e-ISSN: 0975-1556, p-ISSN:2820-2643
Available online on www.ijpcr.com
International Journal of Pharmaceutical and Clinical Research 2024; 16(2); 241-246

Original Research Article

A Clinical Study on Radiolucent(Uric Acid) Stones in Tertiary Care Center

Maddala Sudarsana Rao[1], Rambabu Bala[2], Medavankala Prabhakara Rao[3], Mohammad Jahangir[4], P Shiva Prasad[5]

[1]Assistant Professor, Department of Urology, Andhra Medical College, Visakhapatnam
[2]Assistant Professor, Department of Urology, Andhra Medical College, Visakhapatnam
[3] Associate Professor, Department of Urology, Andhra Medical College, Visakhapatnam
[4]MCH Urology 2nd Year Resident, Department of Urology, Andhra Medical College, Visakhapatnam
[5]Senior Resident, Department of Urology, Andhra Medical College, Visakhapatnam

Received: 25-11-2023 / Revised: 23-12-2023 / Accepted: 18-1-2024
Corresponding Author: Dr. Mohammad Jahangir
Conflict of interest: Nil

Abstract:

Background: Uric acid, first recognized in 1776, is a component of bladder stones that is controlled by metabolism, kidney excretion, and synthesis. Acidic urine and metabolic syndrome are connected to an increased incidence of uric acid stones. The distribution of age and sex, predisposing factors, causal factors, and clinical presentation of uric acid urolithiasis are the main objectives of this study.

Methods and Material: A clinical study on radiolucent stones was conducted at King George Hospital, Visakhapatnam, from July 2021 to July 2023. Fifty cases with symptomatic uric acid calculi were selected based on clinical symptoms and radiological findings. Comprehensive assessments, including history, physical examination, blood and urinary tests, and radiological investigations, were conducted to gather thorough data on uric acid calculi.

Result: In this study, 72% of participants were male, while 28% were female, with a mean presentation age of 34.5 years. The prevalence of uric acid stones was directly linked to a high-protein diet, and the most frequently reported symptom was pain in the loin.

Conclusion: Uric acid calculi exhibit a higher prevalence in men (M: F ratio 5.5:1), typically occurring between 20-40 years (mean age 34.5 years). Low urine pH and volume contribute to their formation. The stones are more common in July to August. Management involves increased fluid intake, alkalinizing measures, preferably using potassium citrate, with or without bicarbonate. Conservative management proves effective for the majority of patients.

Keywords: Uric Acid Calculi, Radiolucent Stones, Urolithiasis.

Introduction

The term "lithic acid" was first used to describe the acidic composition of bladder stones in 1776 when Swedish chemist Scheele extracted uric acid (2,6,8-trioxypurine) from them. The somewhat water-insoluble uric acid produced by human purine nucleotide metabolism is widely distributed in bodily fluids. The rate of uric acid synthesis, the pace at which it is eliminated by the kidneys and gastrointestinal system, and metabolism all affect the amount of uric acid in the blood. The main cause of uric acid stones, the third most common type of kidney stone, is excessively acidic urine; hyperuricosuria and low urine volume also contribute. Uric acid urolithiasis is caused by circumstances that lower urine pH and high urinary uric acid. [1] It has been shown that the prevalence of uric acid stones is rising in line with obesity and metabolic syndrome.

Aciduria has both diet-dependent and diet-independent etiological variables. Most people with uric acid stones have metabolic syndrome, which is sometimes accompanied by clinical gout. Low baseline urine pH and insufficient production of urinary ammonium buffer are common observations. Insulin resistance is thought to prevent ammonia genesis and the excretion of ammonium, which increases the excretion of hydrogen ions in the urine with non-ammonia anions and lowers the pH of the urine. A less common but significant subgroup consists of people with gastrointestinal disorders, particularly those with ostomies or persistent diarrhoea, and cancer patients with a large tumour mass and rapid cell turnover. Uric acid crystal formation in the urinary system frequently presents as dysuria and haematuria and can take the form of crystalluria, stones, or blockage. [2]

Plain radiographs typically show no signs of pure uric acid stones. A stone attenuation of 200–600 HU (x) on a CT scan may indicate the presence of uric acid stones. Radiolucent pure uric acid stones can be observed on renal ultrasonography. A 24-hour urine collection for stone risk analysis is essential to understand the pathophysiology of stone development and may help guide therapy. Both the amount of fluid consumed, and the diet should be adjusted. One of the rare urinary tract stones that can both be successfully eliminated and avoided is uric acid stone.

Raising urine pH from 5.3 to 6.5 causes uric acid to become six times more soluble. Potassium citrate is required to alkalinize the urine to a target pH between 6.2 and 6.8 in order to effectively treat undissociated uric acid, which deprotonates into its significantly more soluble urate form. [3] By using potassium citrate, uric acid calculi can be kept from recurring.

Material and Methods

At King George Hospital in Visakhapatnam, a clinical trial on radiolucent stones was carried out between July 2021 and July 2023. Fifty patients with symptomatic uric acid calculi that were verified by radiographic and sonographic techniques were among the cases that were chosen based on clinical symptoms and radiological results. All of these instances were under the inclusion criteria, whereas patients under the age of 20 and urolithiasis-afflicted pregnant women were excluded. A thorough evaluation was carried out, which included a history, physical examination, blood and urine tests, radiological investigations (X-ray, ultrasound, and plain CT KUB), and a physical examination. In-depth case histories were recorded, prior renal calculi history was noted, and indicators were observed during systemic tests as part of the study. A comprehensive blood picture was performed, as well as serum creatinine, electrolytes, calcium, phosphorus, and uric acid levels. Urine tests measured the ph and volume. Radiological evaluations were carried out, including standard ultrasound and X-ray KUBs, and calculus confirmation was done using simple CT KUB. This comprehensive investigation included a variety of clinical and radiographic tests for a full knowledge of the patients in order to collect comprehensive data on radiolucent stones, with a focus on uric acid calculi.

Results

Table 1: Sociodemographic and dietary pattern of the study population.

	Number	Percentage (%)
Gender		
Male	36	72
Female	14	28
Age(years)		
20-30	26	50
30-40	15	30
40-50	4	8
50-60	3	6
>60	3	6
Diet		
Vegetarian	2	4
Mixed	48	96

The table reflects the distribution of participant demographics and diets. Participants made up 72% men and 28% women. Participants' ages ranged from 20 to 30 years old for 50% of them, 30 to 40 years old for 30%, 40 to 50 years old for 8%, and 50 to 60 years old and over for 6% of them. Merely 4% of the population consumed a vegetarian diet, whilst 96% consumed a mixed diet. This data enables a more thorough understanding of the sample attributes by providing details about the dietary composition, age, and gender of the study participants.

Table 2: Symptoms presented by the study population at the time of admission.

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

Participants' symptom prevalence is shown in the table. All 50 individuals reported experiencing

pain, which was the most prevalent complaint overall. Of the individuals, 38% had vomiting, 36% had burning micturition, 6% had haematuria, and 4% had fever. Of these, 54% had nausea. As pain being the most frequently expressed symptom and other symptoms ranging in frequency, this data provides a thorough study of the symptoms experienced by the research participants.

Table 3: Distribution of Serum Biochemical Parameters Among Study Participants with Urolithiasis.

Parameters(mg/dl)	Number	Percentage
Serum Calcium		
8.5-10.2(Normal)	50	100
>10.2	-	-
Serum Phosphorus		
2.5-4.5(Normal)	48	96
>4.5	2	4
Serum Uric Acid		
3.5-7.2 (Normal)	50	100
>7.2	-	-
Serum Creatinine		
0.8-1.2 mg/dL (Normal)	42	84
>1.2mg/dl	8	16

A complete blood picture was done rule out leukemia and polycythemia. Complete blood picture is normal in the present study.

This table shows how serum biochemical parameters are distributed among urolithiasis patients. The parameters tested include serum calcium, serum phosphorus, serum uric acid, and serum creatinine. Every parameter has two categories: normal and increased ranges. The table shows the proportion of each category together with the number of participants.

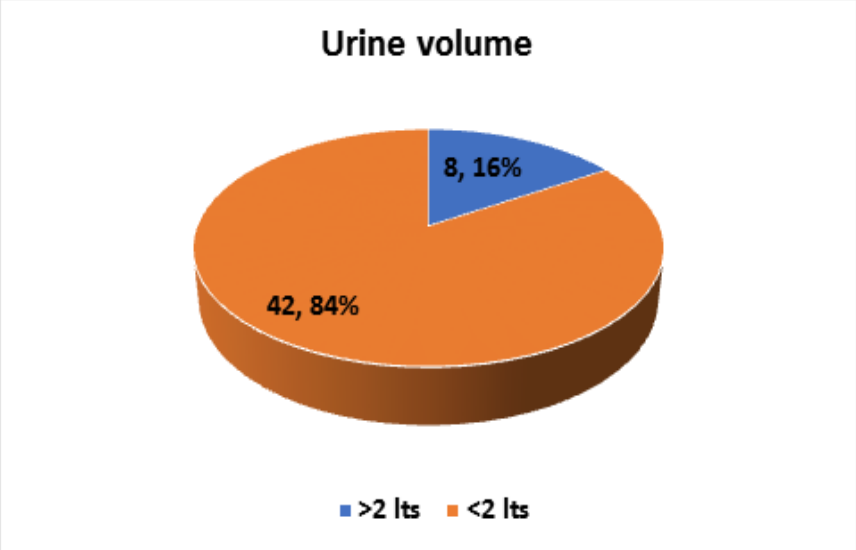
Serum Calcium: All 50 participants had values within the normal range (8.5-10.2 mg/dL).

Serum Phosphorus: Of the subjects, 2 (4%), had levels that were higher than normal (>4.5 mg/dL).

Serum Uric Acid: All 50 participants had normal values (3.5-7.2 mg/dL).

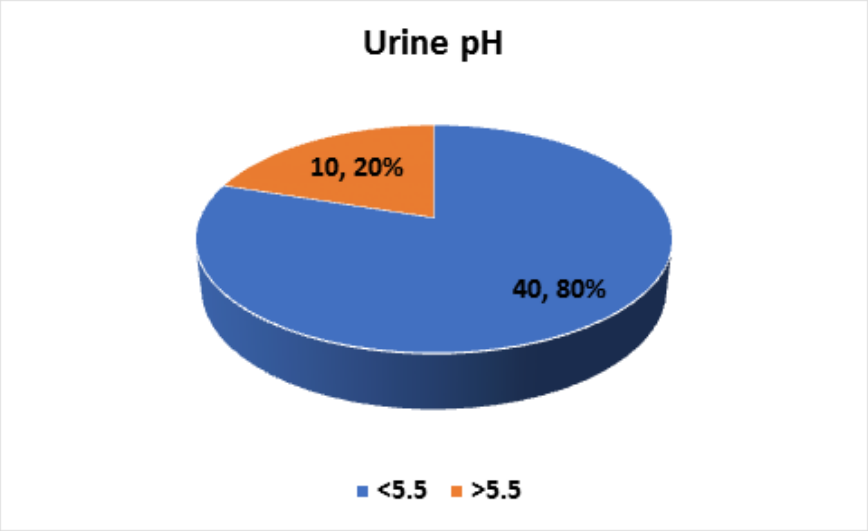
Serum creatinine: 8 subjects (16%) had high values (>1.2 mg/dL).

This information helps determine the biochemical profile of urolithiasis patients by illuminating the frequency of aberrant serum biochemical levels in the research population.



Graph 1: Distribution of Urine Volume Among Study Participants

This pie chart shows how urine volume is distributed among research participants. 84% (42 persons) of the total cases had urine volumes less than two litres, while 16% (8 people) had amounts greater than two litres.

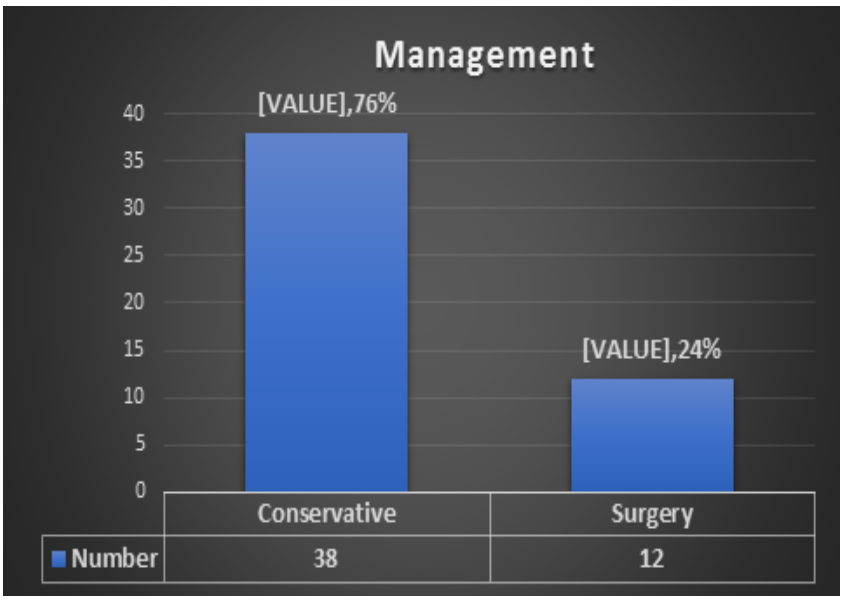


Graph 2: Distribution of Urine pH Among Study Participants

This pie chart displays the distribution of urine pH levels among study participants. Of the samples, the urine had a pH of less than 5.5 in 80% of the cases (40 people), and higher than 5.5 in 20% of the cases (10 people). With regard to renal physiology and the potential advancement of knowledge regarding the factors influencing urolithiasis in relation to urine acidity, this data presents a clear picture of the prevalence of both acidic and non-acidic urine conditions among research participants.

In this investigation, a variety of radiographic procedures were performed, such as plain CT KUB, ultrasonography, and X-rays. Every patient with loin pain had ultrasound KUB, but the calculi's radiolucency prevented X-ray KUB from displaying them.

The existence of calculi was confirmed by plain CT KUB images.



Graph 3: Distribution of Management Approaches Among Study Participants

The study participants' preferred courses of treatment are shown in the table, with 12 (24%) selecting surgical treatments and 38 (76%) selecting conservative therapy. This briefly describes the general tendency for the conditions under study to be treated with conservative methods rather than surgery.

Discussion

Male-to-female ratios were compared in various research, including Baker et al [4] (2.7:1), Lavan et al [5] (2.4:1), C Lieske et al [6] (2:1), and the current study (2.5:1). Within each research participant population, these ratios show the proportion of males to females. The information points to a pattern that is consistent throughout the research, with different ratios but an overall greater representation of men in the cohorts under study.

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

Typically Affects Males More Common-than females[7].

The mean age in years from several investigations, including this one (34.6), Gyawali et al. [8] (40), and Dhanajay V. Bhale et al. [9] (40.2), were compared. The average age of the studies varies, according to the data, with the current study's mean age being marginally lower than that of the other two studies that are cited.

Ageremains an important factor in the presentation of uric acid calculi. In the present study, a total of 50 patients were included and the mean age ofpresentationwas34.6years.

The primary determinant of uric acid stone development is nutrition, as the incidence of uric acid stones is closely correlated with a high-protein diet.

Higher uric acid pH and higher uric acid are caused by an animal protein-rich diet. 96% of participants in the current study had a diverse diet.

Additionally, Griffith HM et al. [10] and Safarine Jad MR et al. [11] concluded that a high-protein diet is directly linked to uric acid stones.

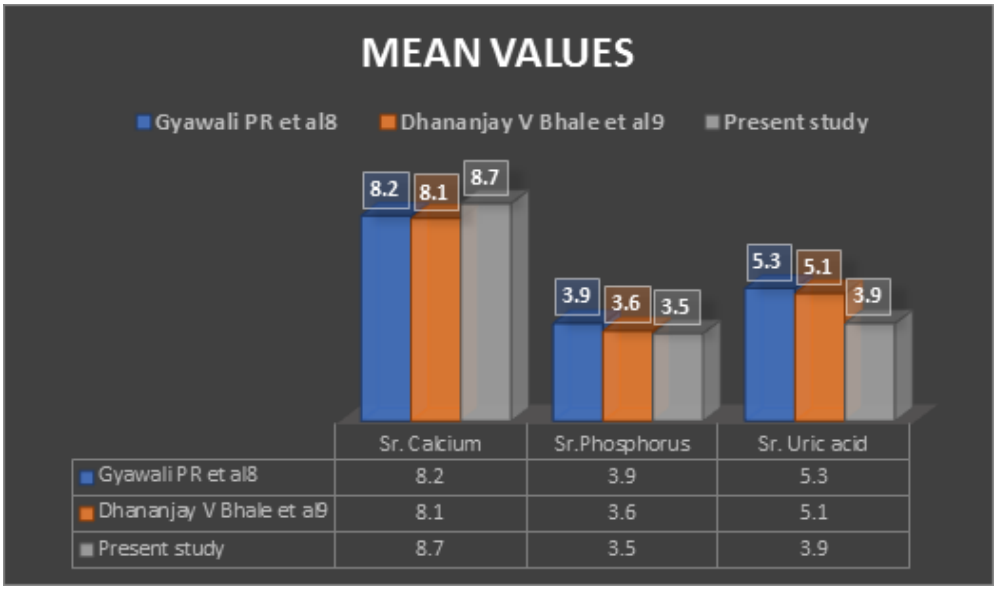
Most renal stones are asymptomatic, according to the literature. In the current investigation, all identified instances of renal colic had loin pain; as a result, 100% of the cases had pain.

The percentage values from three separate studies comparing symptoms like nausea and vomiting — the current study (54%), C Turk et al. [12] (50%), and Evan AP et al. [13] (50%)—are compared. The statistics demonstrate modest changes in percentage values among the research, with the current study having a slightly greater percentage than the referenced studies.

The prevalence of burning micturition is compared between the current study (36%) and Madhavi S et al. [14] (53.84) research. Within each study cohort, these percentage figures most likely indicate the frequency or occurrence of burning micturition as a symptom. In comparison to the current study, the findings point to a higher prevalence of burning micturition in the Madhavi S et al. [14] study.

Inthepresenstudy58%ofpatientswerehavingpasth/ourolithiasis. The percentages pertaining to prior medical history from three separate investigations are included: Moe OW et al [15] (50%), Ljunghall S et al [16] (50%), and this one (58%). These percentage figures most likely indicate the frequency of a particular past medical history or ailment among the participants in each study. The data points to differences in the studies' prevalence of prior medical history; the current study shows a little greater percentage than the studies that are cited.

In the present study serum calcium, serum phosphorus, serum uric acid, serum creatinine, and serum electrolytes were studied. The values areonthe higher side of the normal range but not elevated[17].



Graph 4: Comparison of Mean Serum Calcium, Phosphorus, and Uric Acid Levels in Different Studies

The serum calcium (sr. calcium), serum phosphorus (sr. phosphorus), serum uric acid (sr. uric acid), and mean values across three investigations are shown in the graph. The average levels of these biochemical parameters in the corresponding study groups are represented by these values. The data indicates differences in mean ranges amongst the studies; in comparison to the other cited research, the current study shows somewhat higher mean values for serum calcium and lower mean values for serum phosphorus and uric acid.

Conclusion

Males are more likely to develop uric acid calculi (M:F ratio: 5.5:1), which often manifest between the ages of 20 and 40, with a mean age of 34.5 years. Low urine volume and pH are the main causes, which encourage the formation of insoluble uric acid. Notably, July and August are when people see the stones more often. In order to maintain a specific urine pH range of 6 to 6.5, management options include increased fluid intake to augment urine volume and alkalinization, preferably with potassium citrate. For the majority of patients, conservative treatments that include these procedures work well. Comprehending the seasonal and demographic trends enhances clinical care for patients with uric acid calculi and informs customized preventive measures.

References

1. Balinsky JB. Phylogenetic aspects of purine metabolism. S Afr Med J. 1972;46(29):993-997.
2. Campbell JW. Comparative biochemistry of nitrogen metabolism. In: Campbell JW, editor. The vertebrates. New York: Academic Press; 1970;2.
3. Nevo A, Levi O, Sidi A, Tsivian A, Baniel J, Margel D, et al. Patients treated foruric acid stones reoccur more often and within a shorter interval compared to patients treated for calcium stones. Can Urol Assoc J. 2020 Nov; 14(11): E555–9.
4. Baker K, Costabile RA. Demographics, stone characteristic, and treatment of urinary calculi at the 47th Combat Support Hospital during the first 6 months of Operation Iraqi Freedom. Mil Med. 2007;172(5):498-503.
5. J. N. Lavan; F. C. Neale; S. Posen Med. J. Aust., 1971;2: 1049-1061
6. Lieske JC, de la Vega LS, Gettman MT, et al. Diabetes mellitus and the risk of urinary tract stones: a population-based case-control study. Am J Kidney Dis. 2006;48(6):897-904.
7. Kumari A, Dokwal S, Mittal P, Kumar R, Goel R, Bansal P, et al. An Increase Incidence in Uric Acid Nephrolithiasis: Changing Patterns. J Clin Diagn Res JCDR. 2016 Jul;10(7): BC01–3
8. Gyawali PR, Joshi BR et al. Correlation of calcium, phosphorous, uric acid and magnesium level in serum and 24 hours urine of patients with Urolithiasis. Kathmandu Univ Med J. 2011;34(2)54- 56.
9. Dhananjay V. Bhale, et al. Study of serum calcium, phosphorus & uric acid levels in patients of urinary calculi. International journal of recent trends in science & technology, 2013; 9(2): 189- 190.
10. Griffith HM, O'Shea B, Kevany JP, McCormick JS. A control study of dietary factors in renal stone formation. Br J Urol. 1981 Oct; 53(5):416–20.
11. Safarinejad MR. Adult urolithiasis in a population-based study in Iran: prevalence, incidence, and associated risk factors. Urol Res. 2007; 35(2):73–82.
12. Türk C, Neisius A, Petrik A, et al. Urolithiasis Guidelines [Internet]. European Association of Urology; 2018. Available at: http://uroweb.org/guideline/urolithiasis/
13. Evan AP, Worcester EM, Coe FL, Williams J Jr, Lingeman JE. Mechanisms of human kidney stone formation. Urolithiasis. 2015;43 Suppl 1(01):19-32.
14. Madhavi S, Prathyusha C, Rajender S. Relationship between crystalluria and urinary calculi and associated urinary tract infection. J Microbiol Biotechnol Res. 2012; 2:351-6.
15. Orson W Moe, Nicola Abate, Khashayar Sakhaee.
16. Pathophysiology of uric acid nephrolithiasis, Endocrinology and Metabolism Clinics of North America. 2002:31(4)895-914.
17. Ljunghall S, Danielson BG. A prospective study of renal stone recurrences. Br J Urol. 1984;56:122–24.
18. Sakhaee K. Epidemiology and Clinical Pathophysiology of Uric Acid Kidney Stones. J Nephrol. 2014 Jun;27(3):241–5.