristics and sent for chemical analysis. All the cases managed surgically were followed till discharge and noted for any signs of infection and documented.

Patients with renal calculi of size <0.5mm, pregnant women, patients with age <18 years and > 60 years, Patients with bilateral staghorn calculi were excluded from the study.

## RESULTS

In the present study conducted at a tertiary care hospital for a period of two years, 150 cases were included in the study based upon the inclusion criteria. Males were predominant with 64% of cases and females 36%. Male to female ratio in the study was 1.8:1. The most common age group in the study was 18-30 years with 38.67% followed in order by 51-60 years (23.33%), 31-40 years (21.33%) and 41-5- years (16.67%). The mean age of the study group was 38.21 years. Pain abdomen was the most common presenting symptom (92%) followed by next more common fever (69.33%), burning micturition (65.33%) and other less common include increased frequency (14.67%), poor stream of urine (17.33%) and Hematuria (22.67%). The incidence of calculus was more common on right side (59.33%) than on left side (40.67%) but this association was not statistically significant (P value >0.05).

The kidney and pelvi ureteric junction was the most common site of calculus in the study (45.33%), followed in order of sequence by Vesical and vesico-uretric junction (28%), ureter (24%) and urethral site (2.67%). Both the renal stones and ureteric stones were more common among males than females in present study. The size of the stone ranged from 6mm to 48 mm with a mean size of 12.5mm. 49.33% of them were in the range of 6-9mm. Diabetes was the major associated comorbidity (45.33%) among the cases in the study followed by obesity (BMI >30) 32%, Hypertension 28% and Benign prostatic hyperplasia (BPH) 12% among the males in the study. Statistically significant association was found with Diabetes mellitus and Obesity (P value <0.05) in the study. Among the study patients, 46% of the cases had a history of low water intake (<6 glasses/day) and diets rich in oxalate/citrate/ urate. Statistically significant association was observed with cases of low water intake. (P value <0.05)

**Urine Analysis**

Urine examination was performed for all the 150 patients in the study. Acidic urine was observed in 56% and alkaline in 44% of cases. Pus cells (>10/HPE) were observed in 65.3%, RBC among 37.33%. Bacterial growth was observed in culture in 38.66% with Escherichia coli as the predominant pathogen (64%) followed by Klebsiella (34%) and Pseudomonas (2%). Blood urea and serum creatinine was elevated in 28% of cases in the study. 23% of the cases were anaemic.

(Hb<8%) All the cases were confirmed by performing Ultra sonogram of the abdomen and KUB region. 22% of cases had hydroureteronephrosis.

**Surgery and Outcomes**

Ureteroscopy (URS) was performed in 36 cases (24%), PCNL in 22 cases (14.67%), ECSWL in 46 (30.67%), cystolithotomy in 34 (22.67%) and urethral extraction in 12 cases (8%) (Table 1).

**Table 1: Surgeries performed according to site of calculus.**

Surgery and Site of the calculus	Kidney and PU junction	Ureter and VU junction	Vesical	Urethral	Total
URS	-	36	-	-	36
PCNL	22	-	-	-	22
ECSWL	38	8	-	-	46
Cystolithotomy	-	-	34	-	34
Extraction from urethra	-	-	8	4	12

Table-2 summarizes the type of surgeries performed. PCNL was performed in a total of 22 cases with 8 located in upper pole of kidney and 14 in lower pole and pelvi ureteric junction. The success rate over all was 21 cases with 100% in upper pole and 92.85% in lower pole. Post-operative complications were significantly higher in cases

of PCNL performed on calculi located in upper pole of kidney than ECSWL. ECSWL was performed in 46 cases of the total study, with 38 cases with calculi located in upper pole and in 8 cases the calculi was located in upper 1/3 of the ureter. The success rate was 89.47% in cases with upper pole and 75% among cases with calculi in the upper 1/3 of the ureter.

**Table 2: Surgical details classified based upon the site of calculi.**

Site of calculus	Surgery done	No. of cases	Success of surgery (%)	Post surgical complications			
				Pain	Burning micturition	Fever	Hematuria
Upper pole kidney	PCNL	8	8 (100)	6 (75)	6 (75)	3 (37.5)	0
	ECSWL	38	34 (89.47)	14 (36.84)	12 (31.58)	0	0
Lower pole/Pelvis/PU junction	PCNL	14	13 (92.85)	9 (64.28)	10 (71.42)	8 (57.14)	5 (35.71)
Upper 1/3 ureter	ECSWL	8	6 (75)	5 (62.5)	3 (37.5)	5 (62.5)	1 (12.5)
	URS	4	4 (100)	0	2 (50)	0	2 (50)
Middle 1/3 ureter	URS	8	7 (87.5)	3 (37.5)	5 (62.5)	1 (12.5)	1 (12.5)
Lower 1/3 ureter/ VU junction	URS	24	21 (87.5)	7 (29.1)	24 (75)	0	2 (8.4)
Vesical	Cystolithotomy	34	34 (100)	28 (82.35)	22 (64.70)	8 (14.70)	6 (17.64)
	Extraction from urethra	8	6 (75)	5 (62.5)	5 (62.5)	6 (75)	6 (75)
Urethra	Extraction from urethra	4	4 (100)	1 (25)	0	1 (25)	0

Post-operative pain and burning micturition was the most common complications in cases of ECSWL. Uretheroscopy (URS) was performed in overall cases of 36 with maximum located in lower 1/3 of the ureter (24 cases), 8 cases in middle 1/3 of ureter and 4 in upper 1/3

of ureter. The success rate was 100% in upper 1/3 and 87.5% in middle and lower 1/3 of ureter. Post-operative complications were maximum in cases with calculi in lower 1/3 and maximum among cases with calculi in upper 1/3 of ureter. Among 42 cases with vesical calculi,

34 underwent cystolithotomy with a success rate of 110% and in 8 cases urethral extraction were done with a success rate of 75%. Post-operative complications were higher in cases with cystolithotomy with pain, burning micturition associated with development of fever and Hematuria. The post-operative morbidity was higher in cases of cystolithotomy. Urethral calculi were removed by extraction with a success rate of 100% and less post-operative complications (Table 2).

## DISCUSSION

Urolithiasis a known clinical entity since olden times is a disease with high incidence of recurrence. Differences in the incidence and prevalence of the condition are largely related to differences in the climatic conditions, dietary habits and genetic factors. With increasing westernization of global culture, a marked change in the gender and age distribution is reported throughout the world. Major change in the site of development of the calculus was noticed with changes in the life style. In present study a total of 150 cases of Urolithiasis were studied. According to the literature and studies mentioned, men were more common in the study and the incidence was most common in the age group of 18-30 years. But few studies in contrast mentioned that prevalence of Urolithiasis increases with age both in men and women and less during adolescent period.<sup>5</sup> The mean age of cases in present study was 38.21 years where as the mean age for Urolithiasis was 46.1 in a study done by Hiatt et al in 1982 which shows a drastic change due to westernization.<sup>6</sup> About 30-40 years ago, the male to female ratio was 6:1 to 8:1. With changes in the life style and dietary modifications at present the ratio has decreased to 2:1 which is observed in present study also.<sup>7</sup> Over the last few decades, life style and dietary habits has been westernized in India which caused a great change in age and sex, etiological factors and management of Urolithiasis. Abdominal pain was the most common feature in present study with associated fever and burning micturition which is consistent with the findings of Baker et al.<sup>8</sup> In the present study, the calculus was most common on the right side which is on par with the findings of Safarinejad MR while few of the studies mention an equal frequency on either side.<sup>9</sup> Upper pole of the kidney was the most common site of calculus in the study and associated with pelvi- ureteric junction which coincides with the reports of Sharma N et al but few other studies indicates lower 1/3 of ureter as the most common site of the calculus.<sup>10</sup> In the present study, the incidence of renal calculi was 70% and vesical and urethral calculus was 30% which coincides with the reports of David J et al but differs in study of Rizvi et al who reported a higher incidence of vesical calculus than renal calculus in his study.<sup>11,12</sup> In the present study, statistically significant association was found with less daily water intake, obesity and diabetes mellitus. Findings of present study were consistent with the findings of Lieske JC et al.<sup>13</sup> Studies also reported significant Water intake also reduces the recurrence rate of Urolithiasis. Borghi et al in

his study demonstrated that high fluid intake decreased the recurrence rate of urolithiasis to 12% compared to 27% in the control group.<sup>14</sup> Insulin resistance, characteristic of the metabolic syndrome and type 2 diabetes, results in lower urine pH through impaired kidney ammoniogenesis so promoting uric acid stone formation.

Subjects with greater BMI excreted more urinary oxalate, uric acid, sodium and phosphate than those with lower BMI and there was an inverse relation between BMI and Urine pH. Benign prostatic hyperplasia was associated significantly with development of calculi among men in present study. The magnitude of increased risk for stone formation was higher among female than male.

*Esherichia coli* was the most common urinary pathogen isolated from present study. This coincides with the findings of many studies which reported the same as most common pathogen followed by *Proteus* and *Klebsiella*.

The treatment modalities for Urolithiasis have evolved rapidly in the last 30 years. Non-invasive SWL had become the predominant treatment modality with URS (Ureteroscopy) for only lower ureteral stones and PCNL used sparingly. The prime limiting factor in ECSWL is passage of debris rather than fragmentation of the stone. Few of the studies reported that treatment failure of ECSWL was due to failure to clear stone fragments. In the present study success rate of ECSWL was 89% among calculi located in upper pole and 75% among calculi located in upper 1/3 of ureter. Findings of present study were on par with the findings of Takazawa R et al.<sup>15</sup> Hence ECSWL is recommended as first line therapy in all guidelines for smaller non-lower pole renal stones (<20 mm) whilst only the AFU guidelines recommend ECSWL as choice in stones >20mm. In cases of calculi located in upper 1/3 of ureter <10mm ECSWL is treatment of choice in all guidelines except those of AUA where URS is recommended as first line for all distal ureteral calculi irrespective of size and SWL as second line.<sup>16</sup>

In the present study, cystolithotomy was performed for Vesical calculi with a success rate of 100% with pain being the most common complication. Findings of present study were on par with findings of Abarchi H et al.<sup>17</sup> Park and associates analyzed the outcomes of patients with proximal or distal ureteric calculi treated by either ECSWL or ureteroscopy and found that the efficacy of ECSWL worsened significantly for stones larger than 1 cm (83.6% versus 42.1%), whereas the stone-free rate for ureteroscopic treatment was unaffected by size (88.9% versus 86.6%).<sup>18</sup>

## CONCLUSION

To conclude, a tremendous shift has been observed in age and gender of urolithiasis in recent times due to westernization and change in life style and dietary habits.

Ureteral stones have become more common than renal and vesicular calculi with upper pole of kidney being the most common site of occurrence. Obesity, diabetes and BPH have found with significant association with the development of renal calculus.

The definitive treatment of urolithiasis has become far easier with invent of minimal invasive surgeries with reduced morbidity. For renal calculi, PCNL is the best treatment modality as of now, but it is associated with greater post-operative morbidity. For stone less than 1cm size, ECSWL is a good alternative to PCNL, but has poor clearance rate and thus greater need for auxiliary procedure. For ureteral calculi, both ECSWL and ureteroscopy have given good results but ECSWL is better tolerated by the patients.

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