

Research Article

Epidemiology and chemical composition of upper urinary tract calculiMadhusudan A^{1*}, Mohammed Arif², Ashwin K. Hebbar³, Karthavya S L⁴^{1,3}Assistant Professor, ²Associate Professor, ⁴Intern, Department of General Surgery, Shimoga Institute of Medical Sciences, Shimoga, Karnataka, India***Corresponding author**

Dr A Madhusudan

Email: drmadhusudan.sims@gmail.com

Abstract: Urolithiasis is a world-wide problem, but the incidence differs depending upon geographical location, race, heredity, climate, congenital anomalies of urinary organs, inborn errors of metabolism, age, sex, etc. in India the incidence of urolithiasis is higher in northern states compared to that in southern states. The aim and objectives of the study were to evaluate the patient with upper urinary tract stones in terms of incidence, clinical presentation, age and sex distribution and to study various predisposing factors and chemical composition of upper urinary tract stones. The material for the clinical study of upper urinary tract stones was taken from the cases admitted to Department of General Surgery; Shimoga Institute of Medical Sciences, Shimoga in the period of April 2014 to March 2015. As a routine for the cases of upper urinary tract stones, the patients are subjected to physical examination, routine investigations and ultrasonography of the abdomen. The patients are then subjected to either forced diuresis or surgical procedures like pyelolithotomy or ureterolithotomy or nephrectomy depending upon the size and location of the calculus and extent of renal damage. The stones recovered are then subjected to chemical analysis. In the above mentioned period a total of 29 cases were evaluated and details of these cases were collected from medical records from the MRD, SIMS. The incidence of upper urinary tract stones in our study was 11 per 10,000 hospital admissions. The maximum incidence was observed in the third and fourth decades. The overall male to female ratio is 3.8:1. The incidence of upper urinary tract stone appeared to be high in rural population. Nearly 60% of patients consumed hard water and 75% of patients were non vegetarians. The commonest mode of presentation was loin pain (96.5%). Urinary tract infection was present in 41% of patients and commonest organism being E.coli. In stone analysis it was found that all the stones except one were mixed stones. Calcium (96.5%), phosphate (96.5%) and oxalate (86.2%) were the predominant radicals. One case of pure uric acid calculus was found. The incidence, clinical presentation, age and sex distribution found in this study compares fairly with other Indian series conducted earlier. Comparatively high incidence of urinary calculi in the agriculturists and manual workers reflects the environmental influence of high temperature found in this part of our study. Similarly a higher incidence is noted in rural population who consume mainly ground water which is usually hard in nature. Finally the chemical composition of stones found in this series of study is in concurrence with earlier Indian and western series with calcium, phosphate and oxalate being predominant radicals.

Keywords: Epidemiology, Urolithiasis, Pyelolithotomy.

INTRODUCTION

Urolithiasis is a common affliction of human population with a wide geographical variation. Anthropologic history provides evidence that urinary calculi existed as long as 7000 years ago and perhaps more. The specialty of urologic surgeons was even recognized by Hippocrates, who in his famous oath for physician stated, "I will not cut, even for the stone, but leave such procedures to the practitioners of the craft". In the last two decade there has been significant change in our understanding of causes of stone and its management.

The aim and objectives of the study were to evaluate the patient with upper urinary tract stones in terms of incidence, clinical presentation, age and sex

distribution and to study various predisposing factors and chemical composition of upper urinary tract stones.

MATERIALS AND METHODS

The material for the clinical study of upper urinary tract stones was taken from the cases admitted to Department of General Surgery; Shimoga Institute of Medical Sciences, Shimoga in the period of April 2014 to March 2015.

Source and methods of collection of the data

After admission a detailed clinical history and physical examination were conducted. Emphasis was laid on any previous history of prolonged immobilization, illness, urinary infection, previous operation or any instrumentation. A mid stream

specimen in male and catheter specimen from female were sent for urine routine examination and culture and sensitivity. Estimation of calcium in 24 hours urine was done. Routine blood examination, renal function test, serum calcium, phosphorous and serum uric acid were estimated. All patients were subjected to plain x-ray kidney urinary bladder region, intravenous pyelography and ultrasound examination of the abdomen. After all these investigations, in the preoperative period, patients were given treatment for correction of anaemia, avitaminosis, malnutrition and appropriate antibiotics were started as per urine culture and sensitivity report.

The patients were subjected to one of the following:

A. *Forced diuretic therapy*- This therapy was given to all patients who presented with acute ureteric colic. The patients were given about 2000 ml. of intravenous fluid in 2 hours duration followed by injection Lasix. Antispasmodic was administered before hydration therapy. The urine passed was collected and strained to retrieve stone. X-ray KUB and ultrasound abdomen were done after each trial to note the progress of stone.

B. *Operative procedures*- Depending upon the size and location of the calculus and extent of renal damage, the patients were subjected to pyelolithotomy or ureterolithotomy or nephrectomy. The stones recovered were subjected to chemical analysis after noting down their physical characteristics. The patients were given post-operative instructions depending upon the result of chemical analysis of calculus and any biochemical abnormality found by urine and blood analysis. The cases were followed up for varying length of time.

RESULTS

The incidence of upper urinary tract stones in our study was 11 per 10000 hospital admissions. Out of 29 cases, 21 were renal stones and 8 were ureteric stones. About 23% of renal calculi were bilateral (Table 1).

It was observed that the prevalence of urolithiasis was more in the rural population (17 out of

29 cases) as compared to urban population (12 out of 29 cases). The ratio being 3:2 and out of 29 cases studied, 23 were males and only 6 were females (Table 2).

The maximum incidence in our study was observed in 3rd and 4th decades and about 55.5% of patients fall in this age group (Table 3).

The highest incidence was seen among agriculturists (37.9%) and Daily Wagers (20.70%) (Table 4 & Fig. 1).

Stone formation was more common in people using hard water (58.62%) and more than 75% of patients were non vegetarian in our study. Non vegetarian diet is rich in animal protein and calcium.

In our study loin pain was the most presenting feature with more than 95% of patients. Gross hematuria was present in only 7% of patients; however microscopic hematuria was present in 27.6 % (Table 5).

Positive urine cultures were detected in 12 cases (41.38%). Commonest organism was E. coli (6 cases) followed by Klebsiella (2) and Psudomonas (2).

Blood urea was raised in 2 patients who presented with bilateral renal calculi. Serum calcium was high in one case (12.2mg %) but patient did not have features of hyperparathyroidism and serum paratharhormone was normal. Serum phosphate and serum uric acid were normal in all cases.

The chemical analysis of stone was done and the composition has been tabulated below. All stones except one were mixed stone. There was only one case of pure uric acid stone (Table 6).

It was found that calcium (96.5%), phosphate (96.5%), and oxalate (86.2%) were the predominant radicals (Table 7).

Mixed calcium, oxalate and phosphate stones were predominant in our series (31%). Struvite or triple phosphate stones were found in 3 cases (10%).

Table-1: Incidence based on site of calculi in upper urinary tract

Site	Unilateral		Bilateral	Total	Percentage
	R	L			
Renal	11	5	5	21	72.42
Ureteric	3	5		8	27.58
				N=29	100

Table-2: Sex incidence

Site	Male	Female	Ratio
Renal	17	4	4:1
Ureteric	6	2	3:1

Table-3: Age incidence

Age group	No. of cases	Percentage
1-10	2	6.90
11-20	5	17.20
21-30	7	24.50
31-40	9	31.00
41-50	4	13.80
51-60	2	6.90
Total	29	100

Table-4: Occupation.

Occupation	No. of cases	Percentage
Agriculture	11	37.90
Daily Wagers	6	20.70
House wife	4	13.80
Student	6	20.70
Vendor	1	3.40
Official	1	3.40
Total	29	100

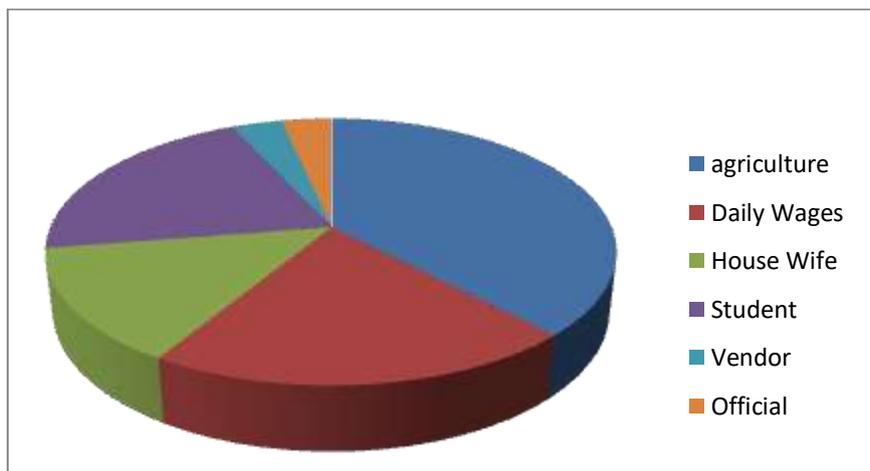


Fig-1: Occupation

Table- 5: Clinical features

Symptom	No. of cases	Percentage
Loin pain	28	96.60
Hematuria	2	6.90
Dysuria	5	17.20
Pyuria	3	10.30
Fever	4	13.80

Table-6: Stone analysis

Constituents	No. of cases	Percentage
Calcium oxalate phosphate	9	31
Calcium oxalate phosphate urate	7	24
Calcium oxalate phosphate carbonate	5	18
Calcium oxalate magnesium ammonium phosphate	4	14
Calcium magnesium ammonium phosphate	3	10
Uric acid	1	3
Total	29	100

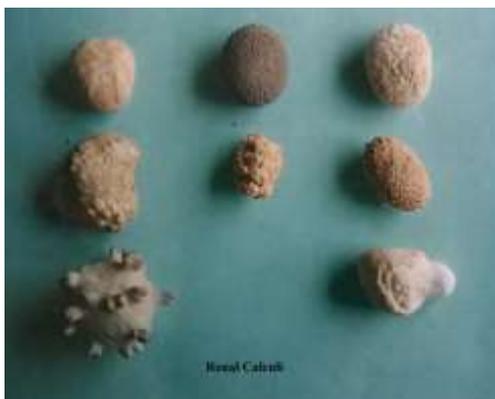


Fig-2: Renal Calculi

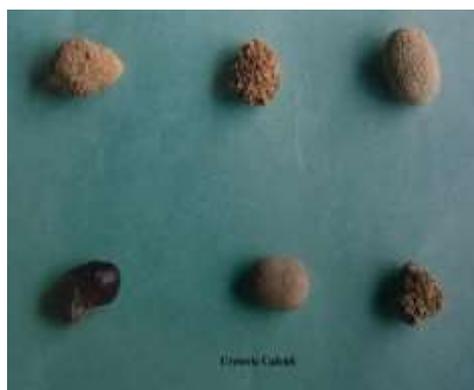


Fig-3: Ureteric Calculi

Table-7: Qualitative analysis of stones

Components	No. of cases	Percentage
Calcium	28	96.5
Phosphate	28	96.5
Oxalate	25	86.2
Urate	8	27
Magnesium	7	24
Ammonium	7	24
Carbonate	5	17.2

DISCUSSION

The incidence of urolithiasis varies in different parts of India. The highest incidence was found in Punjab and lowest in Southern India¹. Incidence and prevalence rates are mostly based on hospital admissions[2]. The average incidence of stone throughout India was estimated at 10 per 1, 00,000 population (Mc Carrison) [1]. The prevalence rate of

urolithiasis has been estimated to be about 15% in India[3, 4], 12% Pakistan[5, 6], 20% in Saudi Arabia[7], 7% in Japan[8, 9]. The incidence in our study was 11 per 10,000 hospital admissions and renal calculi predominated constituting 72% of total upper urinary lithiasis.

It is a disease of middle age. In our series the maximum incidence was found in the third and fourth decades and about 55% of patients fall in this age group. It is similar to the studies conducted by T V R K Rao et al [11] and D S Qaader et al [11]. It was observed in our study that nearly 80% of patients were males. Male/Female ratio is in concurrence with that of in series of T V R K Rao et al [10] and D S Qaader et al [11]. Welshman and McGeown [12] postulated that increased urinary citrate concentration in urine of females may aid in protecting females from calcium urolithiasis. Finlayson [13] postulated that lower serum testosterone levels may contribute to some of the protection that women enjoy against oxalate stone diseases.

In the present study the prevalence is more in the rural population (58.62%) as compared to urban population (41.38%), the ratio being 3:2. We found in our study that the incidence in agriculturists was 37.90% and in daily wagers 20.70%. A study conducted by Patel- Parulben [14] in Saurashtra region states that 49% of patients were farmers and daily wagers. The higher incidence is probably because of prolonged exposure to hard labour outdoors leading to low urine volume and concentrated urine formation which is prone for stone formation.

Stone formation was more common in people using hard water for drinking (59.62%). More than 75% of patients were non-vegetarians in our study. Non-vegetarian diet is rich in animal protein which predisposes to stone formation [15]. PN Rao et al [16] found that dietary advice to increase consumption of fiber, to reduce sugar and animal protein result in significant reduction of urinary excretion of oxalate, calcium and uric acid.

The classic presentation of renal colic is excruciating unilateral flank or lower abdominal pain of sudden onset [17]. In our study loin pain was the presenting feature in more than 95% of the patients. Gross hematuria was present in only 7% of patients; however microscopic hematuria was present in 27.6%. About 17% of patients experienced dysuria and pyuria was noted in about 19% of patients.

Positive urine cultures were detected in 12 cases (41.38%). Commonest organism was *E.coli* (6 cases) followed by *Klebsiella* (2 cases), *Pseudomonas* (2 cases), *Proteus* (1 case) and *Staphylococci* (1 case). *Klebsiella*, *Pseudomonas*, *Proteus* and *Staphylococci* being urea splitting organisms produced alkaline urine and phosphatic calculi. Triple phosphate or struvite stones are often associated with urinary infection especially urea splitting bacteria [18, 19].

Chemical analysis of stone is of paramount importance in planning the treatment for patients and to prevent recurrence which may vary from 8% to 80%

[20]. Mixed calcium, oxalate and phosphate stones were predominant in our series (31%). Struvite or triple phosphate stones were found in three cases (10%). Prien et al. [21] reported an incidence of 34% for mixed calcium oxalate and phosphate stones, while Herring [22] noted 73%. Struvite stones were noted in 15% of cases of Prien's series and 9% of cases of Herring's series.

It was found that calcium (96.5%), phosphate (96.5%), and oxalate (86.2%) were the predominant radicals in our study. The variation in the incidence of component radicals of urinary calculi in different series is probably related to factors like geographical location of the patients, the dietary habits, environmental factors, water source and others.

CONCLUSION

The incidence, clinical presentation, age and sex distribution found in this study compares fairly with other Indian series conducted earlier. Comparatively high incidence of urinary calculi in the agriculturists and manual workers reflects the environmental influence of high temperature found in this part of our study. Similarly a higher incidence is noted in rural population who consume mainly ground water which is usually hard in nature. Finally the chemical composition of stones found in this series of study is in concurrence with earlier Indian and western series with calcium, phosphate and oxalate being predominant radicals.

REFERENCES

1. McCarrison RA; Lecture on the causation of stone in India. *Br Med J*, 1931; 4: 1009-15.
2. Rizvi SAH, Naqvi SA A, Hussain Z, Hashmi A, Hussain M, Zafar M, *et al*; The management of stone disease. *BJU International*, 2002; 89(1): 62-68.
3. Robertson WG; In Hussain I ed; Urolithiasis. Epidemiology and pathogenesis in Tropical Urology and Renal Diseases. London: Churchill Livingstone, 1984; 143-64.
4. Jayadevan S, Marickar YMF, Pillai RN; Incidence and prevalence of urolithiasis in Kerala. *Urolithiasis*, 2000; 2:392-394.
5. Hussain M, Lal M, Ali B, Ahmed S, Zafar N, Naqvi SA, Adib-ul-Hassan RS; Management of urinary calculi associated with renal failure. *J.P.M.A. The Journal of the Pakistan Medical Association*, 1995; 45(8): 205-208.
6. Talati J; The management of lithiasis. Dordrecht. The Netherlands: Kluwer Academic Publishers. 1997: 21-33.
7. Abomelha MS, Al-Khader AA, Arnold J; Urolithiasis in Saudi Arabia. *Urology*, 1990; 35(1): 31-34.
8. Yoshida O, Terai A, Ohkawa T, Okada Y; National trend of the incidence of urolithiasis in Japan from 1965 to 1995. *Kidney international*, 1999; 56(5): 1899-1904.

9. Yamaguchi K, Ohkawa M, Orito M, Fuse H, Nakashima T, Tokunaga S, Hisazumi H; A clinical survey of urinary calculi in terms of stone compositions. *Nihon Jinzo Gakkai shi*, 1988; 30(4): 375.
10. Rao TVRK, Bano S, Das M; Epidemiology of Urolithiasis and chemical composition of urinary stones in Purnia Division of Bihar. *Indian Journal of Community Medicine*, 2006; 31(2):04-2006.
11. DS Qaader, SY Yousif1, LK Mahdi; Prevalence and etiology of urinary stones in hospitalized patients in Baghdad. *Eastern Mediterranean Health Journal*, 2006; 12(6): 853-861.
12. Welshman SG, McGeown MG; The relationship of the urinary cations, calcium, magnesium, sodium and potassium, in patients with renal calculi. *British journal of urology*, 1975; 47(3): 237-242.
13. Finlayson B; Symposium on renal lithiasis. *Renal lithiasis in review. Urol Clin North Am.*, 1974; 1:181-212.
14. Patel, Parulaben B; Analysis of Kidney Stones Prevalent in Saurashtra Region”, thesis PhD, Saurashtra University, 2012; 4.3.4 :07.
15. Robertson WG, Heyburn PJ, Peacock M, Hanes FA, Swaminathan R; The effect of high animal protein intake on the risk of calcium stone-formation in the urinary tract. *Clin Sci (Lond)*, 1979; 57(3): 285-88.
16. Rao PN, Gordon C, Davies D, Blacklock NJ; Are stone formers maladapted to refined carbohydrates? *Br J Urol*, 1982; 54: 575-7.
17. Andrew J, Portis, Chandru P, Sundaram; Diagnosis and Initial Management of Kidney Stones. *Am Fam Physician*. 2001; 63(7): 1329-1339.
18. Griffith DP, Osborne CA; Infection (urease) stones. *Mineral and electrolyte metabolism*, 1987; 13: 278-85.
19. Thompson RP, Stamey TA; Bacteriology of infected stones. *Urology*, 1973; 2(6): 627-33.
20. Smith LH; Symposium on renal lithiasis. Medical evaluation of urolithiasis. Etiologic aspects and diagnostic evaluation. *The Urologic Clinics of North America*, 1974; 1(2): 241.
21. Prien EL; Composition and structure of urinary stone. *The American journal of medicine*, 1968; 45(5):654-672.
22. Herring LC; Observations on their analysis of 10,000 urinary calculi. *The journal of urol*, 1962; 4: 545-562.