

Original Research Article

A clinical study on radiolucent (uric acid) stones in tertiary care centre

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Abstract

Background: Uric acid nephrolithiasis is characteristically a manifestation of a systemic metabolic disorder. It has a prevalence of about 10% among all stone formers, the third most common type of kidney stone. Uric acid stones form primarily due to an unduly acid urine; less deciding factors are hyperuricosuria and a low urine volume.

Aim and objectives: To study and analyze the age and sex distribution of uric acid urolithiasis, to study and identify the predisposing and causative factors and treatment of uric acid urolithiasis.

Methods and materials: The materials for the clinical study on radiolucent (uric acid) stones were selected from the cases presenting with pain in loin attended to urology department in King George Hospital, Visakhapatnam from October 2015 to December 2017. The selection of cases was based on clinical symptoms and radiological findings. The number of cases studied was 50. A detailed history, physical examination, blood and urinary examination were done. X-ray KUB, ultrasound KUB, plain CT KUB was done. Patients were treated either medically or surgically depending upon their condition.

Results: Out of the 50 patients enrolled, there were 36(72%) male and 14 (28%) female patients. Most of the patients (40%) were in the age group 41-50 years. Pain was the most common symptom (100%) followed by nausea and vomiting. Serum creatinine was normal in 84% of cases. Serum uric acid and Serum electrolytes were normal in all the 50 patients. Urine volume was normal (> 2 litres/24 hrs) in 44% of cases. Urine pH was < 5.5 in 92% and urine uric acid is normal in 100% of cases. In the present study, out of 50 patients, 38(76%) were managed conservatively with potassium citrate and 12 patients were treated with various surgical interventions.

Conclusions: Uric acid calculi are more common in men (M: F ratio 2.5:1). Uric acid calculi are caused mostly due to low urinary pH and low urine volume. Type 2 diabetes mellitus and high body

mass index (BMI) are independent risk factors for uric acid stones. Most of the uric acid calculi can be treated conservatively with potassium citrate (30-40 meq/day) in two divided doses.

Key words

Body mass index, Potassium citrate, Uric acid calculi, Urine pH.

Introduction

The vast majority of uric acid stone formers have the metabolic syndrome, and not infrequently, clinical gout is present as well. A universal finding is a low baseline urine pH plus insufficient production of urinary ammonium buffer. Pure uric acid stones are radiolucent but well visualized on renal ultrasound. A 24 hours urine collection for stone risk analysis provides essential insight into the pathophysiology of stone formation and may guide therapy. Management includes a liberal fluid intake and dietary modification.

Materials and methods

The materials for the clinical study on radiolucent (uric acid) stones were selected from the cases presenting with pain in loin attended to Urology Department in King George Hospital, Visakhapatnam from October 2015 to December 2017. The selection of cases was based on clinical symptoms and radiological findings.

Inclusion criteria

- All symptomatic uric acid calculi with radiological/sonographic confirmation.

Exclusion criteria

- Patients < 20 years of age.
- Pregnant women with urolithiasis.

The number of cases studied was 50. A detailed history, physical examination, blood and urinary examination were done. X-ray KUB, ultrasound KUB, plain CT KUB were done. Case history was recorded in detail as per the proforma and salient features and summary of cases were recorded. A note was recorded regarding the previous history of renal calculi. General physical examination was done and then detailed systemic examination was done and signs

observed were recorded in proforma sheets. The following investigations were done:

Blood

Complete blood picture was done. Serum creatinine, serum electrolytes, serum calcium, serum phosphorus, serum uric acid were done.

Urine

A clean specimen of urine (mid-stream in males and catheter specimen in females) were sent for microscopic and macroscopic examinations. 24 hours urine volume, urine pH, 24 hours urine calcium and 24 hours urine uric acid were done.

Radiological

A routine ultrasound KUB, X- ray KUB was done. The presence of calculus was confirmed by plain CT KUB.

Treatment

The patients were treated conservatively with potassium citrate (30 – 40 meq/day in two divided doses).

In cases in which there is severe obstruction, progressive azotemia, serious infection, unremitting pain, patient noncompliance or intolerance of prescribed medication was managed with surgical intervention.

Results

A total of 50 patients who were fulfilling the study parameters were enrolled in the study between October 2015 and December 2017 in a tertiary care centre.

In the present study, the following variables were studied and results were obtained. There were 36(72%) male and 14 (28%) female patients enrolled in the present study. The male to female ratio was 2.5:1 (**Table – 1**).

The mean age of presentation was 43 years. The youngest patient was 26 years and the oldest was

68 years. 5 patients were between 21-30 years, 13 patients between 31-40 years, 20 were between 41-50 years, 8 were between 51-60 years and 4 were > 60 years old (Table – 2).

Table - 1: Gender distribution.

Gender	Number	Percentage
Male	36	72%
Female	14	28%

Table - 2: Age distribution.

Age (in years)	Number	Percentage
21-30	5	10%
31-40	13	26%
41-50	20	40%
51-60	8	16%
>60	4	8%

Table – 3: Diet.

Diet	Number	Percentage
Veg	2	4%
Mixed	48	96%

Table - 4: Symptoms.

Symptom	Number	%
Pain	50	100%
Nausea	27	54%
Vomiting	19	38%
Burning micturition	18	36%
Hematuria	3	6%
Fever	2	4%

Table - 5: Random blood sugar.

RBS	Number	Percentage
<140 mg/dl	31	62%
>140 mg/dl	19	38%

Table - 6: Serum Calcium- Normal range: 8.5 – 10.2 mg/dl

S. Calcium	Number	Percentage
8.5-10.2	50	100%
>10.2	-	-

Out of the 50 patients enrolled for the study, 48(96%) were of mixed diet and only 2(4%) were pure vegetarian (Table – 3).

Table - 7: Serum Phosphorus- Normal range: 2.5- 4.5 mg/dl

S. Phosphorus	Number	Phosphorus
2.5- 4.5	48	96%
>4.5	2	4%

Table - 8: Serum Uric acid- Normal range: 3.4- 7.2 mg/dl

Serum Uric acid	Number	%
3.4- 7.2	50	100%
>7.2	-	-

Table - 9: Serum Creatinine- Normal range 0.8 – 1.2 mg/dl

S. Creatinine	Number	%
0.8- 1.2	42	84%
>1.2	8	16%

Table - 10: Urine volume- Normal >2 lts/24 hrs

Urine volume	Number	%
> 2lts	22	44%
<2lis	28	56%

Table - 11: Urine pH

Urine pH	Number	%
<5.5	46	92%
>5.5	4	8%

Table - 12: Urine uric acid: Normal range 250- 750mg/24hrs

Urine uric acid	Number	%
250-750	50	100%
>750	-	-

Table - 13: Management of uric acid stones.

Management	Number	%
Conservative	38	76%
Surgery	12	24%

Table - 14: Studies comparing gender distribution.

Study	Male: Female ratio
J C Lieske, et al. [3]	2:1
M. Bouatia, et al. [4]	2.1:1
Present study	2.5:1

Table - 15: Age distribution.

Study	Mean age (years)
Qader DS, et al. [5]	38
Present study	43

Table - 16: Comparison of nausea and vomiting.

Study	Percentage
Evan AP, et al. [6]	50%
Present study	54%

Table - 17: Comparison of past history of urolithiasis.

Study	Percentage
Ljunghall S, et al. [7]	50%
Present study	58%

In the present study, the most common symptom observed was pain in abdomen which was present in all patients, the second most common symptom was nausea (54%) followed by vomiting (38%) and burning micturition (36%) as per **Table - 4**.

Table - 18: Mean range (mg/dl).

Study	S. Calcium	S. Phosphorus	S. Uric acid
Gyawali PR, et al. [10]	8.2	3.9	5.3
Dhananjay V. Bhale, et al. [11]	8.1	3.6	5.1
Present study	8.7	3.5	3.9

Table - 19: Mean values.

Study	Urine pH	24 hr uric acid
Sakhae K, et al. [12]	5.4	379
Pak CYC, et al. [13]	5.34	545
Present study	5.3	490

Urological investigations

In the present study the following urine tests were done.

- Urine volume (**Table – 10**).
- Urine pH (**Table – 11**).
- 24 hr uric acid (**Table – 12**).

In the present study, out of 50 patients, 24 hour urine output was < 2 lts in 28(56%) patients and >2 lts in 22(44%) patients.

In the present study only 4(8%) patients had urine pH >5.5 and the remaining 46(92%)

Blood investigations

In the present study the following blood investigations were done.

- Complete blood picture.
- Random blood sugar (**Table – 5**).
- Serum calcium (**Table – 6**).
- Serum phosphorus (**Table – 7**).
- Serum uric acid (**Table – 8**).
- Serum creatinine (**Table – 9**).
- Serum electrolytes.

Complete blood picture was done to rule out myeloproliferative disorders. Complete blood picture was normal in the present study. Serum electrolytes were within normal limits. The serum calcium levels were within normal limits. The serum uric acid levels were within normal limits. Only 2 patients out of 50 had serum phosphorus levels above normal range. Out of 50 patients, 8 patients had serum creatinine above normal range.

patients had urine pH <5.5. All the 50 patients had 24 hour urine uric acid within normal limits.

Radiological investigations

In the present study, the following radiological investigations were done

- X-ray KUB
- Ultrasound KUB
- Plain CT KUB

Ultrasound KUB was done on all patients who presented with loin pain. Out of 50 patients, none of the patients calculi were visible on X-ray

KUB as they are radiolucent. The presence of calculi was confirmed by plain CT KUB in all 50 patients.

Management

In the present study out of 50 patients, 38(76%) were managed conservatively with potassium citrate and 12 patients were treated with various surgical interventions (**Table – 13**).

Discussion

Uric acid stones form primarily due to an unduly acid urine; less deciding factors are hyperuricosuria and a low urine volume. The vast majority of uric acid stone formers have the metabolic syndrome, and not infrequently, clinical gout is present as well. Persons with gastrointestinal disorders, in particular chronic diarrhoea or ostomies, and patients with malignancies with a large tumour mass and high cell turnover comprise a less common but nevertheless important subset. The overall prevalence for stone disease has increased so has the frequency of uric acid stones. Persons older than 65 years of age are twice as likely to develop stones as younger persons [1]. Women have a lower rate of developing kidney stones in general, with a life-time incidence of roughly half that of men. The same applies to uric acid stones where prevalence in women is lower [2].

Pure uric acid stones are radiolucent but well visualized on renal ultrasound. A 24 hour urine collection for stone risk analysis provides essential insight into the pathophysiology of stone formation and may guide therapy. Management includes a liberal fluid intake and dietary modification. Potassium citrate to alkalinize the urine to a goal pH between 6 and 6.5 is essential, as undissociated uric acid deprotonates into its much more soluble urate form.

Gender

In the present study out of 50 patients, 72% of the patients were males and 28% were females, thus giving a male to female ratio of 2.5:1. Stone

disease typically affects males more commonly than females. Relative increase in females is due to modern day dietary habits and lifestyle. The male to female ratio in the present study is in comparison with JC Lieske, et al. study [3] and M. Bouatia, et al. study [4] as per **Table - 14**.

Age distribution

Age remains an important factor in presentation of uric acid calculi. In the present study total 50 patients were included and the mean age of presentation was 43 years. The present study was in comparison with Qaader DS, et al. study [5] as per **Table - 15**.

Symptoms

Pain:

In the present study all the diagnosed cases of uric acid calculi were included who presented with pain in loin hence the percentage of pain was 100%.

Nausea and vomiting

In the present study, nausea was seen in 54% of patients and vomiting was seen in 38 % of patients. The present study was in comparison with Evan AP, et al. study [6] as per **Table – 16**.

Past history of urolithiasis

In the present study, 58% of patients were having past history of urolithiasis. The present study was in comparison with Ljunghall S, et al. study [7] as per **Table - 17**.

Associated co morbidities

In the present study out of 50 patients enrolled for the study, 19(38%) were diabetic. In the present study out of 50 patients, 21(42%) were overweight and 6(12%) were obese.

Diabetes mellitus type 2 and high body mass index (BMI) are independent risk factors for uric acid stones. Urine pH is inversely related to body weight. Type 2 diabetes mellitus results in lower urine pH through impaired kidney ammoniogenesis, thus promoting uric acid stone formation. Central obesity is associated with a predisposition to metabolic syndrome and uric

acid stones. In the present study diabetes mellitus and high BMI are risk factors for uric acid stones in accordance with Cameron MA, et al. study [8] and Daudon M, et al. study [9].

Blood investigations

In the present study serum calcium, serum phosphorus, serum uric acid, serum creatinine, serum electrolytes were studied. The values are on higher side of normal range but not elevated.

The serum calcium, serum phosphorus, serum uric acid levels in the present study are in accordance with Gyawali PR, et al. study [10] and Dhananjay V. Bhale, et al. study [11] as per

Table - 18.

Urological investigations

In the present study the following urine tests are done.

- Urine volume.
- Urine pH.
- 24 hr uric acid.

In the present study, the mean urine pH was 5.3 and 24 hr uric acid was 490 mg/24hr which is in accordance with Sakhaee K, et al. study [12] and Pak CYC, et al. study [13] as per **Table - 19.**

Low urinary pH is the principle metabolic abnormality in patients with uric acid stones. It is the most important and most common cause of uric acid stone formation. Uric acid urolithiasis is usually associated with persistently low urine pH. Increased net acid excretion (NAE) and decrease in renal ammonium(NH₄⁺) is the principle defect. Abundant consumption of animal proteins with their acid load contributes to lowering urine pH.

Radiological investigations

In the present study, patients with pain in loin were evaluated with Ultrasound abdomen and the patients with calculi were further evaluated by X-ray KUB and plain CT KUB. On X-ray stones were not visible as they are radiolucent and all the patients were having calculi on

ultrasonography. The presence of calculi was confirmed by plain CT.

Non contrast CT is the radiological investigation of choice in diagnosis of uric acid calculi. The attenuation values of uric acid calculi are between 200-400 HU. Hounsfield units (HU) (200-400) and ratio of stone density to stone size (<80HU/mm) can suggest the presence of uric acid calculi. The importance of CT in diagnosis of uric acid calculi is in accordance with Resnick MI, et al. study [14] and Spencer BA, et al. study [15].

Ultrasound is particularly important in monitoring and follows up of patients under treatment.

Management

In the present study out of 50 patients, 38 (76%) were treated conservatively with medical management and 12(24%) were treated surgically. In the present study, 38 patients were treated conservatively with potassium citrate. Potassium citrate provides an alkali load. Its characteristic physiological response is a rise in urinary pH & partly to an increase in urine volume. This creates an environment less conducive to the crystallization of uric acid by increasing urinary pH & reducing the amount of undissociated uric acid. The conservative treatment of uric acid calculi in the present study is in accordance with Pak CYC, et al. study [16].

In cases in which there is severe obstruction, progressive azotemia, serious infection, unremitting pain, patient noncompliance or intolerance of prescribed medication was treated by surgical interventions. In the present study 6 patients were treated with DJ stenting, 4 patients by URSL and 2 patients with PCNL.

Conclusion

Uric acid calculi are more common in men (M: F ratio 2.5:1). Uric acid calculi are more common between 31- 40 years of age (mean age 43 years). Uric acid calculi are caused mostly due to low

urinary pH and low urine volume. Type 2 diabetes mellitus and high body mass index (BMI) are independent risk factors for uric acid stones. Most of the uric acid calculi can be treated conservatively with potassium citrate (30-40 meq/day) in two divided doses.

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