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BACTERIOLOGY AND CHEMICAL COMPOSITION OF UROLITHIASIS ACCOMPANYING URINARY TRACT INFECTION IN A TERTIARY CARE HOSPITAL

Medical Science

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ABSTRACT

Background and Objectives: Despite modern antibiotic therapy and technological advances in lithotripsy, the presence of infection in patients with urinary stones, as well as with infectious stones is still a significant cause of morbidity and mortality.

Methods; Patients admitted to the Urology Department who were diagnosed by the urologist as having urinary stones were included in this study. Bacteriological study was conducted on pre-operative urine and operated renal stones along with chemical analysis of stones have been performed in 50 cases of urolithiasis.

Results: The present study thus revealed that urolithiasis is pre-dominant in males. Of these, Bladder stones are found to be commonest followed by Kidney stones. Bacteriological analysis indicates that 20 stones showed microorganism. The infection stones were recovered more in males. The stones composed of calcium oxalate and calcium phosphate are more common. The commonest pathogen recovered from pre-operative urine culture and stone culture was *E.coli* (42.86% and 66.67%)from mixed stones composed of calcium oxalate with cal¬cium phosphate and triple phosphate.

Conclusion: The micro-organism can influence the stone forming process in many different ways. According to this view stone formation is a multifactorial and dynamic process. A knowledge of chemical composition of renal stones may be of great importance both as a guide for the clinical management and also for preventive measures in reducing the risk of prevalence and recurrence of urolithiasis in this region.

KEYWORDS

Urolithiasis, Operated Renal Stones, Pre-operative Urine Samples, Chemical Analysis, *E.coli*

INTRODUCTION

Renal stone disease has been recognized in many parts of the world since antiquity. It is one of the most painful and most common urological disorders.[1]Numerous risk factors responsible for or contributing to stone formation have been identified including environmental, metabolic, dietary, racial, sex, obstructive uropathy and infection of urinary tract. The last is an important risk factor and at least in females, urinary tract infection is one of the most common causes of Urolithiasis.[2]

The association between infection of the urinary tract and urinary calculi is well known and has been documented for many years. Incidence of urinary tract infection in stone patients varies from 7% to 60% reported in previous studies.[3-6]Infection favours the formation of urinary calculi.

The predominant bacteria found in the nuclei of urinary calculi are *Staphylococcus and Escherichia coli*. Urea splitting organisms like *Proteus spp.*render the urine alkaline and hence are known to promote stone formation in both clinical and experimental studies .These are the required conditions for the formation of magnesium ammonium phosphate calculi which are generally stag horn. Other bacteria like *E. coli* commonly observed in urinary infection are not urea splitting[7,8]

Recurrence of urinary tract infection and stone is commonest and major health problem and it is necessary to eradicate infection. For study of aetiology and treatment of patients with urinary calculi it is necessary to perform urine culture , the chemical composition of stone and antimicrobial sensitivity of urine culture isolates.

The prevalence of renal stone formation is approximately 2-3% in the general population. Alarming high incidence of Urolithiasis with varied chemical composition of calculi has been reported from different regions of India.[9-11] Hence the present study was undertaken to identify Bacteriological Profile of pre-operative urine samples and operated stones collected from urolithiasis patients and to analyse the chemical composition of operated stones in a tertiary care hospital.

MATERIALS AND METHODS

This Cross-Sectional Study was conducted on patients of urolithiasis admitted in Urology Department of Tirunelveli Medical College for management of renal stones during the period of 6 months from March 2018 to August 2018.The study protocol will be carried out after approval by the Institutional Scientific and Ethics Committee.

Study population

Patients of urolithiasis admitted in the Urology Department for management of renal stones.

Sample Collection and processing:

Bacteriological study was conducted on pre-operative urine and operated renal stones.Pre-operative urine samples were collected aseptically for macroscopic and microscopic examination. Both pre-operative urine and operated renal stones were processed for bacteriological culture.

Before giving antibiotic treatment preoperative midstream sample of urine was collected in sterile container. The pre-operative urine samples were inoculated into Nutrient agar, MacConkey's agar and Blood agar plates and were incubated at 37°C for 18-24 hours for isolation of etiological agents. The isolated organisms were identified by standard techniques. Antibiotic sensitivity was done by using disc diffusion (Kirby and Baur) method [12]

Urinary calculus was collected after the operation in a sterile container whenever possible. Processing of stones for bacteriological culture was done as described by Ohkawa et al.[13] The renal stones were thoroughly rinsed in sterile physiological saline and then crushed with sterile hack-saw. The crushed stone core was cultured in 5ml Thioglycollate broth which was incubated at 37°C for 18-24 hours and then subcultures were made on Blood agar and MacConkey's agar plate for isolation of aetiological agents. The isolated organisms were identified by standard techniques[12] Also the antibiotic sensitivity of bacterial isolates was done by using disc diffusion (Kirby Baur) method.

Some part of calculus was used for chemical analysis. First the physical characteristics of the calculi were seen, such as size, shape, weight, number, colour, surface and consistency. Chemical analysis of operated Renal stones for oxalate calcium magnesium, ammonium and phosphate were performed.

A specially designed proforma, containing general information about the patient, urinary symptoms and signs, was filled out for every patient included in this study. After clinical examination every patient was investigated in this manner: Urine analysis, Imaging methods, Blood examination and Chemical composition of the stones.

RESULTS

A total of 50 patients with a all age groups & either sexes, Clinical diagnosis of urinary calculi were studied. The incidence of renal stone was more in males (68%) as compared with females (32%)and also the incidence of infection stone was more in males as compared to females. The incidence of sterile kidney stones was 72% whereas the percentage of infection stones was 28% more in Vesical (50%),Kidney stones, (28.57%) and ureteric stones, (21.43%).Out of 50 cases of urolithiasis 14 cases were culture positive, i.e., infection stones whereas 36 cases proved culture negative.**[Table - 1]**

Incidence of sterile renal stones composed of calcium oxalate and calcium phosphate (84.31 %) was more in comparison to infection stone (15.69%) of same composition. By contrast the incidence of infection stones was more in stones composed of uric acid (75%), calcium phosphate(33.33%) and calcium oxalate (25%).**[Table - 2]**The comparison of micro-organisms isolated from crushed stones (28%) and pre-operative urine (12%), showed that *E. coli* was the predominant micro-organism isolated from preoperative urine as well as from crushed stone core culture (42.86% and 66.67%) followed by *Klebsiella pneumoniae*, *Pseudomonas Proteus* and *Streptococcus faecalis* were recovered in least number of cases.**[Table - 3]***E. coli* was isolated in maximum number from stones composed of calcium oxalate and calcium phosphate.

Out of 50 cases, 20 cases(40%) showed infection in pre-operative urine and/or stone core culture while rest of 30 cases(60%)were sterile for both pre-operative urine and crushed stone core culture. Out of 20 cases, 8 cases(40%) were both positive Pre-operative urine culture and stone core culture and showed same organisms which were also isolated from pre-operative urine culture. While the stone core culture alone was positive in 10 cases(50%) whereas 2 cases (10%) showed positive urine culture whereas their stones were sterile for culture.

DISCUSSION

The study was conducted on 50 patients of urolithiasis which include identification of causative micro-organisms from pre-operative urine, crushed stone core culture and chemical analysis of stones. The incidence of renal stone was more in males (68%) as compared with females (32%)and also the incidence of infection stone was more in males as compared to females. This study was similar to the study of Simon et al.[14] The higher incidence of renal stones in males in comparison to females may be due to increased serum testosterone level which favours increased endogenous oxalate production by liver which in turn predisposes to oxalate stone formation. Moreover, increased urinary citrate concentration in females may help in protection against calcium urolithiasis.[15]

Urolithiasis was mainly observed in Vesical (50%), Kidney stones, (28.57%) as compared to stones lodged in Ureter (21.43%).Moreover 71.43% kidney stones were found to be sterile on culture whereas in urinary bladder, infection stones were more frequent (48.57%). This could be that kidney acts as a first barrier filter for crystals thereby damaging tubular epithelium which acts as a nidus for sterile stone formation. Recurrent urinary tract infection predisposes to infected renal stone formation in urinary bladder due to proximity of bladder to urethra.

[16]

In this study the increased incidence of stones composed of calcium oxalate and calcium phosphate (36%) is in conformity with the observation made by Sutor and Wooley et al and Sharma et al.[17-19] The observed variation in chemical composition may be due to geographical variation and dietary habits which have some contributory influence in the incidence of urinary tract calculi and type of calculi which occur within a given area.[20]

The bacteriological study of urine and stone samples revealed that commonest pathogen was *E. coli.E. coli* is not a urease producing organism and is not considered to be a stone producing micro-organism.[21] However the present study revealed that *E. coli* was the predominant micro-organism recovered from mixed stones (calcium oxalate and calcium phosphate). The present finding is consistent with the study of Dajani and Shahabi Bratell et al. [22,23] The recovery of *E. coli* from mixed stones indicates that non-urease producing organisms probably also contribute in the calculus formation at some stage of theirdevelopment.

While correlating the result of concurrent bacteriological analysis of 20 cases of infected stones , it is evident that same organisms from urine culture and stone culture were isolated in 8 (40%) cases but different organisms in 10 (50%) cases. Thus it appears that voided urine does not always reflect the bacteriology of urinary tract stones which is in agreement with the results of previous studies. [24,25] The findings might be due to intermittent release of small number of micro-organisms from the stone which may or may not be isolated from urine. The explanation for presence of bacteria within the calculi may be due to insignificant intermittent bacteraemia from where the bacteria are excreted in renal pelvis and may act as a nidus for deposition of crystals either by damaging the mucous coat or perhaps also by acting as a nidus for crystallization of salts.[17]

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 will prevent complete eradication of urinary tract infection by conventional antibiotic therapy and thus allow the development of resistant organisms with intermittent shedding in urine. Thus a vicious cycle starts, infection bringing about stone formation and stone formation causing infection.[26,27]

CONCLUSION

The present study revealed that urolithiasis is predominant in males.Of these, kidney stones are found to be commonest followed by bladder stones. Bacteriological analysis indicates that only in few stones micro-organisms were identified. The mixed stones composed of calcium oxalate and calcium phosphate are more common and *E. coli* was the predominant microorganism. So it is concluded from present study that the microorganism can influence the stone forming process in many different ways. According to this view stone formation is a multifactorial and dynamic process.A knowledge of chemical composition of renal stones may be of great importance both as a guide for the clinical management and also for better understanding of physicochemical principles underlying the formation of calculi that may help to give advice and suggestions for the people and patients to carry out preventive measures in reducing the risk of prevalence and recurrence of urolithiasis in this region.

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TABLE-1 Number of cases having stones according to their site with relation to Infection

Sl no.	Stone		Sterile stone						Infection stone					
			Male		Female		Total		Male		Female		Total	
	Site	No	No	%	No	%	No	%	No	%	No	%	No	%
1	Kidney	15	6	40.00	3	20	9	60	2	13.33	1	6.67	3	20
2	Bladder	22	10	45.45	7	31.82	17	77.27	5	22.73	2	9.09	7	31.82
3	Ureter	13	8	61.54	2	25	10	76.92	3	23.08	1	7.69	4	30.77
	Total	50	24	48	12	24	36	72	10	20	4	8	14	28

TABLE-2 Number of cases having stones according to chemical composition

Sl no.	Type of stone	Total no of stone	Sterile stone		Infection stone	
			No of cases	Percent	No of cases	Percent
1	Calcium oxalate	16	12	75	4	25
2	Calcium phosphate	12	8	66.67	4	33.33

3	**Calcium oxalate and Calcium phosphate**	18	15	83.33	3	16.67
4	**Uric acid**	4	1	25	3	75
	Total	50	36	72	14	28

TABLE-3 Distribution of Bacterial species among Stone culture and Pre operative urine culture

Sl no.	Microorganism	Preoperative urine culture		Crushed stone culture	
		No of cases	Percent	No of cases	Percent
1	***Escherichia coli***	4	66.67	6	42.86
2	***Klebsiella pneumoniae***	2	33.33	4	28.57
3	***Pseudomonas aeruginosa***	0	0	1	7.14
4	***Proteus mirabilis***	0	0	1	7.14
5	***Enterococcus faecalis***	0	0	2	14.29
	Total	6	100	14	100

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