



Profiling and management of ureteric calculi in a tertiary care teaching Hospital – A descriptive cross-sectional study

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Abstract

Ureteric calculi, due to its chance of complication and its painful nature it becomes a global health burden. Profiling and management of ureteric calculi aspects involves understanding epidemiology, clinical presentation, key factors such as age, gender, seasonal distribution and its diagnostic modalities such as ultrasonography, CT scan plays a pivotal role in accurate localization and size of ureteric calculi. Wide spectrum ranging of management involves conservative measures to surgery. Conservative management involves hydration, pain management to facilitate stone passage and to alleviate symptoms. Surgery management includes ureteroscopy with laser lithotripsy, percutaneous nephrolithotomy (PCNL), laparoscopic ureterolithotomy, pushback PCNL and extracorporeal shockwave lithotripsy (ESWL), offers effective means for stone fragmentation and removal. For effective tailored management of ureteric calculi, they should be profiled.

This is a study of 90 patient with calculi disease of ureter seen during a period of one and half year, from October 2019- April 2021 who presented at southern railways headquarters' hospital with special reference to clinical evaluation with thorough clinical examination along with epidemiology workup, radiological and relevant blood investigation. The current study aims to assess clinical, imaging, laboratory parameters of patients with ureteric calculi, confirm diagnosis and its intraoperative findings to arrive at decision making process and finally emphasis on treatment modalities at different levels and compare the result with similar published studies.

Keywords: Ureteric calculi, kidney stones, management, treatment outcomes, descriptive study, patient profiles

Introduction

Urolithiasis is a stony concretion created by a cluster of crystalline or amorphous particles precipitated in urine. Urinary stone disease is a major health problem that concerns millions of patients worldwide, since it affects 2–3% of the population with a high recurrence rate of almost 50% and presents with various patterns, clinical presentation, treatment, and outcome. After infection and prostatic diseases, calculi are the most common presentation in urological practice. Ureteric calculi are a complex disease and it can be treated effectively by a multifactorial approach.¹ The epidemiological characteristics of urolithiasis have continued to evolve in recent years in response to changes in dietary habits, health conditions, environmental factors and the prevalence of diseases that predispose to the risk of nephrolithiasis. Imaging is a vital contribution to diagnosis. With the advent of endoscopy, it has become the gold standard treatment for most of the calculus in developed countries^[1, 2]. As there is increasing trend in urinary tract calculi, due to its morbid pain and may end up renal failure, it should be profiled and treated accordingly. In our clinical practice, we have been observing numerous ureteric calculi cases being treated by different interventions with varied treatment outcomes. Documenting the clinical and radiological profile, treatment outcomes may aid in more in depth understanding about the nature of this disease in the local population in a geographical locality. This will be useful in early diagnosis/referral and timely management. This eventually will have huge positive impact on treatment outcomes, in terms of morbidity associated with ureteric calculi.

Review of Literature

Age

Adults are mostly affected by urinary calculi^[3]. Compared to adults urinary calculi is being a rare disease with overall incidence being stable^[4]. Incidence of urolithiasis is in peak between 20 and 50 years^[5]. Most of the patients report onset of symptoms of the disease in the 2nd decade of life with decreasing onset through the 3rd, 4th and 5th decade^[5]. With increasing in age studies have shown there will be increase prevalence of stones as conducted in Italy, Greece, Germany, Iceland, Turkey, Iran, and the United States^[6]. In Korea, the prevalence rates decreased in men with age, but increased in women with a peak at age 60 to 69 years^[6]. Peak incidence of stone formation ranging from 40 to 49 years in Japan, USA and Iran, except in Japan where women had a peak incidence between 50 to 59 years with incidence among Iran men age groups are lower in comparison to all two countries^[7].

Male: Female Ratio

Except for those due to infection urolithiasis is a disease with a clear male predominance for all stone types. Daudon *et al*^[8] observed for calcium oxalate and urate there is a male predominance and a female predominance for struvite and calcium phosphate stones. Scales *et al*^[9], observed a change in the prevalence of treated stone disease by gender from a 1.7:1 to 1.3:1 male-to-female ratio. Knoll *et al*^[10], observed a 2.7:1 male-to-female ratio for the most common calcium-containing calculi. male-to-female ratio range from 1.6:1 in Thailand and 1.15:1 in Iran to 5:1 in Saudi Arabia 2.5:1 in Iraq^[11, 12].

Location

Coll and colleagues^[13], noted that based on stone location spontaneous passage rate of stone was 48% for those in the proximal ureter, 60% for mid ureteral stones, 75% for distal ureteral stones, and 79% for stones in the vesicoureteric junction. Song and colleagues^[14], in (46.3%), stones were located at ureterovesical junction (UVJ), (30.5%) in proximal ureter and in 16.8% in distal ureter. Karenbaker Maj *et al*^[15] observed a significant predominance of lower ureteral stones with 63% in distal ureter and 87% at the VUJ. Removal efficacy with ureteroscopy (URS) is determinant by location of calculi in ureter, whereas it does not appear to impact the results of extracorporeal shock wave lithotripsy (ESWL)^[16].

Diagnostic Modalities

Ultrasound, plain abdominal radiography, computed tomography and intravenous urography are the principal investigation for suspected ureteric colic.

Ultrasonography (USG)

Advantage: Stones situated at PUJ, VUJ, and in renal calyces are directly visualized by ultra-sonogram. DISADVANTAGES: Stones located between the PUJ and VUJ, however, are extremely difficult to visualise with ultrasonography.

Plain Radiograph of the Kidney, Ureter and Bladder (KUB)

Sensitivity of x-ray KUB is 45–60% in the evaluation of acute flank pain^[17]. Identification of ureteric calculi is made difficult by overlying stool or bowel gas, and radiolucent stones which are visualized for 10–20% of the stones is not possible with KUB.

Non-Contrast Enhanced Computed Tomography (CT)

Advantages

Non contrast CT can visualize both radiolucent and radiopaque stones, which has largely replaced IVU has become the first line investigation. CT has sensitivity, specificity and positive predictive value of 96%, 100% and 100%, respectively^[18].

In comparison to plain KUB, CT confirms the presence of a stone while former only assess the radio opacity of stone. CT abdomen also shows stone at distal ureter. Avoidance of intravenous contrast medium and identification of extra-urinary pathology also adds benefit. The incidence of extra-urinary abnormality detected with CT is reported to be 6–12%^[19].

Disadvantages

As compared to IVU unenhanced CT is not capable of finding functional evaluation of the kidneys and is unable to assess the degree of obstruction, which may affect clinical management. But CT is capable of identifying secondary features of obstruction such as hydronephrosis, renal enlargement, hydro ureter and inflammatory changes of the perirenal fat. These can be a reliable parallel of delayed excretion on IVU.

CT has 3 times radiation exposure compared to IVU and 10 times in comparison to x-ray KUB, with malignancy risk of 1 in 4000. But low dose and ultra low-dose CT can reduce radiation exposure by 50% and 95%, respectively, with comparable detection rates of calculi.

Management of Ureteric Calculi

Most of the patients with ureteric calculi are treated conservatively by analgesic and observation. For most calculi surgical intervention is needed only if conservative treatment fail, Michael *et al* recommends that stone passage should not exceed 4–6 weeks due to the risk of renal damage. Based on stone size, stone position, degree of impaction and degree of obstruction spontaneous passage is determined. The recognition of urgent and emergency requirements for urologic consultation, effective pain control and understanding of the impact of stone location and size on natural history and definitive urologic management are the main factors for treatment.

Medical Expulsive Therapy (MET)

AUA/EAU guidelines for ureteral stone performed a meta-analysis of medical expulsive therapy trials using alpha blockers. Distal ureteral stones less than 10mm in size are the patient needed to advocate for MET by alpha blockers as it shortens the duration of passage of calculi in ureter^[20]. But Pickard R *et al*^[21] on randomized controlled trial failed to demonstrate any benefit from the use of tamsulosin or nifedipine.

Conservative Management

It is not suitable for patients with infections or in patients with potential danger for renal function^[22]. As seen earlier 2 to 4 mm in size will pass spontaneously in 95% within a period of 40 days^[22]. Spontaneous passage of Stones above 6 mm in diameter are less likely to pass spontaneously.

Surgical/ Endoscopic Management

“The 2016 American Urological Association (AUA)/Endourological Society guidelines have suggested more specific indications for surgical management. The guidelines recommend surgery in the following scenarios^[20]. Ureteral stones >10 mm, Uncomplicated distal ureteral stones ≤10 mm that have not passed after 4-6 weeks of observation, with or without MET, Symptomatic renal stones in patients without any other aetiology for pain, Paediatric patients with ureteral stones that are unlikely to pass or in whom MET has failed, Pregnant patients with ureteral or renal stones in whom failed observation has failed”. General contraindications to definitive stone manipulation include: Active, untreated UTI, Uncorrected bleeding diathesis

The techniques available when the stone fails to pass spontaneously are: Stent placement, Ureteroscopy (URS), Extracorporeal shockwave lithotripsy (ESWL), Ureterolithotomy, Percutaneous nephrolithotomy

Ureteroscopy (URS)

First rigid ureteroscope was developed by Perez-Castro in collaboration with Karl Storz in 1980, was a breakthrough and become development in the field of urology^[23]. With further technological advancement it is possible for easier and better access to nearly all areas in the urinary tract via the urethra, thereby removing the need for any surgical incision. With chip to tip technology of modern digital flexible ureteroscopy transferring electronically the image detected at the tip of a scope to the image displayed on a monitor.

Electrohydraulic, ultrasonic lithotripsy and holmium laser were developed later, enabling the fragmentation of ureteric

stones. But in patients with ureteric stricture ureteroscopy cannot be passed hence it become contraindication for URS. Minimally invasive URS are suitable for patients who are unfit for open surgery [24]. URS include failed previous SWL, HU> 1000, size 5 to 30 mm, combined approach with percutaneous nephrolithotomy (PCNL). With rigid ureteroscopy more distal stones have higher success rates compared to the more proximal. Flexible ureteroscopy recommend for proximal ureteric calculi because Proximal stones have tendency to fall back into the kidney, Current guidelines recommend URS, over other treatments modalities including SWL, for majority of the ureteric stones.

URS vs. ESWL

Re-treatment rate of SWL is 20-30% along with fragment passage difficulty in ureter favours URS more than SWL where URS can be done at one session. URS has superior stone-free rates 79% whereas SWL has 68% for proximal ureteral calculi measuring 10mm. The stone-free rate for mid-ureteral stones was not significantly different between URS and SWL, but for distal stones, URS yielded better stone-free rates.

Treatment Selection

As the size of the stone increases, the intensity of the treatment needs to provide should increase as well, because less intense treatments are less effective with larger stones. Thus, with increase in stone size URS become better option than SWL and Percutaneous nephrolithotomy becoming most useful for the very large ureteral stones. Taking location under consideration for proximal ureteral stone, complications of URS increase, but those of SWL are relatively stable and for distal ureteric stones URS is ideal. Other general trends are more obvious; as stones get harder, they are better treated with endoscopy rather than SWL.

AIM: To study the clinical, radiological profile and management of ureteric calculi in tertiary teaching institute.

Objective

Primary Objective: To observe features of ureteric calculi in terms of Epidemiological characters, size of calculi, Treatment options based on calculi size

Secondary Objective: To observe features of ureteric calculi in terms of Microbiological content, Calculi correlation with seasonal variation, Median hospital stay.

Inclusion Criteria: All patients aged 10 years and above with ureteric calculi requiring hospital admission with ureteric colic, altered renal function test and patients who await's for surgery.

Exclusion Criteria: Ureteric calculi with neurogenic bladder, metabolic disorder, stricture urethra, Patients who are not willing to give consent.

Methodology: After obtaining institutional ethics committee clearance, the patients admitted in department of surgery fulfilling the inclusion and exclusion criteria will be enrolled into the study. After obtaining Written and informed consent from all the patients who are willing to participate in the study. All patients are subjected to detailed clinical and radiological works up like history taking, abdominal examination, USG abdomen / and CT KUB. Complete hemogram, urine analysis, urine culture, serum biochemistry including urea and creatinine were performed in all patients. Calculi are treated conservatively or surgically according to hospital protocol.

Ethical issues: No ethical issues as part of study we are not doing any additional investigation or the procedure and no monetary loss to institution as this test are done day to day practice

Statistical methods: Descriptive analysis will be carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Data will also be represented using appropriate diagrams like bar diagram, pie diagrams and box plots. No inferential statistics will be done as the current study is descriptive study and no hypothesis is being tested. IBM SPSS statistical software will be used for data analysis

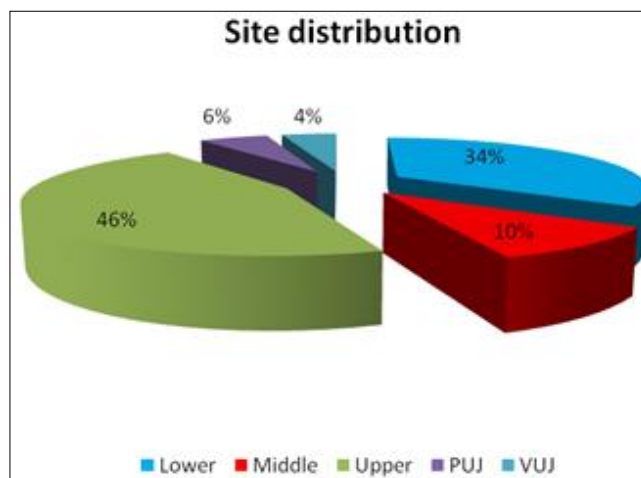


Fig & Table 1: Descriptive Analysis of Site of Ureteric Calculi Distribution in Study Population (N=90)

Site distribution		
	Frequency	Percent
Lower	31	34.4

Middle	9	10.0
Upper	41	45.6
PUJ	5	5.6
VUJ	4	4.4
Total	90	100.0

The above table shows the distribution of sites of calculi among the study population in upper 45.6% were there, next

to that lower it is 34.4 % and Middle was 10 % and PUJ and VUJ were 5.6% and 4.4% distributed.

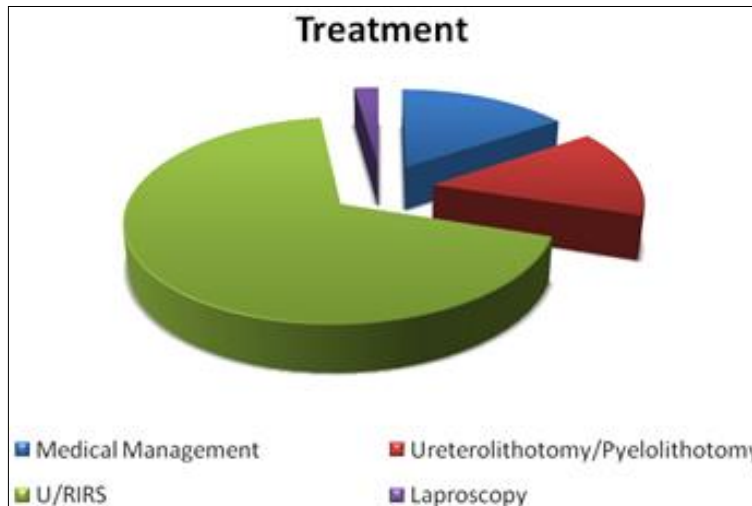


Fig & Table 2: Descriptive Analysis of Treatment of Ureteric Calculi Distribution in Study Population (N=90)

Treatment		
	Frequency	Percent
Medical Management	14	15.6
Push back URS PCNL	13	14.4
URSL	61	67.8
Laparoscopic Ureterolithotomy	2	2.2
Total	90	100.0

The above table and pie diagram shows the distribution of treatment among the study population medical management

were 15.6%,PCNL is 14.4%, URSL/RIRS is 67.8% and Laproscopic Ureterolithotomy is 2.2%.

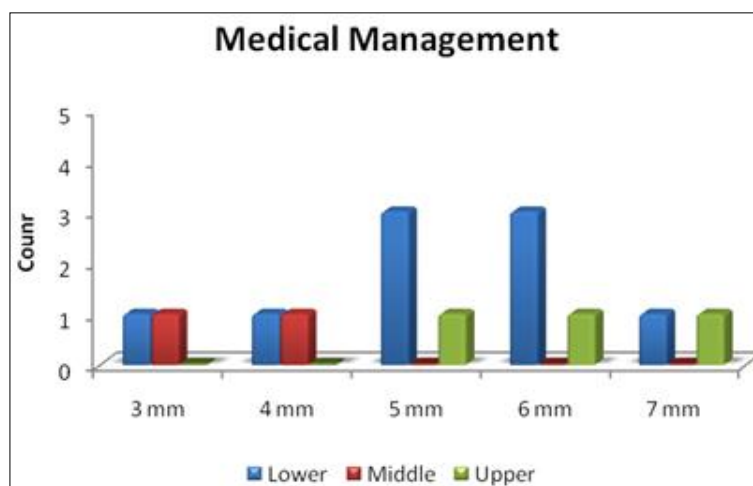


Fig & Table 3: Frequency Bar Chart with Comparison of Medical Management Depend Upon Size and Site of Ureteric Calculi in Study Population

		Stone size / mm					Total no of patient underwent successful medical management
		3 mm	4 mm	5 mm	6 mm	7 mm	
Site of stone impaction	Lower	1	1	3	3	1	9
	Middle	1	1	0	0	0	2
	Upper	0	0	1	1	1	3
Total		2	2	4	4	2	14

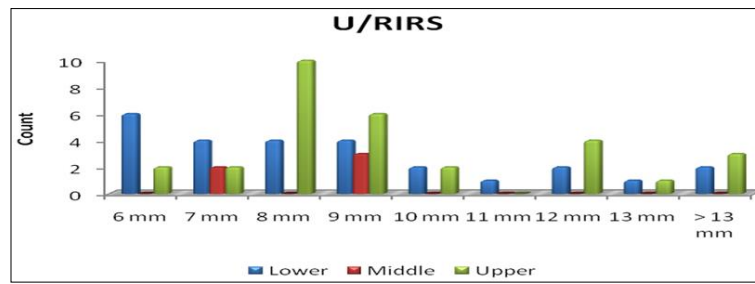


Table & Fig 4: Comparison of Ureteroscopic Management Depend Upon Size and Site of Ureteric Calculi in Study Population

		Stone size / mm									Total
		6 mm	7 mm	8 mm	9 mm	10 mm	11 mm	12 mm	13 mm	> 13 mm	
Site of stone impaction	Lower	6	4	4	4	2	1	2	1	2	26
	Middle	0	2	0	3	0	0	0	0	0	5
	Upper	2	2	10	6	2	0	4	1	3	30
Total		8	8	14	13	4	1	6	2	5	61

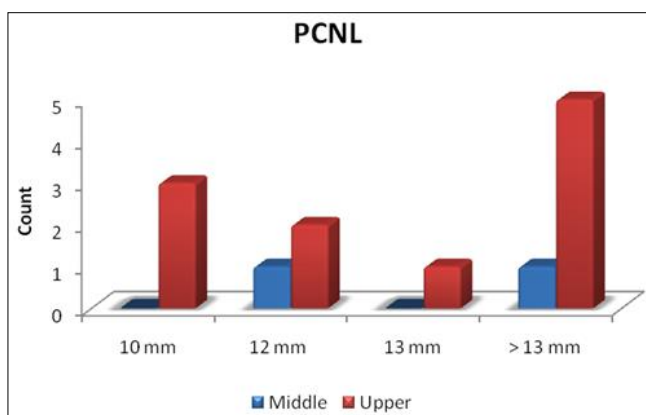


Table & Figure 5: Comparison of Pcnl Management Depend Upon Size and Site of Ureteric Calculi in Study Population

		Stone size / mm				Total
		10 mm	12 mm	13 mm	> 13 mm	
Site of stone impaction in ureter	Middle	0	1	0	1	2
	Upper	3	2	1	5	11
Total		3	3	1	6	13

Age

A total of 90 patients were included in this study. Of these, the maximum incidence of ureteric calculi appeared in the age group of 41 to 60 yrs, age group(41.1%), with a mean age of 45.7. Several authors have reported 20 to 50 yrs age as the period of maximum incidence of urinary calculi. 19 However, in the study conducted by Romero and colleagues in countries like Japan and the USA, the age at peak incidence was higher, i.e. around 40-49 years [25]. 3 cases are paediatric patients

Sex

Of the 90 patients, 68.9% were male. The sex incidence ratio for male: female is 2.2:1. Similar study results are seen in a study conducted by Knoll *et al* [26], which observed a 2.7:1 male-to-female ratio for the most common calcium-containing calculi. Scales *et al* [27], have observed an incidence and have reported sex incidence from 1.7:1 to 1.3:1 male-to-female ratio between 1997 to 2002. In other developing countries, the male-to-female ratio range from 1.6:1 in Thailand and 1.15:1 in Iran [28, 29], 5:1 in Saudi Arabia and 2.5:1 in Iraq.

Clinical Presentation

78.9% of patients presented with colicky abdominal pain, which is the commonest symptom in ureteric calculi.

Site Distribution

Of 90 patients, more than half were present 46(51.2%) with calculi in the upper ureter including pelviureteric junction, which is explained by its narrowest part of the ureter. However, Song and colleagues [30], found that 46.3%, stones were located at the ureterovesical junction (UVJ), 30.5% in the proximal ureter and 16.8% of stones in the distal ureter. Conversely, Baker and colleagues [25] have observed a significant predominance of lower ureteral stones with 63% in the distal ureter and 87% at the VUJ. Similarly, a study from Nepal, also observed distal ureter to be the most common site of ureteric stone [31] Due to mean calculi size was 8mm, Upper ureteric calculi are most common in this study.

Sizedistribution

The majority of the stones were less than 1 cm in size (71%). Prstojevic *et al* [32] showed that the most common size of the calculi observed was 15 mm. This relatively low incidence of larger stones may probably be due to patients seeking medical attention immediately once they have developed pain. However, the mean stone size was 8mm, Song and colleagues [31] observed the mean size of the stones to be 4.87±3.49 mm. The largest stone in our series measured 20mm.

Side Distribution

A right sided 53% laterality was noted in this study population. Alshoabi SA [33] *et al* had similar finding.

Microbiological Content

11.1 % of individuals had positive urine cultures, mainly E. coli as a causative organism, which was sensitive to third generation cephalosporins like cefotaxime. Remaining organisms include Proteus, Klebsiella and Pseudomonas. The findings are similar to the study by Golechha and Solanki [34] wherein E-coli formed the major organism followed by Pseudomonas.

Investigation

Renal function tests are done in all patients. 17 patients had marginal elevation in renal parameters, 5 patients had renal failure associated with urosepsis for which emergency surgical intervention was done.

CT has 100% sensitivity and specificity compared to other investigation [35]. The test of choice at our institution for diagnosing an acute ureteric stone is USG or CT abdomen, which identifies site, size, and associated hydronephrosis. For 82.2% of patients, CT scans were done using primary imaging modality or following USG.

Treatment Distribution

14 in-patients (12.6%) were managed medically. Of them, 8 patients had stone sizes of 5mm or less. Lower ureteric stones were observed in 9 cases; middle ureteric calculi 2 cases, and in upper ureter 3 cases. 7 patients passed calculi spontaneously during in hospital stay after a variable observation period of 1 to 7 days. 5 out of 8 patients who had the stone size of 5mm or less in the lower ureter were passed spontaneously. Spontaneous stone passage rate was 62.5% which is comparable with the reports published by the authors of the 2007 AUA Ureteral Stone Guidelines, who showed that 68% of patients with < 5mm one passed spontaneously [36]. Ordon *et al* [37] have reported that 95% of ureteral stones 2 to 4 mm in size will pass spontaneously. 61 patients (67.7%) of patients underwent ureteroscopy. Among the 61 patients who underwent ureteroscopic stone removal, 26 patients were from the lower ureteric region; 5 patients from the middle ureteric region; and 30 patients from the upper ureteric region.

The maximum size of the stone that was removed by ureteroscopy was 20mm in size in the upper ureter removed with a flexible ureteroscope. Out of 10 upper ureteric calculi with calculi, more than 10mm, 7 were removed with flexible ureteroscope, tawfik *et al* [38] shows out of 29 patients 28 were easily assessed with flexible ureteroscope. Out of 35 lower ureteric calculi 9 were treated medically, and the rest 26 were treated with a ureteroscope. Ureteroscopic removal of stone for lower ureteric calculi is a preferred line of treatment than open surgical procedures. Among the 13 patients who underwent percutaneous nephrolithotomy or laparoscopic Ureterolithotomy, 11 patients [84.6%] had stones in the upper ureter, stone clearance rate of upper ureteric calculi 100% for study conducted by Murthy, N. Rama, *et al* [39]. The maximum size of the stone that was removed by laparoscopic surgery was 25mm in our study, whereas 47 mm in the study conducted by Guo-Liang Lu [40]. Out of 90 patients, 2 patients underwent laparoscopic Ureterolithotomy. Post operative periods were uneventful.

Median Hospital Stay

All patients stayed up to 3-7 days after endoscopic procedures, with a mean stay of 5.3 days. Similar observation was seen in a study conducted by Nguyen HD⁶⁷ with a mean hospital stay of 4.5days.

Sesionaldistribution

Most of the patients having ureteric calculi were in the month of may to july, which correlates with observation by Robertson

Conclusion

1. The peak age incidence of ureteric calculi was found in the age group of 41–60 years, and the male to female ratio was 2.2:1.
2. Right-sided laterality was noted in this study.
3. 71.1% of stones were less than 1 cm in size.
4. 11.1% of patients had positive urine cultures, with E.coli as a causative organism.
5. Colicky abdominal pain was the most common clinical presentation.
6. Most patients with ureteric calculi had normal renal function tests, as most were unilateral.
7. In our institution, CT was the primary method of diagnosing ureteric calculi.
8. A lower ureteric stone of 5 mm or less passed spontaneously at a rate of 62.5%. It is concluded that symptomatic management with observation is preferred in lower ureteric calculi with a stone size of 5 mm or less.
9. Ureteroscopic stone removal is the preferred line of management in patients with lower ureteric calculi of size more than 5mm.
10. Flexible ureteroscopy was preferred in upper ureteric calculi in our institution.
11. PCNL was the line of management for patients with large stone sizes (greater than 1 cm).

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