e-ISSN: 0976-822X, p-ISSN:2861-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2023; 15(5); 510-516

Original Research Article

An Observational Study Assessing Correlation of Clinico-Pathological Factors in Urolithiasis with Special Reference to Urinary pH and Urinary Culture

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Received: 07-2-2023 Revised: 20-03-2023 / Accepted: 26-04-2023

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Conflict of interest: Nil

Abstract

Aim: The aim of the study was to assess the correlation of clinico-pathological factors in urolithiasis with special reference to urinary pH and urinary culture**.**

Material & Methods: A prospective study was conducted in the Department of Microbiology in collaboration with Department of General Surgery and Biochemistry. A total of 100 patients having urolithiasis, admitted at Darbhanga Medical College and Hospital, Darbhanga, for elective stone removal between in between the duration of 1 year.

Results: 70% patients belonged to 21-60 years of age group. There were 70% male in the study. In the study 55% of the patients belong to lower and 35% to middle socio- economic strata with only 10% belongs to higher. In our study positive family history was found in 60% of patients. Upper urinary tract stones in this pH range (4.5-6.5) were 60% and lower urinary tract stones constituted 20%. In renal, 35% had culture negative and 28% had culture positive.

Conclusion: With the precise knowledge on epidemiological profile on urolithiasis, the involved risk factors and knowledge of the stone constituents, it may be necessary to take certain precautionary steps like improving socioeconomic status, literacy, inculcating hygienic habits, avoiding and treating urinary tract infection, maintaining asepsis during urinary catheterization / instrumentation and low calcium containing diet, which may all probably decrease the incidence and morbidity of patients suffering from urolithiasis. The patients with an episode of stone disease or with a family history of the same are at high risk and should be closely screened for presence of metabolic disorders and routinely followed up to prevent further recurrences.

Keywords: Urinary Stone, Pathogenesis, Urinary Ph, Culture.

Introduction

Renal stones are formed within the kidneys, and this is called nephrolithiasis. Urolithiasis is a condition that occurs when these stones exit the renal pelvis and move into the remainder of the urinary collecting system, which includes the ureters, bladder, and urethra. [1] Prevalence of urinary stones is very high in many parts of the World. Urolithiasis or urinary tract stone effects people worldwide with the prevalence ranging from 1-20%. [2] Recurrence rate of

calcium oxalate stones is about 10% at one year, 35% at 5 years and 50% at 10 years. [3,4,5] The etiology of urolithiasis is multifactorial including environmental, behavioral, genetic and metabolic and have identified risk factors of stone formation and recurrence. [6] Recurrence of stone formation increases the risk of renal dysfunction which can cause a complication of renal failure. An imbalance of stone modulators (Promoters and inhibitors) in urine causes the development of the stones.

Elevation of stone promoters (e.g.-calcium, oxalate, phosphate and uric acid) or reduction of the inhibitors (e.g.-Citrate, potassium, magnesium and) creates supersaturated urine, consequently, nuclear crystals aggregate and eventually calculi are formed. Metabolic abnormalities causing, an equity of the promoters and inhibitors such as hypercalciuria, hyperoxaluria, hyperuricosuria and hypocitruria have been considered as major metabolic risk for the formation of urinary stones. [6] Calcium containing stones are the most common renal stones. [7,8] Metabolic abnormalities such as low volume urine in 24hr along with change in pH and urinary infections are supposed to be major risk factors. Urinary pH in stone disease may vary from 4.5 to 8.0 The average pH in urolithiasis varies between 5.5 and 6.5. Acidic urinary pH ranges between 4.5 to 5.5, whereas alkaline pH is considered to be between 6.5 to 8.0.

In presumed UTI patients, a pH of greater than 7.5 suggests infection most commonly with Proteus. When bacteria trapped in urine that pools above a blockage leads to urinary tract infections. Long-time blockage of the urinary tract leads to urine backs up in the tubes inside the kidney, causing excessive pressure that can cause the pressure hydronephrosis and eventually damage the kidney. The earliest type of stone known to afflict human was the infection (struvite) stones. These account for 2 to 20% of all stones. Proteus Mirabilis is the most common organism associated with struvite calculi. [9] Urease containing bacteria are frequently associated with stone formation. The knowledge of these metabolic abnormalities is very important in the prevention and treatment of urolithiasis.

The present study was an attempt to study the correlation of clinico-pathological factors in urolithiasis with special reference to urinary pH and urinary culture.in Bihar region.

Material & Methods

A prospective study was conducted in the Department of Microbiology in collaboration with Department of General Surgery and Biochemistry. A total of 100 patients having urolithiasis, admitted at Darbhanga Medical College and Hospital, Darbhanga, for elective stone removal between in between the duration of 1 year.

Inclusion Criteria-

- Both male and female between age of 1 to 70 yrs.
- All patients admitted to hospital with renal, ureteric and vesical calculus which were radiologically confirmed.

Exclusion Criteria-

- History of any surgery for urinary lithiasis.
- Urinary stone in congenital urinary disorders

The demographic details and associated factors with urolithiasis such as past and family history of stone disease, history of hypertension, diabetes mellitus, and gout were recorded in predesigned proforma.

Collection of Samples:

The 24 hours urine samples were collected from all patients. It was collected in wide capped clean transparent graduated plastic collection bottle. Volume of specimen was noted and used for analysis.

For pH determination morning samples were used. Method:

The on off switch of the instrument is set on a start position and power cord is connected with mains to get it on. 5 minutes period is allowed to warm up the pH meter, and its needle adjustment is verified at pH scale 7.0. Then prior this the instrument electrodes are regenerated as follows.

1. Both the electrodes including the reference electrodes are put in 0.1 NaCl solutions for overnight. The electrodes are thoroughly washed with distilled water in one of the electrodes saturated KCL solution is filled inside with the help of capillary pipettes.

Standardization:

The pH meter is standardized with a series of standard buffer solution of pH 0.07 and 9.2 to read the pH of each standard buffer values.

Measurement of Urinary pH:

Electrodes were thoroughly washed with glassed distilled water while the instrument's pH measurement knob was at start position. The pH of distilled water was checked by selecting the knob to 0-8 pH scale. In all cases, the pH of distilled water was around 5.8 to 6.0. The instrument pH scale knob was put al neutral point. The pH of standard buffer checked and any deviation from the pH scale of 4 was corrected with the standard knob. Against, the electrodes were washed thoroughly with distilled water and in similar manner, the pH of urine sample were recorded. Electrodes were carefully washed with distilled water between each reading

Sample Preparation, Isolation, and Identification of Bacteria [10,11,12]

The midstream urine specimen was cultured from each patient before surgical stone removal. The stone was also collected from the same patient after surgery. Using the semiquantitative method, 10^5 colony-forming units per milliliter (CFU/ml) of urine was considered as significant bacteriuria and further processed for identification of organisms. The bacterial pathogens were identified up to species level by standard microbiological techniques like colony morphology, Gram staining, and several biochemical tests. Antimicrobial susceptibility of the isolates was determined by the Kirby–Bauer disc-diffusion method on Muller–Hinton agar (MHA) according to Clinical Laboratory Standards Institute (CLSI) guidelines.[13]

Media Used:

1. MacConkey Agar of CLED Agar was used in most of the cases.
2. Peptone water.
3. Nutrient Broth.
4. Nutrient Agar.
5. A drop of the sample was taken with the help of nichrome wire loop on the MacConkey's media plate and was well smeared on it.

Incubation:

Inoculated media was placed in an incubator at 37degree C and kept for 24 hours only. If no growth took place after this period, the culture was labeled as sterile.

Isolation of the organisms

The organism was identified and confirmed after seeing:

1. The colony character.
2. The morphology of the organism (Gram Staining)
3. Biochemical reaction.

From the cultured growth of organisms, a portion of the colony was transferred to the peptone water (Peptone 1%, NaCl 5% 100 c.c.) and kept in the incubator at the temperature of 37 deg. c for 2-4 hours.

This sub culture was used for:

1. Observing motility by hanging drop method.
2. Various biochemical reactions like, fermentation of various sugars done.

3. To test the sensitivity of various drug

Statistical analysis

All data collected were entered in MS excel 2007 and analysed using SPSS 21.0. For descriptive analysis, percentage and ratio were calculated with tabular and graphical presentation of analysis. For inferential statistics, the chi-square test was applied to find out the relationship between dependent and independent variables. values <0.05 were considered statistically significant.

Results

Table 1: Demographic details

Age groups in years	N%
21-40	35 (35)
41-60	35 (35)
>60	30 (30)
Gender	
Male	70 (70)
Female	30 (30)
Socio-economic status	
Lower	55 (55)
Middle	35 (35)
High	10 (10)
Family history	
Yes	60 (60)
No	40 (40)

70% patients belonged to 21-60 years of age group. There were 70% male in the study. In the study 55% of the patients belong to lower and 35% to middle socio- economic strata with only 10% belongs to higher. In our study positive family history was found in 60% of patients.

Table 2: pH of urine & distribution of urinary tract stone

	Upper urinary tract stones	Lower urinary tract stones
4.5-5.5	30 (30)	20 (20)
5.6-6.5	15 (15)	13 (13)
6.6-8.0	10 (10)	12 (12)

Upper urinary tract stones in this pH range (4.5-6.5) were 60% and lower urinary tract stones constituted 20%.

Table 3: Study of urine culture and location of urinary stone

	Culture Positive	Culture Negative
Renal	28 (28)	35 (35)
Urethral	12 (12)	10 (10)
Bladder	10 (10)	5 (5)

In renal, 35% had culture negative and 28% had culture positive.

Discussion

Urolithiasis is one of the frequently encountered urological disorders, common throughout the world. [14] The association between urolithiasis and urinary tract infections (UTIs) is well known and is frequently detected. Their interrelationship can be defined in two ways: urolithiasis following UTIs, i.e., “infection-induced stones” or urinary stone with subsequent UTIs as its complications. [15]

Approximately, 15% of urinary stones are infective stones. However, formation of all non-infective urinary calculi is a consequence of unknown changes in kidney tissue or metabolic disturbances. [16] The history describes infective stone or struvite as the most common type of urinary stones containing magnesium ammonium phosphate, whereas urea-splitting bacteria like Proteus spp., Staphylococcus aureus, Klebsiella spp., Providencia spp., and Urea plasma urealyticum are commonly responsible for struvite stone. The antimicrobial agents could not invade, where these bacteria lie within the interspace of stones in urinary tract. Thus, the outcome is progressive expansion of stones because of persistent infection over a period of weeks or months. [15,17] To prevent infectious complications and subsequent recurrence of residual stones after surgical removal, association of microbes in the stone and proper antibiotic therapy are essential. The selection of antibiotic agents is based on bacteria isolated from urine culture; however, the efficacy of treatment of stone bacteria cannot be ascertained due to uncertainty in similarity of stone and urine bacteria. Similarly, biochemical profile of the patient should be evaluated to ameliorate metabolic disorder and to inhibit reoccurrence of metabolic stone. Therefore, characterization of calculus material aids knowledge to establish the management of a patient postoperatively. [18,19]

70% patients belonged to 21-60 years of age group which was comparable to Nicar MJ. [20] There were 70% male in the study. In the study 55% of the patients belong to lower and 35% to middle socio-economic strata with only 10% belongs to higher which were similar to Kapadia T, Vani SN. [21] In our study positive family history was found in 60% of patients which were similar to the study conducted by Fakhrossadat Mortaza. [22] Upper urinary tract stones in this pH range (4.5-6.5) were 60% and lower urinary tract stones constituted 20% and similar results were seen in the study by Davidman M. Schrnitz P. [23] In renal, 35% had culture negative and 28% had culture positive. Parson et al [24] concluded that bacterial infection promotes urolithiasis by promoting crystal adherence by damaging normal bladder mucosal cover. Comarr et al [25] reported that Patients with indwelling Foley's catheter or lower urinary tract voiding dysfunction are prone to develop these stones.

It has been hypothesized that alteration in urinary enzymes, i.e., decreased urokinase and increased sialidase in urine, leads to the formation of mineralizable matrix. Microorganisms like Proteus mirabilis and Escherichia coli associated with infection-induced stones inhibited the urokinase and stimulated the sialidase activity leading to matrix formation, in turn causing increased crystal adherence to the renal epithelium. [26] An alternative explanation for the presence of bacteria within stone and urine is that of secondary ascending infection from the bladder urine. Penetration of bacteria in the stone prevents complete eradication of urinary tract infection by conventional antibiotic therapy, allowing the development of resistant organisms with intermittent shedding in urine. It is a vicious cycle of infection bringing about stone formation and stone formation causing infection. [27,28]

Conclusion

With the precise knowledge on epidemiological profile on urolithiasis, the involved risk factors and knowledge of the stone constituents, it may be necessary to take certain precautionary steps like improving socioeconomic status, literacy, inculcating hygienic habits, avoiding and treating urinary tract infection, maintaining asepsis during urinary catheterization / instrumentation and low calcium containing diet, which may all probably decrease the incidence and morbidity of patients suffering from urolithiasis. The

patients with an episode of stone disease or with a family history of the same are at high risk and should be closely screened for presence of metabolic disorders and routinely followed up to prevent further recurrences.

References

1. Scales Jr CD, Smith AC, Hanley JM, Saigal CS, Urologic Diseases in America Project. Prevalence of kidney stones in the United States. European urology. 2012 Jul 1;62(1):160-5.
2. Stamatelou KK, Francis ME, Jones CA, Nyberg Jr LM, Curhan GC. Time trends in reported prevalence of kidney stones in the United States: 1976–1994. Kidney international. 2003 May 1;63(5):1817-23.
3. Johnson CM, Wilson DM, O'Fallon WM, Malek RS, Kurland LT. Renal stone epidemiology: a 25-year study in Rochester, Minnesota. Kidney international. 1979 Nov 1;16(5):624-31.
4. Novak TE, Lakshmanan Y, Trock BJ, Gearhart JP, Matlaga BR. Sex prevalence of pediatric kidney stone disease in the United States: an epidemiologic investigation. Urology. 2009 Jul 1;74(1):104-7.
5. Trinchieri A, Ostini F, Nespoli R, Rovera F, Montanari E, Zanetti G. A prospective study of recurrence rate and risk factors for recurrence after a first renal stone. The Journal of urology. 1999 Jul;162(1):27-30.
6. Curhan GC. Epidemiology of stone disease. Urologic Clinics of North America. 2007 Aug 1;34(3):287-93.
7. Singhal PC, Jacobson AL, Mandin H, Hyne JB. Calcium dynamics in idiopathic calcium stone formers. Biochemical medicine. 1983 Feb 1;29 (1):122-33.
8. Schlieper G, Westenfeld R, Brandenburg V, Ketteler M. Vascular calcification in patients with kidney disease: inhibitors of calcification in blood and urine. InSeminars in dialysis 2007 Mar (Vol. 20, No. 2, pp. 113-121). Oxford, UK: Blackwell Publishing Ltd.
9. Griffith DP. Urease stones. Urol Res. 1979; 7(3):215-21.
10. Shah P, Baral R, Agrawal CS, Lamsal M, Baral D, Khanal B. Urinary Calculi: A Microbiological and Biochemical Analysis at a Tertiary Care Hospital in Eastern Nepal. International Journal of Microbiology. 2020 Sep 12;2020.
11. Mackie & McCartney, Practical Medical Microbiology, pp. 84–88, Churchill Livingstone, London, UK, 14th edition 2011.
12. W. Winn, S. Allen, W. Janda, E. Koneman et al., Koneman's Color Atlas and Textbook of Diagnostic Microbiology, Jones & Bartlett Learning, Burlington, MA, USA, 6th edition, 2006.
13. Clinical and Laboratory Standard Institute, Performance Standard for Antimicrobial Disk Susceptibility Tests, Document No M100-S23, Clinical and Laboratory Standard Institute, Wayne, PA, USA, 23rd edition, 2013.
14. Pandeya DR, Adhikari D, Risal S, Baxi J, Singh PP. Epidemiology and etiopathogenesis of urinary calculi in western Nepal (Pokhara). Nepal Medical College Journal: NMCJ. 2006 Sep 1;8(3):190-3.
15. Tavichakorntrakool R, Prasongwattana V, Sungkeeree S, Saisud P, Sribenjalux P, Pimratana C, Bovornpadungkitti S, Sriboonlue P, Thongboonkerd V. Extensive characterizations of bacteria isolated from catheterized urine and stone matrices in patients with nephrolithiasis. Nephrology Dialysis Transplantation. 2012 Nov 1;27(11):41 25-30.
16. Bichler KH, Eipper E, Naber K, Braun V, Zimmermann R, Lahme S. Urinary infection stones. International journal of antimicrobial agents. 2002 Jun 1; 19(6):488-98.

17. Shafi H, Shahandeh Z, Heidari B, Sedigiani F, Ramaji AA, Pasha YR, Kassaeian AA, Pasha AA, Mir MR. Bacteriological study and structural composition of staghorn stones removed by the anatrophic nephrolithotomic procedure. Saudi Journal of Kidney Diseases and Transplantation. 2013 Mar 1;24(2) :41 8-23.
18. Griffith DP, Gibson JR, Clinton CW, Musher DM. Acetohydroxamic acid: clinical studies of a urease inhibitor in patients with staghorn renal calculi. The Journal of urology. 1978 Jan 1; 119(1):9-15.
19. Griffith DP, Moskowitz PA, Carlton Jr CE. Adjunctive chemotherapy of infection-induced staghorn calculi. The Journal of urology. 1979 Jun 1;121 (6):711-5.
20. Nicar MJ, Hill K, Pak CY. Inhibition by citrate of spontaneous precipitation of calcium oxalate in vitro. Journal of bone and mineral research. 1987 Jun; 2(3):215-20.
21. Kapadia T, Vani SN: Urolithiasis in childhood. Indian J Pediatrics 1992: 59(4): 549—551.
22. Fakhrossadat Mortaza, MD; Leila Mehbubi2, MD; clinical feature and risk factors of peadiattricurolithiasis, Iran J Ped June 2007, vol- 17(No-2); 129-133.
23. Davidman M. Schrnitz P: Renal tubular acidosis pathophysiological approach HospPract 1986; 23: 77—81.
24. Parsons CL, Stauffer C, Mulholland SG, Griffith DP: The effect of ammonium on bacteria adherence to bladder transitional epithelium J: Urol 1984; 132 366 —366.
25. Comarr AE, Kawaichi GR, Bors E: Renal calculosis in patients with traumatic cord lesions, J Urol 1962: 85 647 —656.
26. Du Toit PJ, Van Aswegen CH, Steyn PL, Pols A, du Plessis DJ. Effects of bacteria involved with the pathogenesis of infection-induced urolithiasis on the urokinase and sialidase (neuraminidase) activity. Urological Research. 1992 Oct; 20:393-7.
27. Nemoy NJ, Stamey TA. Surgical, bacteriological, and biochemical management of infection stones. Jama. 1971 Mar 1;215(9):1470-6.
28. Wickham JE. Matrix and the infective renal calculus. British Journal of Urology. 1975 Dec;47(7):727-32.