

Clinical Study on Upper Urinary Tract Calculi: A Prospective Study

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Abstract

Introduction: Nephrolithiasis is a very common pathology globally with prevalence rates ranging from 7–13% in North America, 5–9% in Europe, and 1–5% in Asia. In the United States alone, kidney stones have been reported to affect 8.8% of the population.

Aims And Objectives: To study the clinical manifestations of upper Urinary tract calculi. To study various modalities of management of these calculi.

Materials And Methods: A prospective interventional study was done from 2018 to 2020 in Kakatiya Medical College, Mahatma Gandhi Memorial Hospital, Warangal, India. The total period of study was 24 months. Cases were selected from the OPD and from in patients in the wards who presented with Upper urinary tract calculi. **DISCUSSION:** In the present study, study group was divided into 4 groups based upon age. 18-30, 31-40, 41-50 and >50 years, with higher incidence in 3rd and 4th decade. In 2nd decade 12 members, in 3rd and 4th decade 15 members in each group and in > 5th decade 8 members are taken.

Conclusion: Upper urinary tract calculus has male dominance and more incidence in 3rd and 4th decade. Incidence is more in mixed diet population and people consuming <2 ltrs/day water. Most common presentation is pain abdomen and nausea and vomiting. burning micturition, fever and gravaluria are also seen. most common finding is renal angle tenderness.

Key words: Upper Urinary Tract calculi, Urolithiasis, Symptoms

INTRODUCTION

Nephrolithiasis is a very common pathology globally with prevalence rates ranging from 7–13% in North America, 5–9% in Europe, and 1–5% in Asia. In the United States alone, kidney stones have been reported to affect 8.8% of the population^[1]. A contemporary review by Romero *et al* revealed that stone prevalence has been increasing by age in Iceland, Iran, Germany, Turkey, Greece and the United States^[2] with a peak incidence in the third or fourth decade of life in most countries^[3]. The stone burden seems to be slightly higher in males than females at a ratio of 2:1.^[4]

In the context of India, KSD is prevalent, with an expectancy of 12% in a total population reported to

be prone to urinary stones^[5]. Of this 12%, 50% of the population are severely affected by renal damage, which even leads to a loss of kidneys. Unlike in South India, where a few reported percentages affected by Urolithiasis, in North India, there is a steep 15% of the population within the realm of KSD. Thus, considering the prospects of the kidney stone belt, which are affected by KSD in India, a proper corollary needs to be established. This stone belt occupies areas of Maharashtra, Gujarat, Rajasthan, Punjab, Haryana, Delhi, Madhya Pradesh, Bihar, and West Bengal. In these regions, the frequency of the prevalence and recurrence rate of renal stone is high in most of the members of a family.^[6]

Although difficult to estimate accurately the incidence of upper urinary tract calculi in different populations, the risk of forming upper urinary tract calculus is increasing among all and it is estimated that such stones affect 5 to 15% of population in the West.^[7]

Until 1980 urinary calculi were a major health problem, with significant proportion of patients requiring extensive surgical procedures and a sizable minority losing their kidney. The

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advent of extracorporeal techniques for stone destruction and refinements in endoscopic surgery and laparoscopy however has greatly decreased the morbidity of management of urolithiasis and reduced the length of hospitalization.^[8]

Although very few individuals die as a result of stone disease, it does lead to substantial morbidity from pain, urinary tract infection and obstructive uropathy. Various factors such as dietary habits, occupation, urinary infection, prolonged immobilization are responsible for formation of stones.

Surgery forms the cornerstone for management of urinary stones in the form of endourological procedures and open procedures. While there have been rapid advances in technology related to surgical aspects of stone treatment, these have outstripped our ability to prevent formation and recurrence.

Hence this study will evaluate the modes of presentation of upper urinary tract calculi and also to study the various modes of management of these calculi.

Aims and Objectives of the Study

1. To study the clinical manifestations of upper Urinary tract calculi.
2. To study various modalities of management of these calculi.
3. To study efficacy of conservative/medical management of small sized calculus.

MATERIAL AND METHODS

Patients and Methods

A prospective interventional study was done from 2018 to 2020 in Kakatiya Medical College, Mahatma Gandhi Memorial Hospital, Warangal, India. The total period of study was 24 months. Cases were selected from the OPD and from in patients in the wards who presented with Upper urinary tract calculi. Proforma with relevant history, clinical examination and investigations was prepared and patients were assessed.

Type of Study

A Prospective study with 50 patients diagnosed with Upper urinary tract calculi were included in the study.

Inclusion criteria

All patients with Upper urinary tract calculi between the ages of 18-70 years, who attended the OPD and those admitted in MGM Hospital and who were willing to undergo investigations, treatment and willing for follow up.

Exclusion criteria

1. Patients with stone disease with renal failure requiring dialysis.

2. Patients with associated stones in the lower urinary tract.
3. Children below the age group of 12 years.

Study done as prospective study

Patients were studied and analysed in detail, with regard to; History

- Clinical Examination Routine Blood Investigations
- X ray KUB, USG, CT Scan, IVU (in certain cases only)
- Based on the provisional diagnosis, patients were subjected to surgery or conservative management as the case required. Cases were again analysed based on;
 - Complications
 - Post Operative Course and outcome.
 - Patients were followed up for a period ranging from 1 month to 18 months to detect any recurrence.

OBSERVATIONS AND RESULTS

Total numbers of patients were 50 and were divided into 4 age groups and each age group to two sex groups. 18-30, 31-40, 41-50 and >50 years

Statistical description of age groups: Mean age of the study group was 42.5 + or – 11.9 years. with maximum age in the study group was 64 years and minimum was 21 years.

sex distribution of study group: Out of 50 patients 30 are male and 20 are female.

DIET of study group: 42 Out of 50 patients in the study consumed mixed diet and 8 were vegetarian.

WATER Intake of study group: In the present study 52 % of patient consumed Less than 2 litres of water/day.

Clinical presentation of study group:

	No	%
Pain abdomen	36	78
Nausea / Vomiting	31	62
Fever	6	18
Burning Micturition	16	32
Haematuria	5	10
Graveluria	2	4

Pain abdomen was the commonest mode of presentation (72%) followed by Nausea/Vomiting (62 %), burning micturition(32% Haematuria(10%), graveluria(4%) and fever (12%)

SIGNS of study group: In the present study 18 patients had abdominal tenderness in the Lumbar and iliac fossa. Renal angle tenderness was present in 26 cases and mass per abdomen in 3 cases.

Investigations of study group: USG and KUB X ray and CT was done in all patients in the study where as IVU were done in all cases of renal stones and 12 cases of ureteric stones.

In this study Ureteroscopic Pneumatic Lithotripsy was performed in 1 person with proximal, 3 persons with mid and 11 persons with distal ureteric calculi with a success rate of 75%, 75% and 100% respectively. Ureterolithotomy was done in 3 patients with impacted stones and calculus size greater than 1.5cms with 100% success rate [Tables 1 and 2].

DISCUSSION

A total of 50 patients with upper urinary tract calculi were taken in present study. Their data has been analyzed and described below.

In the present study, study group was divided into 4 groups based upon age. 18-30, 31-40, 41-50 and >50 years, with higher incidence in 3rd and 4th decade. In 2nd decade 12 members, in 3rd and 4th decade 15 members in each group and in >5th decade 8 members are taken.

In the present study, upper urinary tract stone shows a peak incidence in between the 3rd and 4th decade of life accounting for 60 percent of cases, which is similar to incidences in Zeng Q, He Y. *et al.* Upper urinary tract calculus occurred predominantly in males and was almost twice more common than females in this study. 60% of males were affected where as 40% of females were affected. This is similar to a study by Reid. M *et al* affected males were 64% and females affected were 36%. This is comparable to the 40.1 years and 2:1 male to female ratio observed in Accra by Kluffio *et al* 30 years ago. The male preponderance is probably due to increased testosterone levels, which results in increased endogenous oxalate formation and predominantly outdoor occupation in males.

However chronic Urinary tract infection, cystinuria, hyperparathyroidism causes urolithiasis more in female in whom recurrent idiopathic calculi or uric acid calculi stands prominent in etiology. Incidence of urolithiasis stands equal for male and female in childhood. It is postulated that lower testosterone in female and children may protect them against oxalate calculi.

In the present study 16% population are taking pure vegetarian diet and 84% population taking mixed diet implying lower incidence on population on vegetarian diet. more than half of mixed diet population consume moderate to large quantities of animal proteins. This is comparable to study done by Trinchieri A, Power C *et al*

which shows incidence of stone higher in those who consume high quantities of animal proteins.

It has been found that increased consumption of dietary proteins lead to increased urinary excretion of calcium and oxalate and decreased excretion of citrate, which leads to stone formation. There exist a direct relationship between non-vegetarian food habit with kidney stone formation. A diet rich in animal protein, because of its high purine content, which produces uric acid in its catabolism, may increase the risk of uric acid stone formation.

In this study we established significant relationship between high intake of animal protein and stone formation. This study suggests that vegetarians are at a lower risk for stone formation in contrast to non-vegetarian.

However, a randomized prospective dietary intervention study Romero V *et al*, demonstrated that reduction of sodium and animal protein and maintenance of normal dietary calcium intake attenuates stone activity in recurrent hypercalciuric stone formers.

In the present study 52% population are taking less than 2 ltrs per day of water and 48% are taking more than 2 ltrs per day, indicating importance of water intake in relation to stone formation. water plays a key role for stone neutralization.

It has been seen in a study by López M *et al*, that the incidence of urinary stones is higher due to low water intake which coincides with this study.

In the present study pain abdomen and nausea/vomiting is the main clinical presentation. 36 members presented with pain abdomen, 31 presented with nausea/vomiting, 16 members presented with burning micturition, 6 presented with fever, 5 with haematuria, 2 with graveluria.

A similar study by Reid. *et al*, shows 87% flank pain, 22% nausea, 3% emesis and 3% urosepsis. In a study by Gyasi- Sarpong K. *et al*, commonest symptom was flank pain, seen in 134 (78.8%) patients followed by colicky abdominal pain in 18 (10.6%) patients. Five of the

Table 1: Age and sex distribution of study group

Age	Sex				Total	
	Female		Male		Count	%
	Count	%	Count	%		
18-30	4	8.0%	8	16.0%	12	24.0%
31-40	6	12.0%	9	18.0%	15	30.0%
41-50	7	14.0%	8	16.0%	15	30.0%
>50	3	6.0%	5	10.0%	8	16.0%
Total	20	40.0%	30	60.0%	50	100.0%

patients with flank pain also had macroscopic hematuria on presentation.

In the present study 26 members have renal angle tenderness, 18 with abdominal tenderness and 3 members have mass per abdomen.

In the present study 9 members have hypertension, 7 have diabetes mellitus, 3 have BPH, and 14 members have recurrent stones. In a study by Shah P *et al*, 18 (20.5%) respondents were hypertensives and 6 (6.8%) were diabetics and Past history of urolithiasis was present in 2 (2.3%) cases.

Several studies have established hypertension as an independent risk factor of urolithiasis with a proposal that abnormalities in renal calcium metabolism exist among patients with hypertension, leading to increased urinary calcium excretion. Urinary stone disease has been increased globally and occurred more frequently in subjects with diabetes than nondiabetics with a predominance of urolithiasis with uric acid. The reason for a higher occurrence of urolithiasis in diabetes mellitus has been explained as insulin resistance and lower urine pH through impaired kidney ammonia genesis, promoting uric acid stone formation. Although a low urinary pH plays a major role in the formation of uric acid kidney stones, a defect in renal acid excretion also could lead to hypocitraturia, an important risk factor for calcium stones

In this study urine examination shows albumin in 8 members, sugar in 9 members, pus cells seen in 6 members, rbc seen in 38 members, 16 members show

crystals. among those with crystals few have calcium oxalate and few have calcium phosphate.

Radiological investigations done in the present study included plain X ray KUB, CT KUB, Intravenous urography, and Ultrasonography. USG and KUB X ray was done in all patients in the study where as IVU were done in all cases of renal stones and 8 cases of ureteric stones.

Plain X ray KUB and CT KUB demonstrate calculi in 100 % cases, which is similar to study by Pollack.HM *et al*, in which X ray KUB demonstrate stone in 90% of cases. Where as USG was able to demonstrate calculi or give indirect evidence of ureteric calculus in the form of hydronephrosis. Study by Jackman *et al*, shows that Plain abdominal x-ray is more sensitive than CT for diagnosing radio opaque stones. To facilitate follow up of patients with calculi plain abdominal x-ray should be performed when a stone is not clearly visible on CT. X- ray KUB has been shown to be more effective than IVU for the diagnosis of calculi in an emergency setting. In a patient with acute onset of flank pain and hematuria, a positive plain abdominal film diagnosed the presence of ureteral calculi with 96% accuracy.

In the current study the main procedure done for ureteric stones was Ureteroscopy pneumatic lithotripsy, only 3 patients underwent ureterolithotomy.

Ureteroscopic Pneumatic Lithotripsy formed effective treatment of calculi in all positions in the ureter, but was easily done in lower ureteric calculi. It was helpful even in impacted stones in lower ureter.

In 2 cases there was injury to the ureter and the procedure was abandoned after stenting. In two cases of upper and mid ureteric calculi, the calculi slipped into the kidney, which was later treated by E.S.W.L.

In this study Ureteroscopic Pneumatic Lithotripsy was performed in 1 person with proximal, 3 persons with mid and 11 persons with distal ureteric calculi with a success rate of 75%, 75% and 100 % respectively, compared to study by Chow GK *et al* stone extraction rate was 94.4% of which, Distal stone extraction rate was 97.2% and proximal stone extraction rate was 76.5% showing similar results.

A study by Randal *et al* 50% success rate for proximal, 80% for mid and 99% for distal ureteric calculi. Another study by Turk *et al* showed a stone free rate of 95% for ureteroscopic removal of stones in the lower third of ureter with 5% short term complications

Ureterolithotomy was done in 3 patients with impacted stones and calculus size greater than 1.5cms with 100%

Table 2: Operative procedure done for ureteric calculus

Site	Ureteroscopic Pneumatic Lithotripsy			Ureterolithotomy
	Upper	Mid.	Lower	
Num.	1	3	11	3
%	4.34	13.04	47.82	13.04
Success	75	75	100%	100%

Table 3: Comparison of symptoms of presentation in different studies

Symptoms	Reid. M. <i>et al</i>	Present Study	Gyasi- Sarpong K. <i>et al</i>
Pain abdomen	87%	72%	78.8%
Nausea / vomiting	20%	62 %	
Fever	2%	12 %	
Haematuria	3%	10 %	2.9%
Gravalluria	-	4%	
Burning micturition	-	32%	

success rate and without any complications. Open surgery for ureteric stones is now reserved for managing the complications of other forms of stone removal, but it is rarely indicated as primary modality of therapy

In the present study 27 members show renal calculi in which bilateral calculi is seen in 4 members, unilateral right calculi is seen in 12 members, unilateral left calculi in 11 members. Among renal calculi 5 members shows calculi in upper pole, 9 shows calculi in middle pole and 13 shows calculi in lower pole. In a study by Chande M *et al* 6 members shows calculi in upper pole, 10 shows calculi in middle pole and 17 shows calculi in lower pole.

Renal stones were mainly treated by E.S.W.L, which accounted for 55.5% of patients. 44.5 % of patients were treated by open surgical procedures.

Pyelolithotomy was done in 8 patients, extended pyelolithotomy was done in 2 patient, Nephrolithotomy was done in one patients and 1 patient underwent nephrectomy as the patient had pyonephrosis with non-functioning kidney. open procedures for renal calculi are rarely performed now a days.

20 patients in study group are treated with E.S.W.L required 50 sittings for successful clearance of calculi. Average no of sittings overall were 2.5. Average no of sittings are 2 to 3 for upper and middle calyceal stones where as lower calyceal stones required 4 to 5 sittings, indicating lower pole calculi are more resistant to fragmentation owing to increased infundibulopelvic angle, narrow infundibulum and multiple lower pole calyces.

Recent study by A. Srivastava *et al* of E.S.W.L on lower calyceal stones showed that overall stone clearance rates for stones <2cm in lower calyx was 78%. Only the infundibulopelvic angle was significant among the angles and stone size was a significant factor. Clearance rate for stones less than 1cm was 86% and for stones 1-2 cms was 74%.

All patients were treated on opd basis and none of them required hospitalization. Patients with renal stones who were treated by open surgical procedures required prolonged hospital stay, which was greater than 10 days.

Patients underwent E.S.W.L on out patient basis and did not require hospitalization. It was noted in this study that all patients treated by open surgical procedure on kidney required prolonged hospital stay of around 10days. This was due to increased time required for postoperative recovery from surgery and complications. All patients were discharged only after satisfactory wound healing and suture removal. The advantages of noninvasive and minimally

invasive procedures have undermined the role of open stone surgery in recent days.

In the present study, study group was divided based on size of calculus into 3 groups. Among them <1 cm stone is seen in 10 members in ureteric calculi group and in 3 members in renal calculi group. 1-2 cm stone is seen in 13 members in ureteric calculi group and in 9 members in renal calculi group. >2 cm stone seen in 15 members in renal calculi group.

In the present study, among 13 people in renal and ureteric group with < 1cm they were allowed to plan conservative management and remaining was planned for surgical management. patient with failed conservative management and >1cm and with anatomical changes due to stone were planned for surgical management.

Complications which occurred as a result of both open and endourological surgical procedures was pain in maximum number of patients accounting for 60.86 % of patients with ureteric stones and 55.5% of patients with renal stones.

Wound infection rate was about 11% in renal open surgical procedures where as no patients with ureterolithotomy had wound infection. Haematuria was reported in 2 patients who underwent URS and PNLT and in 3 patients with renal calculus treated with E.S.W.L.

One case had residual calculus in the ureter as there was trauma to ureter during procedure and in 2 patients in renal calyx, in those ESWL was performed in later dates.

Haemorrhage during surgery, which required blood transfusion occurred in one patient with nephrolithotomy. None of the patients of our study group had other complications like Pyonephrosis, Respiratory infection, paralytic ileus or urinary fistulae. Complications in those procedures performed in this study was treatable and no mortality was there in the study group.

Complications in a study by Khalaf I *et al* occurred in 186 (35%) cases that mainly included intra-operative and early post-operative bleeding. Blood transfusion was needed in 23.3% of cases. Other complications included fever, leakage, pneumothorax, wound infection and ileus. Pneumothorax occurred in 10 cases (1.9%), 5 of them needing chest tube drainage for few days. Most of these complications were managed conservatively.

Salvage nephrectomy (secondary nephrectomy) was needed in two cases due to uncontrollable bleeding. The factors influencing the occurrence of operative complications included recurrent stone surgery, stone size and site, the

type of ORSS, the presence of anatomical abnormalities and the experience of the surgeon.

Mortality occurred in two cases; the first patient developed hemorrhagic shock which was uncontrolled, and the patient died on the 3rd post-operative day. The second patient developed septicemia and died 30 days after surgery.

Unsatisfactory peri-operative outcome (90 days after surgery) occurred in 101 cases (19%) and included significant residual fragments in 59 (11%), chronic pyelonephritis in 18 (3.4%), stricture at the ureteropelvic junction (UPJ) in 11 (2.1%), perinephric abscess in 4, pyonephrosis in 3, and deterioration of renal function in 92 cases (17.3%). Deterioration of renal function occurred secondary to obstructive, infective or iatrogenic causes.

SUMMARY

A prospective interventional study of upper urinary tract calculi was carried out from 2018 to 2020 in the Kakatiya Medical College, Mahatma Gandhi Memorial Hospital, Warangal, India. The total period of study was 24 months. A total of 50 patients with upper urinary tract calculi were included in the study.

- In the present study, study group was divided into 4 groups based upon age, 18-30, 31-40, 41-50 and >50 years, with higher incidence in 3rd and 4th decade. In 2nd decade 12 members, in 3rd and 4th decade 15 members in each group and in > 5th decade 8 members are taken. Mean age of population 42.5 years with standard deviation of + or - 11 years.
- In the present study 30 members males and 20 members females are included, implying increased incidence of stones in male population.
- In the present study 16% population are taking pure vegetarian diet and 84% population taking mixed diet implying lower incidence on population on vegetarian diet.
- In the present study 52% population are taking less than 2 ltrs per day of water and 48% are taking more than 2 ltrs per day, indicating importance of water intake in relation to stone formation. Water plays a key role for stone neutralization.
- In the present study pain abdomen and nausea/vomiting is the main clinical presentation. 36 members presented with pain abdomen, 31 presented with nausea/vomiting, 16 members presented with burning micturition, 6 presented with fever, 5 with haematuria, 2 with graveluria.
- In the present study 26 members have renal angle tenderness, 18 with abdominal tenderness and 3 members have mass per abdomen.
- In the present study 9 members have hypertension, 7 have diabetes mellitus, 3 have BPH, and 14 members have recurrent stones.

- In the present study urine examination shows albumin in 8 members, sugar in 9 members, pus cells seen in 6 members, rbc seen in 38 members, 16 members show crystals.
- Radiological investigations done in the present study included plain X ray KUB, Intravenous urography, and Ultrasonography. USG and KUB X ray was done in all patients in the study where as IVU were done in all cases of renal stones and 12 cases of ureteric stones.
- In the present study 23 members have ureteric calculus of which 8 members have right sided calculus, 15 members show left sided calculus. No one has bilateral calculus.
- Among ureteric calculus group 3 members have calculi in upper 1/3, 5 members have calculus in middle 1/3, 15 members have calculi in lower 1/3.
- In the present study 27 members show renal calculi in which bilateral calculi is seen in 4 members, unilateral right calculi is seen in 12 members, unilateral left calculi in 11 members.
- Among renal calculi 5 members show calculi in upper pole, 9 show calculi in middle pole and 13 show calculi in lower pole.
- In the present study, study group was divided based on size of calculus into 3 groups. Among them <1 cm stone is seen in 10 members in ureteric calculi group and in 3 members in renal calculi group. 1-2 cm stone is seen in 13 members in ureteric calculi group and in 9 members in renal calculi group. >2 cm stone seen in 15 members in renal calculi group.
- In this study Ureteroscopic Pneumatic Lithotripsy was performed in 1 person with proximal, 3 persons with mid and 11 persons with distal ureteric calculi with a success rate of 75%, 75% and 100% respectively. Ureterolithotomy was done in 3 patients with impacted stones and calculus size greater than 1.5 cms with 100% success rate.
- Pyelolithotomy was done in 8 patients, extended pyelolithotomy was done in 2 patients, Nephrolithotomy was done in one patient and 1 patient underwent nephrectomy as the patient had pyonephrosis with non-functioning kidney.
- 20 patients in study group are treated with E.S.W.L. required 50 sittings for successful clearance of calculi. Average no of sittings overall were 2.5. Average no of sittings are 2 to 3 for upper and middle calyceal stones where as lower calyceal stones required 4 to 5 sittings.
- Pain abdomen and haematuria were the commonest post interventional complications. Wound infection was seen in 5 patients who underwent open renal surgical procedure, haemorrhage and residual calculus is rare complications.

CONCLUSION

- Upper urinary tract calculus has male dominance and more incidence in 3rd and 4th decade.
- Incidence is more in mixed diet population and people consuming <2 ltrs/day water.
- Most common presentation is pain abdomen and nausea and vomiting, burning micturition, fever and gravaluria are also seen. most common finding is renal angle tenderness.
- Xray and CT KUB has more sensitivity, IVU has more specificity.
- Ureteroscopic pneumatic lithotripsy has high success rate, there was a rare need for open urethrolithotomy for ureteric calculus.
- ESWL remains the commonest and best procedure for both renal and ureteric calculus with high success rate.
- Open surgical procedures for renal stone are rarely performed and was only done in case of large calculi and only in complicated cases.
- Minimal invasive surgeries remains the gold standard in treatment of both ureteric and renal stones both

in terms of complications and mortality compared to open surgeries.

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