Review of paediatric patients with Urolithiasis, in view of development of Urinary Tract Infection

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Abstract

Objective: To assess the development of UTI in paediatric patients, presented to OPD with urolithiasis. To ascertain what general parameters are associated with UTI, and examine specific characteristics of the calculi.

Method: It was a retrospective study. Files of paediatric patients from July 2000 to December 2004 were reviewed. Only those patients with calculi and absent UTI and upto 5 years age were studied. All files of patients, primarily presenting with UTI, and those with documented urological procedures prior to UTI occurrence, were excluded from the study. Ultrasound and X-ray techniques were used to determine stone size and location. Collected urine samples were screened for UTI; organisms were isolated and cultured using Cystine Lactose Electrolyte Deficient (CLED) culture medium.

Result: A total of 149 patients were studied. The mean age was 3.05±1.25 years, [77.2 %] were males [22.8%] females. Urinary tract infection [UTI] was found in 37.6% cases. Age status was significantly associated with UTI [p=0.008] along with the anatomical location [p=0.021]. The most common organism found on our culture plate of UTI positive patients was E. coli (21.4%). Bacteria were most sensitive to aminoglycoside group [16%] of antibiotics.

Conclusion: We found a significant association between age, anatomical location of stones and UTI. These factors should be considered in paediatric patients to prevent UTI and its complications (JPMA 58:653; 2008).

Introduction

The Afro-Asian stone-forming belt stretches from Sudan, the Arab Republic of Egypt, Saudi Arabia, the United Arab Emirates, the Islamic Republic of Iran, Pakistan, India, Myanmar, Thailand, and Indonesia to the Philippines. A local study has revealed that stone disease affects all age groups from less than 1 year old to more than 70 and that the prevalence of calculi ranges from 4 to 20 percent.[1] Amongst other countries in the region, they are most prevalent in Pakistan[2,3] where stone patients represent the bulk of all urological patients. Renal stones are amongst the several causes of urinary tract infection. Another local study suggested that Urinary tract infection (UTI) being a significant problem in children, requires identification of organisms and prompt treatment to reduce the related morbidity and mortality.[4]

One of the predisposing factors of urinary tract infections is urolithiasis.[5] Episodes of urinary tract infection have shown to increase the risk of renal scarring in childhood.[6] A consequence of renal scarring, a few individuals will develop hypertension, major pregnancy complications, and end-stage renal disease in adulthood.[6] Therefore identification of UTI in paediatric patients with urolithiasis prompts urgent management.

The objectives of our study were to assess the development of UTI in paediatric patients, who presented to the OPD with urolithiasis only. To ascertain what general parameters are associated with UTI and examine specific characteristics of the calculi.

Methodology

This was a retrospective study conducted in Sindh Institute of Urology & Transplantation (SIUT) Pakistan. The medical records of 196 patients who had presented between July 2000 and December 2004 were evaluated using a Performa. The selection criteria were an age limit of five years, presence of calculi and the absence of Urinary Tract Infection (UTI) at the time of presentation. All files of patients, primarily presenting with UTI and those with documented urological procedures prior to UTI occurrence if any, were excluded from the study. Files with incomplete data or lost to follow up were removed.

Patient files fulfilling the criteria were reviewed and the data collected. The variables noted were age, sex, stone type, stone size, bilateral or unilateral renal involvement, anatomical location of calculi, incidence of UTI, causative agent of UTI, patterns of sensitivity and resistance to different groups of antibiotics and family history for stones. Ethical criteria and boundaries with patient confidentiality was maintained.

Ultrasound and X-ray techniques were used to determine stone size and location. Stone analysis was performed using Infrared spectrometry technique. Collected urine samples were screened for UTI; organisms were isolated and cultured using Cystine Lactose Electrolyte Deficient (CLED) culture medium. Those samples testing positive for micro organisms, were then followed up with sensitivity and resistance reports. The minimum requirement for considering presence of UTI was, 105 CFU/ml (colony forming units) of growth in the culture medium.

The data was entered and analysed using SPSS version 13.0. The statistical methods applied to compile and present our results were frequencies (mean, mode and standard deviation) and chi-square test was used for association between variables. The p value of < 0.05 was considered as significant.

Results

Of the 196 patients who fulfilled the inclusion criteria,

Table 1: General characteristics of patients [n=149].

Variables	No. of patients	Percentage %	Total
Age/Years			n=149
0 - ≤ 1	10	6.7	
1 - ≤ 2	41	27.5	
2 - ≤ 3	32	21.5	
3 - ≤ 4	39	26.2	
4 - ≤ 5	27	18.1	
Gender			n=149
Male	115	77.2	
Female	34	22.8	
Site			n=149
Unilateral	131	87.9	
Bilateral	18	12.1	
Stone type			n=149
a] pure			n=98
Ammonium hydroxyurate	51	52.4	
Calcium Oxalate	30	30.3	
Others	17	17.3	
b] Mixed stone [nidus]			n=51
Ammonium hydroxurate	9	17.6	
Calcium Oxalate	33	64.7	
Struvite	9	17.6	
Anatomical location			n=149
Kidney	86	57.7	
Ureter	26	17.4	
Vesicle	37	24.8	
Size/ cm			n=149
0.1 < - ? 1.0	70	47	
1.0 < - ? 2.0	63	42.2	
2.0 < - ? 3.0	16	10.8	
Urinary Tract Infection			n=149
Positive	56	37.6	
Negative	93	62.4	
Organism			n=56
Escherichia coli	18	21.4	
Proteus	5	8.9	
Klebsiella	6	10.7	
Pseudomonas	5	8.9	
Candida sp.	4	7.1	
Others	7	12.5	
Mixed growth	11	19.6	

Table 2: Association between UTI and other Variables [n=149]

Variables	Urinary Tract infection Present Freqeuncy	Percentage	P-Value
Stone type			
Ammonium hydroxyurate [n=51]	20	39.2	
Calcium Oxalate [n=30]	10	33.3	0.495
Others [n=17]	4	23.5	
Mixed stone [n=51]	22	43.1	
Age / years			
0 - ≤ 1 [n=10]	6	60	
1 - ≤ 2 [n=41]	18	43.9	
2 - ≤ 3 [n=32]	17	53.1	0.008
3 - ≤ 4 [n=39]	5	12.8	
4 - ≤ 5[n=27]	10	37	
Gender			
Male [n=115]	42	36.5	0.622
Female [n=34]	14	41.2	
Site			
Unilateral [n=131]	49	37.4	0.902
Bilateral [n=18]	7	38.9	
Anatomical Location			
Kidney [n=86]	27	31.4	
Ureter [n=26]	15	57.7	0.021
Vesicle [n=37]	14	37.8	
Stone size / cm			
0.1 < - ≤ 1.0	24	34.3	
1.0 < - ≤ 2.0	26	41.3	0.708
2.0 < - ≤ 3.0	6	37.5	

47 were excluded due to incomplete data.

In the remaining 149 (76%) patients, the mean age was 3.05±1.25 years. Of the sample, 115 [77.2 %] were males and 34 [22.8%] females. The general characteristics of the patients are shown in Table 1. Overall 56 patients [37.6%] developed urinary tract infection, amongst the females 41.2% and males 36.5%. A total of 18 [12.1%] patients with bilateral stones were identified in our study, of which 38.9% had urinary tract infection (Table 2).

Stone analysis revealed a variety of pure and mixed stones. Amongst the pure stone types, the greatest frequency was found of Ammonium hydroxyurate [52.4 %]. Of the mixed stone category nidus Calcium Oxalate stone nidus was found to be the most frequent [64.7%].

The most common anatomical location for calculi was observed to be the kidney [57.7%]. In our study, the range of stone sizes was from 0.1 - 3.0 cm. The mean size was 1.21± 0.69 cm. UTI was commonly associated within the range of 1-2 cm 41.3% (Table 2).

The most common organism found on our culture plate of UTI positive patients was E. coli 21.4%. In our culture and sensitivity testing, we found that gram negative bacteria were most sensitive to aminoglycoside group [16%] of antibiotics. The infective bacteria were most resistant to penicillin group [22.6%] and folate antagonist group [16%] of drugs. In the gram positive bacteria cultured from our UTI positive samples, Quinolone/ Floroquinolone drug groups [21.4%] were found to be most effective in limiting the bacterial growth, whereas the penicillin group [40%] met the most resistance.

Out of the 149 patients with calculi, 29 [19.4%] were found to have a positive family history of stones of which 14 [48.2%] developed urinary tract infections.

Age status was significantly associated with UTI [p=0.008]. The most frequent age group of patients to acquire UTI was below 1 year (Table 2).

Anatomical location was also significantly associated with urinary tract infections [p=0.021]. Most frequently urinary tract infections occurred in patients with calculi present in the ureter (Table 2). There was no significant association between UTI and stone type [mixed or pure], gender, site or size.

Discussion

A recent WHO publication states that urinary tract infections (UTI) are one of the most common bacterial infections in children and that in the first year of life its rates are 2.7% in males.[7] This study has found the frequency of UTI in males under the age of 1 year with stone disease to be 66.6%; this is considerably higher than expected. Inferring from this data we may suggest that this rise could be due to the presence of urolithiasis in our study population.

Our study shows the ratio of male to female patients was 3.4:1. This is in comparison to a local study done at Civil Hospital, Karachi.[1] This maybe a coincidental finding or it may just represent the actual frequency in our settings.

This presented study revealed that paediatric patients' with stone disease were seven times more likely to have unilateral tract involvement as compared to bilateral involvement and yet one third of patients in both cases acquired UTIs. This shows that bilateral involvement did not affect the frequency of UTI in our patients. Questions about the association between bilateral involvement and long term complication still remain and more research needs to be done in this regard.

Our study also showed that 25% of all females with bilateral calculi and 42.8% of males under the age of five years developed UTI. We could not find any similar studies to compare our results.

Holmgren K, et al,[8] in Scandinavia studied 1325 patients who were hospitalized for stone disease with positive urine cultures. Amongst the UTI positive cultures, E. coli was the most frequent micro organism (35%) followed by proteus (28%). Another study by Mohammed Akram, et al in Aligarh, India also revealed E. coli as the predominant bacterial pathogen of community acquired UTIs.[9] This study also showed E. coli as the most frequent organism causing UTI [21.4%], followed by Klebsiella and Proteus respectively

[10.7%] and [8.9%]. These results identify E. coli as the predominant cause of UTI in developing country settings.

In developing countries, 30 % of all paediatric urolithiasis cases occur as bladder stones. The cause for bladder stones in children is a poor diet high in cereal content and low in animal protein, calcium, and phosphates.[10] Our study showed that kidney was the most frequent location for stones, followed by bladder and UTI was significantly associated with ureteric stones 57.7%.

Our study also indicated that there was no significant association between the size of a calculus and UTI. It can cause pressure and pain, with the risk of kidney damage, bleeding and infection. Smaller stones may partially block the ureters or the urethra. These stones may cause ongoing urinary tract infection or kidney damage if left untreated.[11]

A study conducted at Kathmandu Medical College, reported that all organisms causing UTI were sensitive to nitrofurantoin and amoxicillin. Ciprofloxacin was found to be least effective.[12] Another study by Mohammed Akram et al at Aligarh demonstrated an increasing resistance to Co-trimoxazole and extended spectrum b-lactamase among UTI pathogens in their community.[9] Our study showed that penicillin group of drugs met the most resistance and amino glycosides group were the most effective. These results can help the medical practitioners in empirical therapy to benefit patients. In day and age there is constant enhancement of drugs, this sensitivity and resistance pattern is bound to change. Continuous research and clinical trials are therefore mandatory.

Conclusion

A significant association between age, anatomical location of stones and UTI was observed. These factors should be considered in paediatric patients to avoid UTI and its complications. The sensitivity and resistance pattern is helpful in selecting drugs for better empirical response in the treatment of UTI.

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