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A Cross Sectional Study of Urolithiasis Patients Coming to a Rural Hospital of South-West Rajasthan

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Abstract

Introduction: Urolithiasis is a common clinical problem worldwide that involves stone formation in any portion of human urinary system by successive physicochemical events of super saturation, nucleation, aggregation and finally retention.[1] Climatic conditions, dietary habits, local geology and mineral hydrology are some of the very important factors leading to incidence of renal calculi in most of the countries. A number of these causes are modifiable, like causes related to dietary habits, life style diseases, fluid intake and hardness of consumable water. *Aims and Objectives:* Profiling of urolithiasis patient coming to a rural hospital in the South West Rajasthan, with a wide village outreach program in terms of demography, dietary habits, co-morbidities, hardness of consumed water, site of stone in urinary tract and complications related to it. The objective is to suggest measures for prevention and minimization of incidence and morbidity related to urolithiasis. *Material and Methods:* We studied 257 patients presenting to J. W. Global Hospital and Research Centre, Mount Abu, Sirohi, Rajasthan with urolithiasis during 18 months of period between September 2017 to March 2019. With their due informed consent; thorough physical examination with basic investigations (CBC, RBS, Serum Creatinine, Serum Calcium, Serum Acid, Urine examination, Abdomen Ultrasound, TDS of consumable water) done to evaluate causes of urolithiasis. Other specific investigations like urine culture and sensitivity, X-Ray KUB, CT Urogram, stone analysis etc. done on individual basis to reach definitive diagnosis. *Results:* Majority of the population was young with 55.2% of the patients between the ages of 18–50 years. Result showed male predominance; male and female patients were 61% and 39% respectively. Classical flank pain 57.2% and burning micturition 76.7% were the chief presenting complaints. 75.9% patients consumed less than 2.5 Litres/day water for drinking on most of the days. 51.8% consumed untreated ground water, while 48.2% consumed treated water either from government supply or water filter or after boiling the water. Water hardness, thus seems to work in association with other factors as a risk factor for urolithiasis. *Conclusion:* 75.9% patients consumed less than 2.5 litres water for drinking on most of the days; but drinking more than 2.5 litres of water per day couldn't save one fourth (24.1%) of our study population from contracting urolithiasis. Excessive water intake does not seem to save you always. About half of patients 51.8% consumed untreated ground water, while 48.2% patients consumed treated water either from Government supply or their own water filter or boiling the water before consumption. In spite of the fact that untreated ground water was high in TDS (78.9% samples found to be high in TDS) and those of treated water, including government supply (only 0.02% samples found to be high in TDS), the incidence of urolithiasis in the two groups is not significantly different, indicating that the source of water has little bearing on the incidence of urolithiasis. However, if we ignore the source of water, The TDS level of consumed water in 60.3% of our population was in the high range, while rest consumed soft water. Water hardness, thus seems to work in association with other factors as a risk factor for urolithiasis.

Keywords: Urolithiasis; Water Hardness Diet; Water Intake; South-West Rajasthan.

Introduction

Urolithiasis is a common clinical problem worldwide that involves stone formation in any portion of human urinary system (kidney, ureter and urinary bladder) by successive physicochemical events of super saturation, nucleation, aggregation and finally retention.[1] Men are more likely to have urolithiasis than women, with a risk ratio of 2:1, although this gap appears to be narrowing over time. The exact symptoms of urolithiasis depend on the location and size of the calculi in the urinary system. General signs and symptoms may include renal or ureteral colic, hematuria, urinary tract infection, abdominal pain. Climatic conditions, dietary habits, local geology and mineral hydrology are some of the very important factors leading to incidence of renal calculi in most of the countries. A number of these causes of urolithiasis may be modifiable.

Amongst the easily modifiable causes of urolithiasis there are causes related to dietary habits, causes related to life style diseases, fluid intake and hardness of consumable water. To reach correct diagnosis one need to choose appropriate diagnostic modality on basis of clinical examination and symptoms of patient. Through this study we will be able to interrelate the above assessed variables and thus possible recommendation, based on the findings can be made. It would help people and authorities to be aware of these modifiable causes so that the quality of life can be improved, and economic burden on the healthcare system and on the society can be reduced.

Materials and Methods

Study area: The study was done in J.W Global Hospital and Research Centre, Mount Abu, Rajasthan.

Study population: The targeted people were the patients coming to our hospital who were ultrasonographically proved to have urolithiasis. They were asked to participate in the study. This sample would represent the population of Southwest Rajasthan.

Sample Size and Sample technique: This was a prospective, observational, cross sectional study. The sample size was calculated according to the following formula: $n = \{Z^2*p*(1-p)\}/d^2$ where n = desired sample size, Z = standard error of the mean which corresponds to 95% confidence level (1.96), p=prevalence of condition being studied, d=precision with which p is determined (0.05). The minimum sample size according to above formula considering prevalence of 12% and CI of 95% is 163 patients.

Total 257 patients of all age groups were included in the study, who visited medical, surgical, pediatrics OPD and IPD in fulfillment of inclusion criteria and participated in study within research duration period of 18 months (September 2017 to March 2019).

Data collection technique and tools: Informed consent from the patient was taken. Permission was obtained from the ethical committee of the hospital. History taking and examination was done by the researcher himself with a uniform checklist. All the laboratory investigations were done in the hospital pathological laboratory. Ultrasound examination of the whole abdomen was done. X Ray KUB /IVP, CT Urogram, CT Pelvis in selected cases were done. Hardness of water (TDS in ppm) were measured by Aquapro digital water tester HM digital. Stones chemical composition analysis (in selected cases) done by FTIR (Fourier-transform infrared spectroscopy) from special laboratory which had a double layer quality check (Internal & External quality control).

Data analysis: The data was coded and entered into Microsoft Excel spreadsheet. Analysis was done using SPSS version 20 (IBM SPSS Statistics Inc., Chicago, Illinois, USA) Windows software program. The variables were assessed for normality using the Kolmogorov Smirnov test. Descriptive statistics included computation of percentages, means and standard deviations. The independent t test (for quantitative data within two groups) was used for comparison of all clinical indicators. Chi-square test used for qualitative data whenever two or more than two groups were used to compare. Level of significance was set at $P \leq 0.05$.

Results

Majority of the population was young 55.2% of the patients between the ages of 18–50 years. Male and Female urolithiasis patients were 61% and 39% respectively, showing male predominance. Classical flank pain 57.2% and burning micturition 76.7% were the chief presenting complaints of urolithiasis. 75.9% patients consumed less than 2.5 Litres/day water for drinking on most of the days. 51.8% consumed untreated ground water, while 48.2% consumed treated. Water hardness, thus seems to work in association with other factors

as a risk factor for urolithiasis.In spite of the fact that untreated ground water was high in TDS (78.9% samples found to be high in TDS) and those of treated water, including government supply (only 0.02% samples found to be high in TDS), the incidence of urolithiasis in these two groups is not significantly different, indicating that the source of water has little bearing on the incidence of urolithiasis.

Discussion

Mankind has been afflicted by Urolithiasis since centuries. Urolithiasis is a common clinical problem worldwide that involves stone formation in any portion of human urinary system (kidney, ureter and urinary bladder) by successive physicochemical events of supersaturation, nucleation, aggregation and finally retention.[1] It is one of the most painful of the urologic disorders, and it is proven to be an important cause of renal failure Urolithiasis is a global problem spanning all geographic regions with an estimated annual incidence of 1%, prevalence of 3–5% and a lifetime risk of 15–25%. Once afflicted, urolithiasis tends to be recurrent in the most of cases.[2] In Indian population, about 12% of them are expected to have urinary stones and out of which 50% may end up with loss of kidney functions.

In India, the "stones belt" comprises of parts of Gujarat, Rajasthan, Maharashtra, Punjab, Haryana, Delhi and states of north-east.[3–4] Pattern of urolithiasis in human population varies according to age, sex, geography, social status, genetic and environmental factors.[2]

Rajasthan is the largest state of India (342,239 km^2 wide) with total population of 6,85,48,437 and relatively low population density of 201 people/ km^2. According to physical geography, the southern western parts of the state are classified under the Peninsular Plateau. Aravalli mountain ranges break up districts of South Rajasthan. Udaipur, Chittorgarh, Dungarpur, Banswara, Rajsam and and Sirohi are districts of South zone of Rajasthan. Sirohi, Jalore, Barmer, Pali lies in the southwest Rajasthan. South Zone regions of Rajasthan is economically one of the poorest with 39% of state's tribal population.[5] Pendse et al.[6] had reported a high and progressively increasing incidence of urolithiasis in Udaipur and some other parts of Rajasthan in the western part of India.

More than four-fifth (82%) of our study population belongs to South West Rajasthan and nearly one-fifth (18%) of the study population belongs to places outside of South West Rajasthan. From South West Rajasthan 76% of study population belongs to Sirohi district. And from Sirohi district 84% of study population were from Abu road subdivision. Since our hospital is located at Mount Abu (Abu road subdivision) therefore, it attracts large population in and around Abu road area. This hospital also attracts a larger population of Brahma Kumaris who are staying at different Brahma Kumaris Ashrams across the world as this hospital is run by charitable trust of Brahma Kumaris.

Chief complaints of Urolithiasis

Classical flank pain 57.2% and burning micturition 76.7% were the chief presenting complaints of urolithiasis. Around 36.6% had dysuria, 36.6% had complaints of frequent urination and 31.9% had complains of fever/chills. There were symptoms of LUTS in 13.2%. Gross hematuria was complained by 9.7% patients. Other complains 26.8% including lower backache 9.7%, bloating 7% and heart burn 10.1% was present. There was only single patient 0.4% presented with complains of acute urinary retention. There was incidental finding of urolithiasis (Asymptomatic) in routine checkups of 7.4% patients.

Recurrence of Urolithiasis

In our studied population 70% were having the first urolithiasis episode. 30% were recurrent stone formers. Recurrence of urolithiasis after the first stone episode were 14%, 6%, and 10% within less than 5 years, between 5 to 10 years, and more than 10 years, respectively.

Risk Factors of urolithiasis

Non-Modifiable risk factors of urolithiasis:

Age wise distribution of patients with urolithiasis: In our study, urolithiasis was more common in young study population between the age group of 18–50 years (55.2%). Mean age of the patient was 44.24± 18.03.

Gender wise distribution of patients with urolithiasis: We observed male predominance in patients presenting with urolithiasis. In our study, ratio of male: female 1.5:1. Male patients were 60.7% and Female patients were 39.3%.

Heredity and Urolithiasis: In our studied population overall 53.3% patient's relatives i.e. 20.6% first degree relatives (one or more) and 32.7% second degree relatives (one or more) had history of urolithiasis anytime, in their lifetime. And 15.9% of family relatives i.e. first degree relatives (one or more) 5.4% and 10.5% second degree relatives (one or more) are currently having urolithiasis. That can be due to the same dietary habits, water consumed from the same source. Genetic predilection could also be a factor in these cases.

Modifiable risk factors of urolithiasis

BMI wise distribution of urolithiasis patients: In our study most of the patients 48.2% had normal BMI range.28.4% patients were underweight i.e. BMI<18.5; and about 23.4% patients were obese and pre-obese. These findings indicate that urolithiasis is as common in underweight and overweight group combined as it is in normal weight population.

History of past illness wise distribution: Recurrent UTI was present in 26.4% of our studied population. Hypertension in 20.6% and Diabetes in 16.3% were present. 8.9% and 3.9% had cardiac illness and chronic pulmonary disease respectively. Hypothyroidism and hyperthyroidism 3.5% and 0.8% were present in our studied population.7.7% had history of BPH. 7% had undergone genitourinary surgery in the past in view of urolithiasis. 5.1% had history of some congenital renal disease, medical renal disease or chronic kidney disease.

Focus on primordial, primary prevention of chronic illnesses like Recurrent UTI and Hypertension should be done as they add a significant morbidity and socioeconomic burden as complications of urolithiasis.

Socio-economic status

The role of occupation or education level in urolithiasis is still controversial. Some researchers found people with sedentary jobs (usually with high education level) are more prone to urolithiasis, however, others also demonstrate a positive relationship between urinary stones and people with more physical works (less educated).

Occupation: Majority of our studied population 40.8% were either staying at home/ashram or were housewives, 18.3% were working outdoors (farmers, labourers, village artisan). Another 40.9% study population were salaried / self-employed / students/unemployed. Large people were sedentary workers and few were physical workers.

Socio-economic class: In our studied population 50.9% were either primary educated (33.8%) or illiterate (17.1%). And An almost equal proportion were secondary educated (22.6%) and graduates (25.3%) were seen. Very few professionals (1.2%) participated. An equivalent amount of highly educated and formally educated was having urolithiasis.

In our studied population patients with less than ₹ 10000 per month income were 32.3%, between ₹ 10000–30000 income per month were 38.1%, between ₹ 30000–60000 income per month were 19.1% and few people 10.5%had income more than ₹ 60000 income/month.

Diet wise distribution: In our study we found that, majority of patients (67.7%) were vegetarian, 5.8% patients and 26.5% were taking non-vegetarian regularly (consuming more than 4 times in a week) and occasionally (consuming at least once in a week) respectively.

Personal Habits: In our studied populations 38.1%, 29.2% and 18.3% were chronic tobacco chewers, smokers and alcoholics respectively. 45.1% of patients use to drink more than 4 cups of tea per day on most of days. 24.1%patients preferred to add salt (one-fourth to half tablespoon or pinch of salt) over every cooked meal most of the days. Only 21% patients consumed fibrous diet at least once in their daily meal on most of the days. There were 0.8% patients using opioids regularly.

Fluid Intake: 24.1% in our studied population admitted that most of the days they consume water more than 2.5 litres per day. Whereas, 75.9% patients consumed less than 2.5 litres water for drinking on most of the days.

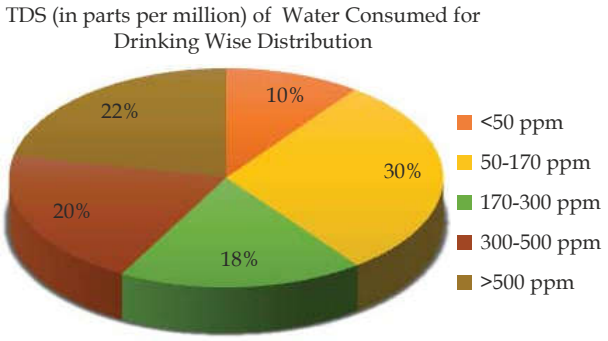
Drinking water source and hardness of drinking water consumed with urolithiasis

Hardness of water consumed for drinking:

Table 1: TDS (in parts per million) of water consumed for drinking by studied population wise distribution.

TDS of Water in parts per million	Frequency	Percentage
<50ppm	26	10.1
50–170ppm	76	29.6
170–300ppm	47	18.3
300–500ppm	52	20.2
>500ppm	56	21.8

Graph 1: TDS (in parts per million) of water consumed for drinking by studied population wise distribution.



□ig□ prevalence rate of urinary tract stone disease in people living in □ard water areas □as been reported by Mc□arrison□ D □arker and S Donnan[8] □ □ambal et al.□ and Teotia M et al.[10]□ w□ile J Jolly[11] and J Mates[12] reported increase correlation of stones and □ard water. □mong urolit□iasis patient in our study□□ardness of water (over marginally acceptable for drinking) and address wise distribution Pali s□ows a statistically signi□cant positive correlation (P value □0.05). w□ere as □ardness of water (over marginally acceptable for drinking) in people coming from □t□er region s□ows a negative correlation.

Relation of Hardness of water (over marginally acceptable drinking water i.e. >300ppm) and address wise distribution:

Table 2: □elation of □ardness of water (over marginally acceptable drinking water i.e. more t□an □00ppm)and address wise distribution.

Address	Hardness		Total	P value
	More than 300 ppm	Less than 300 ppm		
Siro□i	8□	10□	1□5	0.1□
Pali	□	0	□	0.0□(S)
Jalore	10	2	12	0.□5
□armer	1	0	1	0.0□
□t□ers	□	□2	□□	0.0□(S)

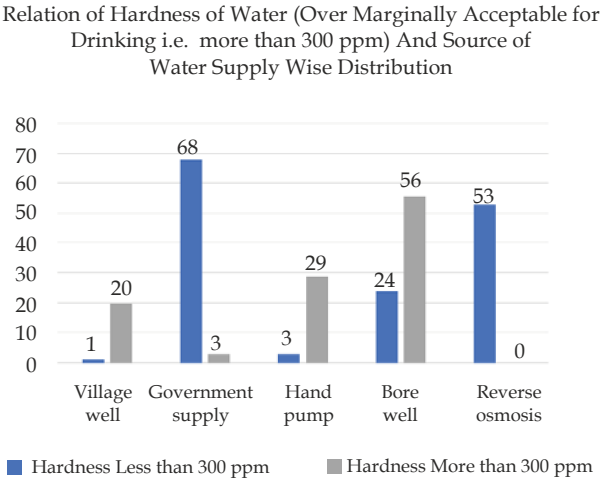
□mong urolit□iasispatient in our study□□ardness of water (over marginally acceptable for drinking) and source of supply wit□ □and pump□□ore well s□owsa statistically signi□cant positive correlation (P value □0.05). □□ereas □ardness of water (over marginally acceptable for drinking) wit□ □everse osmosis and □overnment supply s□owsa negative correlation. □ater □ardness seems to affect t□e incidence of urolit□iasis□ alt□oug□ marginally. Treated water □as been proved to reduce water TDS signi□cantly□it seems wise to motivate people to treat water before consumption.

Relation of Hardness of water (over marginally acceptable for drinking i.e. >300 ppm) and source of water supply:

Table 3: □elation of □ardness of water (over marginally acceptable for drinking i.e. more t□an □00ppm) and source of water supply.

Consumed Water Source	Hardness		Total	P value
	Less than 300 ppm	More than 300 ppm		
Village well	1	20	21	0.88
□overnment supply	□8	□	□1	0.001(S)
□and pump	□	2□	□2	0.0□(S)
□ore well	2□	5□	80	0.001(S)
□everse osmosis	5□	0	5□	0.001(S)

Graph 3: □elation of □ardness of water (over marginally acceptable for drinking i.e. more t□an □00ppm) and source of water supply wise distribution.



Serum Creatinine and Serum uric acid in our studied population: □ut of 25□ patients in our study□□□□ □ad serum uric acid wit□in normal range.21.0□ □ad serum uric acid levels more t□an t□e normal limits. □nly 2□ □adserum uric acid level less t□an t□e normal limits (i.e. 2.□□□.0mg/dlin female□ □.□□□mg/dln male).85.□□ patient □ad serum □reatinine level wit□in normal range and 1□.□□ □ad serum □reatinine level more t□an 1.2mg/dl.

Location of stones based on ultrasonography: In our studied population□2□□ patients □ad renal stones□out of w□ic□ 8□.2□ were unilateral and 1□.8□ □ad bilateral renal calculi. □ig□tkidney □ad 5□.1□ in w□ic□10.□□□2□.2□□1□.and 2.□□ were in rig□t kidney upper□middle□lower and pelvis respectively. T□ere were 1.□□ □aving stone in rig□tP□J□w□ereasin rig□tureter □□ were □aving stone. In left kidney overall □□.2□were □aving stones out of w□ic□ □.□□□□□.2□□25.□and □.□□ were in left kidney upper□middle□lower and pelvis respectively. T□ere were 1.□□ □aving stone in left P□J□w□ereasin left ureter □.2□were □avingstone. 1.□□ were □aving stone in urinary bladder and 0.8□ □adstone present in t□euret□ra.Inour studied population □□.2□□ad solitary stones. □□ereas at

least two stones at different sites of urinary tract were present in 13.2% and Multiple calculi were present in 22.6% patients.Most of the renal stones 81.7% were less than 5mm size, 19.1% and 8.9% were between the size of 5mm to 10mm and 10.1mm to 20mm respectively. 5.8% had stone size more than 20mm of size. 19.8% had hydronephrosis/ hydroureteronephrosis. 8.9% had hydronephrosis which were 3.5%, 5.1%, 0.4% in right kidney, left kidney and bilateral kidney respectively. Whereas 10.9% had hydroureteronephrosis which were 5.5%, 4.3%, 1.2% in right ureter, left ureter and bilateral ureter respectively.

Chemical Composition of Stone analysis done in studied population: 15 patients in studied population agreed to carry out stone analysis. Out of which 73.3% had chemical composition of Calcium Oxalate Monohidrate and Calcium Oxalate dihydrate stones. 13.3% of them had Calcium oxalate + Uric acid stones. 6.7% patient each had chemical composition of Calcium oxalate Apatite and Calcite +Apatite.

Management of Urolithiasis in our study population

In our studied population Almost 90% of urolithiasis patient diagnosed were conservatively managed. Around 10% undergone surgical management PCNL (5.8%), URS (2.7%) and Suprapubic (1.6%) Lithotripsy/Cystolithotomy.

Conclusion

53.3% patients had a relative suffering from urolithiasis. One in four of our patients had Recurrent UTI (26.4%) and one in five had Hypertension in our studied population. They add a significant morbidity and socioeconomic burden as complications of urolithiasis. 75.9% patients consumed less than 2.5 litres water for drinking on most of the days; but drinking more than 2.5 litres of water per day couldn't save one fourth (24.1%) of our study population from contracting urolithiasis. Excessive water intake does not seem to save you always. In our studied population, about half of patients 51.8%consumed untreated ground water, while 48.2% patients consumed treated water either from Government supply or water filter or boiling the water. In spite of the fact that untreated ground water was high in TDS (78.9% samples found to be high in TDS) and those of treated water, including government supply (only 0.02% samples found to be high in TDS), the incidence of urolithiasis in the two groups is not significantly different, indicating that the source of water has little bearing on the incidence of urolithiasis.However, if we ignore the source of water, The TDS level of consumed water in 60.3% of our population was in the high range, while rest consumed soft water. Water hardness, thus seems to work in association with other factors as a risk factor for urolithiasis.

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