

Types of Renal Stones and its Variation with Age and Gender in a University Hospital of Nepal

Joshi HN, Singh AK, Karmacharya RM

Department of Surgery
Dhulikhel Hospital, Kathmandu University Hospital
Kathmandu University School of Medical Sciences
Dhulikhel, Kavre, Nepal.

Corresponding Author

Hem Nath Joshi
Department of Surgery
Dhulikhel Hospital, Kathmandu University Hospital
Kathmandu University School of Medical Sciences
Dhulikhel, Kavre, Nepal.
E-mail: hemnjoshi@hotmail.com

Citation

Joshi HN, Singh AK, Karmacharya RM. Types of Renal Stones and its Variation with Age and Gender in a University Hospital of Nepal. *Kathmandu Univ Med J. Online First.*

ABSTRACT

Background

Types of renal stones have profoundly changed in the last half-century, parallel to the change in lifestyle and dietary habit, with an increase of calcium stones. Among many lithogenic factors age and gender are considered to be associated with the types of renal stones. Studies evaluating the influence of age and gender on the distribution of the types of urinary calculi are scarce in Nepal.

Objective

To explore the influence of age and gender on different types of urolithiasis.

Method

This is a single center prospective study encompassing urolithiasis during a study period of 18 months. All the stone retrieved from the patients after surgery were sent for biochemical analysis of the stone. The result was then compared with the age and gender of the study population.

Result

Calculi from a total of 107 patients were analyzed (62 from males and 45 from females). Mixed stones consisting of calcium oxalate and calcium phosphate were the predominant constituent in 74.16% of stones, followed by uric acid, struvite and cystine stones. We found predominance of Calcium stones in males (47.66%) vs 36.44% in females and predominance of struvite stones in females (7.47%) vs 3.73% in males. Age group of 21-40 years has the main burden of stone.

Conclusion

Being aware and having better knowledge of risk factors, composition and correlation with age and gender can provide personalized guidance to prevention and avoid recurrence of urolithiasis.

KEY WORDS

Renal stones, Urolithiasis, Urinary Calculi

INTRODUCTION

Urinary tract stone disease is one of the most frequent events that probably affects the population in all countries. However, the probability of forming stones considerably differs in various parts of the world. It ranges from 1-5% in Asia, 5-9% in Europe, 13% in North America to 20% in Saudi Arabia.^{1,2} Incidence and prevalence rate has been higher in developed countries and the trend seems to be increasing in developing countries.³ The differences among countries reflect several lithogenic factors which includes age, gender, dietary habits, fluid intake, climate, occupation, socio-economic status, genetic and metabolic diseases.⁴ Due to this continuous changes in these lithogenic factors, the relationship between frequency, age, sex and composition can also change with time.

Accordingly, stone composition has changed in time from predominantly urate and phosphate to calcium oxalate (CaOx) now as the main component of 60-80% of stones. (5) The number of stone formers in females are increasing in the past decades but the male: female ratio still remains high.⁵ Presently, CaOx and uric acid (UA) stones are more frequent in males than in females, whereas calcium phosphate (CaPO₄) and struvite stones are more prevalent in females.⁷ However, only few reports to date have considered the relationship between stone composition and patient's age. In an older study done in 1997 stone disease was more common in age group of 20-40 years with calcium oxalate and or calcium phosphate being the most common stone types.⁸ A recent study of Daudon et al. analyzes the changes in stone composition according to age and gender of patients in France.⁵ In this paper the variation of types of stone in relation to age and gender has been reported and is the basis for our study in the context of Nepal.

METHODS

This is a prospective study conducted at the Dhulikhel Hospital, Kathmandu University Teaching hospital of Nepal for the duration of 18 months from July 2016 to January 2018. During this study period 389 patients were operated for urolithiasis. Out of 389 patients, those who gave consent for stone analysis and in those cases where the adequate sample could be collected for analysis were included in the study. Total of 107 patients were eligible for the study. Bladder stones were excluded from the study.

All stones collected were analyzed at the department of Biochemistry following their standardized technique and the patient was given a structured proforma to fill in order to know the socio-demographic status, significant medical history, complaints and also the comorbid condition presented at the time of examination.

The data was entered in SPSS version 25.0 and analyzed. Age grouping was done as follows: less than 20 years, 21-

40 years, 41-60 years and more than 60 years. Age in years was analyzed as mean and range. Chi-squared tests and ANOVA were used to assess the effects of Gender and Age group on stone type. For level of significance p value less than 0.05 was considered.

RESULTS

There were 107 patients who agreed for stone analysis following procedure for urolithiasis. There was male predominance with male: female ratio was 1.3:1. The mean age of the participant was 38.94 ± 14.01. The demographic details of the participants are mentioned in table 1. The majority of the stones were mixed type. Calcium oxalate (CaOx) and calcium phosphate (CaPO₄) (n=80) were the most common followed by uric acid stones (n=13). This was followed by struvite stones (n=12) and cystine stones (n=2). While seeing the variation of types of stones in different gender, we found out of 80 mixed stones; 63.75% were in male and 43.25% were in female. Among uric acid stones, 53.84% were in males and remaining 46.16% were in females. Similarly, 66.66% of struvite stones were in females and 33.33% were in males. All the cystine stones were in females (fig. 1).

Table 1. Demographic Details of the Participants

Variables	Study n (% Distribution)	Others	
Gender	Male	62 (57.95%)	M: F=1.3:1
	Female	45 (42.05%)	
Age	<20 Years	7 (6.54%)	Mean Age 28.94 SD:14.01 Range: 4-89 Years
	21-40 Years	58 (54.20%)	
	41-60 Years	36 (33.60%)	
	>60 Years	6 (5.60%)	
Diet	Preferably Non-vegetarian	95 (88.70%)	
	Vegetarian	12 (11.30%)	

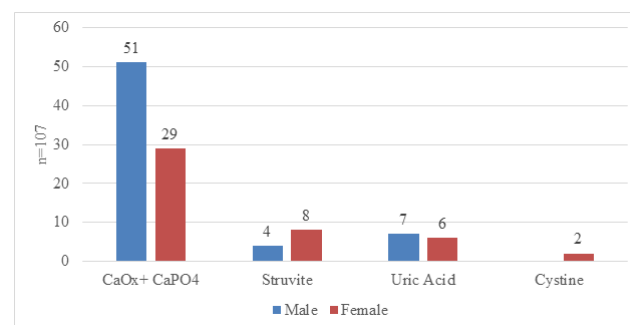


Figure 1. Different types of stone and its variation with Gender

There was a positive association between gender and mixed stones. There was a strong predilection of male and CaOx + CaPO₄ stones (p=0.036) (table 2). However, there was no association of gender with any other types of stones in this study (table 3). Most common age group was 21-40 years (54.20%) followed by 40-60 years (33.64%) of age. However there seem to be no correlation with age and types of stone (table 3 and 4).

Table 2. Correlation of Gender with Types of Urolithiasis

Variables	Male	Female	P Value
CaOx + CaPO ₄	51	29	0.036
Struvite Stone	4	8	0.067
Uric Acid Stone	7	6	0.749
Cystine Stone	0	2	0.175*

*Fischer Exact Test Applied;
Significant α is p<0.05

Table 3. Types of Renal Stone and its Variation with Age

		CaOx+CaPO ₄	Struvite	Uric Acid	Cystine	
Age	less than20	5	1	1	0	7
	21-40	43	6	8	1	58
	41-60	27	4	4	1	36
	> 60	5	1	0	0	6
	Total	80	12	13	2	107

Table 4. Types of Renal Stone and its correlation with Mean Age

S. N	Types of Stone	Mean Age	P (Significance α)
1	CaOx + CaPO ₄	39.80	p=0.956
2	Uric Acid Stone	35.62	
3	Struvite Stone	36.83	
4	Cystine Stone	39.00	

DISCUSSION

In Nepalese patients, urolithiasis is more common in males. This has been reported in many other studies and also supported by our study.⁸⁻¹⁰ We found the male to female ratio was 1.3:1. Contrary to this, a study done in Nepal by Koirala found female population to have more stones than in male.¹¹ However, this study had sampling bias and was not a comparative cohort study. Stapleton, F.B in 2002 stated that the stones are more common in men than women because of large muscular mass in comparison to females.¹² However the female stone formers are increasing so rapidly that the male: female ratio once was 3:1 which has now decreased to 1.3:1.¹³ The mean age of participants were 38.94 ± 14.01, range 4-89 years. In our study the most common age group of stone formers are 21-40 years of age. It accounts for around 54.20% of all participants. The least was in less than 20 years and more than 60 years of age. Study done by Khan et al. in 2013 also had similar findings where they found the majority of

stone formers were of 21-40 years of age (65.80%).¹⁴ This was also supported by study done by Altaf et al. who found the common age group to be 15-30 years.¹⁵

Mixed stone consisting of CaOx and CaPO₄ were the common type of stones. It was around 74.16% of total stones; followed by uric acid stones, struvite stones and cystine stones respectively. Calcium oxalate and calcium phosphate (mixedstones) were found to be the commonest types of stones in many pronounced literatures in Nepal and outside Nepal.^{5,9,11,16-19} There seems to be increased chances of stone formation in the patient who preferably consumes non-vegetarian diet; mainly animal proteins than those consuming vegetarian diet. Nouvenne et al. did a study on dietary habit and its association with renal stone where they emphasized the benefits of a vegetarian diet in prevention of renal stones provided intake of calcium and oxalate is balanced.²⁰ In our study too we saw very low number of cases having stones who consumes only vegetarian diet vs non-vegetarian diet (11.30% vs 88.70%).

The types of stones greatly differ according to age and gender. This difference is thought to have persisted throughout life.⁵ Calcium oxalate and calcium phosphates stones are more related to dietary habits thus it is more common in adult age group than in children whereas stones related to genetic diseases are more common in children.⁹ Similar to this study, we found that calcium oxalate and calcium phosphate were the most common types of stones in age group 21-40 years. This accounts for 53.75% of all the mixed stones. However, calcium oxalate and calcium phosphate stones were in majority numbers in almost all age groups and it didn't show any statistical significance in the study.

We found that there was male predominance of CaOx stones independently as well as a combination of CaOx + CaPO₄ was high in male populations. There was strong positive correlation between mixed stones and the male gender (p=0.036). Daudon M et al in 2004, analyzed 27980 stones and found that there was male predominance of calcium stones.⁵ He also mentioned the prevalence of uric acid stones was increasing. In the same study he mentioned that struvite stones are outnumbered in the female population. In our study we found similar results with 66.66% of total struvite stones in the female population. This was contrary to the study done by Alaya et al. in 2010, where they studied 205 calculi and found that predominance of calcium oxalate in females (59.1% vs 50.8%), and a male preponderance for struvite stones (12.3% vs 1.2%).⁹ This study was alarming to note the change in pattern of urolithiasis.

This study was conducted on a small number of patients and should be considered a pilot study. Larger study populations can yield more accurate results and have stronger implications. Stone analysis was qualitative and done by chemical analysis whereas the quantitative analysis done can be better correlated and the modern means of

knowing the composition using spectrometry could help in the typing of stone better. Further larger study is warranted to explore the types of urinary stone and the relationship of age and gender to it.

CONCLUSION

The epidemiology of renal stone about calcium oxalate and calcium phosphate stones being the most common type of stones is persistent in our country. Calcium oxalate, which is still the dominant component of stones, is with a rising trend in proportion to the whole calculi irrespective of age and gender. Therefore, these compositions must be kept in mind while managing cases of urolithiasis in Nepal, particularly for prevention and prophylaxis of recurrence.

REFERENCES

- Sorokin I, Mamoulakis C, Miyazawa K, Rodgers A, Talati J, Lotan Y. Epidemiology of stone disease across the world. *World J Urol*. 2017;35(9):1301–20.
- Favus MJ. Epidemiology of Nephrolithiasis. In: *Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism: Eighth Edition*. Wiley Blackwell; 2013. p. 856–9.
- Kodama H, Ohno Y. Descriptive epidemiology of urolithiasis. Hinyokika Kiyo [Internet]. 1989 Jun [cited 2020 Apr 21];35(6):923–34. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/2678977>
- Liu Y, Chen Y, Liao B, Luo D, Wang K, Li H, et al. Epidemiology of urolithiasis in Asia. *Asian J Urol* [Internet]. 2018;5(4):205–14. Available from: <https://doi.org/10.1016/j.ajur.2018.08.007>
- Daudon M, Doré JC, Jungers P, Lacour B. Changes in stone composition according to age and gender of patients: A multivariate epidemiological approach. *Urol Res*. 2004;32(3):241–7.
- Seitz C, Fajkovic H. Epidemiological gender-specific aspects in urolithiasis. *World J Urol*. 2013;31(5):1087–92.
- Gault MH, Chafe L. Relationship of frequency, age, sex, stone weight and composition in 15,624 stones: Comparison of results for 1980 to 1983 and 1995 to 1998. *J Urol*. 2000;164(2):302–7.
- Curhan GC, Willett WC, Rimm EB, Stampfer MJ. Family history and risk of kidney stones. *J Am Soc Nephrol*. 1997 Oct;8(10):1568–73.
- Alaya A, Nouri A, Najjar MF. Changes in stone composition according to age and gender in Tunisian children. *J Pediatr Urol* [Internet]. 2010;6(4):364–71. Available from: <http://dx.doi.org/10.1016/j.jpuro.2009.10.014>
- Lieske JC, Rule AD, Krambeck AE, Williams JC, Bergstralh EJ, Mehta RA, et al. Stone composition as a function of age and sex. *Clin J Am Soc Nephrol*. 2014;9(12):2141–6.
- Koirala S. Significance of analysing chemical composition of renal stones. *J Pathol Nepal*. 2014;4(7):560–4.
- Stapleton FB. Childhood stones. *Endocrinol Metab Clin North Am*. 2002;31(4):1001–15.
- Scales CD, Smith AC, Hanley JM, Saigal CS. Prevalence of kidney stones in the United States. *Eur Urol*. 2012 Jul;62(1):160–5.
- Ghazi Khan, Sajjad Ahmad, Sadia Anwar MM. Gender and Age Distribution and Chemical Composition of Renal Stones. *Gomal J Med Sci*. 2013;11(2):167–70.
- Altaf J, Arain AH, Kella NL, Shafique-ur-Rehman. Chemical analysis of urinary stones and its locations Associated to urinary tract. *J Liaquat Univ Med Heal Sci*. 2013;12(3):203–7.
- Risal S, Risal P, Pandeya DR, Adhikari D, Bhattacharya CS, Singh PP, et al. Spectrum of stones composition: a chemical analysis of renal stones of patients visiting NMCTH. *Nepal Med Coll J* [Internet]. 2006 Dec [cited 2020 Apr 18];8(4):263–5. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/17357646>
- golechha, Solanki A. Bacteriology and chemical composition of renal calculi accompanying urinary tract infection. *Indian J Urol* [Internet]. 2001;17(2):111. Available from: <http://www.indianjurol.com/article.asp?issn=09701591;year=2001;volume=17;issue=2;epage=111;epage=117;aulast=golechha>
- Bangash K, Shigri F, Jamal A, Anwar K. Spectrum of Renal Stones Composition; Chemical Analysis of Renal Stones. *Int J Pathol* [Internet]. 2011;9(2):63–6. Available from: <http://jpathology.com/wp-content/uploads/2016/03/Spectrum-of-Renal-Stones-Composition-Chemical-Analysis-of-Renal-Stones1.pdf>
- Pandeya DR, Adhikari D, Risal S, Baxi J, Singh PP. Epidemiology and etiopathogenesis of urinary calculi in western Nepal (Pokhara). *Nepal Med Coll J*. 2006;8(3):190–3.
- Nouvenne A, Ticinesi A, Morelli I, Guida L, Borghi L, Meschi T. Fad diets and their effect on urinary stone formation. *Translational andrology and urology*. 2014 Sep;3(3):303.

Changes in dietary habit from vegetarian to more non-vegetarian (animal product), climatic changes and high BMI seems to be the cause of increased calcium oxalate stones. All ages are susceptible for urolithiasis, no age group has predilection for any specific type of stones however adults (21-40 years) are major stone formers. There is male predominance of calcium stones (p=0.036) and female predominance of struvite stones.

ACKNOWLEDGEMENT

The author would like to thank the Department of Biochemistry for conducting the qualitative analysis of stones which was a tough ask. We are very grateful to the patients who agreed to participate in the study.