DOI: https://doi.org/10.53350/pjmhs020231711172

ORIGINAL ARTICLE

Clinical Spectrum and Radiological Evaluation of Urinary Tract Infections in Children

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ABSTRACT

Objective: To evaluate clinical spectrum and radiological findings in pediatric patients presenting with urinary tract infection.
Study Design: Cross sectional study
Place and Duration of Study: Radiology and Pediatric Departments, Niazi Medical & Dental College, Niazi Welfare Teaching Hospital Sargodha from 1st January 2023 to 31st July 2023.
Methodology: One hundred and fourteen children were enrolled. Urine samples of patients under three months of age were collected by suprapubic aspiration, while in the older children urine was collected by clean catch method or via catheter in catheterized children. All children and neonates having urine routine examination proven urinary tract infections were enrolled in the study. The radiological investigations included ultrasound of the renal tract, intravenous pyelography and micturating cystourethrogram. Clinical signs and symptoms of urinary tract infections, radiological findings, and the history of recurrent urinary tract infections, as well as any complications arising from this infection, were documented using separate questionnaires.
Results: There were 52.6% males and 47.4% females. Fever was a prevalent clinical symptom, observed in 57.0% of cases, while vomiting was documented in 16.7% of patients. Failure to thrive was reported in a minority of cases (12.3%), while abdominal pain was relatively common (31.6%). Edema, dysuria, hematuria, urinary urgency, urinary incontinence, and urinary retention were generally rare symptoms in this population.
Conclusion: The diagnosis and management of pediatric urinary tract infections, underscoring the importance of early detection, individualized treatment, and evidence-based guidelines. It contributes valuable insights to the field, while also recognizing the need for further research to enhance our understanding of this prevalent pediatric condition.
Keywords: Urinary tract infection, pediatric population, ultrasound, IVU, MCUG

INTRODUCTION

Urinary tract infection (UTI) is a significant source of morbidity in children and one of the frequent causes of bacterial infection of children. Overall, the prevalence varies from 6-8% among childhood peaking in infants, toddlers and adolscents.[1] About 7% girls and 2% boys develop urinary tract infections by 6 years of age.[2] It causes serious bacterial infections in infants below 3 months of age that is why, evaluation for urinary tract infections is recommended in all infants below 3 months of age.[2]

About 30% children will get another urinary tract infection 6 to 12 months after initial episode.[3] Urinary tract infection can be divided into febrile or upper urinary tract infection and afebrile urinary tract infection or lower urinary tract infection[4]and the cause of recurrence is usually vesicoureteral reflux and bladder and bowel dysfuinction[1]or urinary tract malformations.[4] Urinary tract infections may be complicated by renal abscess, acute kidney injury or sepsis, renal scarring, hypertension and end stage renal disease in long run.[2]

Young children with UTI present with nonspecific symptoms like vomiting, abdominal pain, irritability, poor feeding, increased urinary frequency and dysuria or hematuria. Children below 2 years may have vomiting, failure to thrive, diarrhea, sepsis and pyrexia of unknown origin.[5] E. coli, Klebsiella, Staph aureus, Pseudomonas, Proteus, enterococcus and Enterobacter are different causative organisms involved in causing UTI but E. coli accounts for about 85-90% of cases.[3,4]

Urinary tract infection in young children is a significant source of imaging in young children. Ultrasound being a non-invasive and readily available modality remains the first line investigation to assess renal and bladder morphology, congenital anomalies, renal scarring,[5] pelviureteric junction (PUJ) obstruction, vesicoureteral reflux and non-refluxing megaureter.[6]

Received on 17-08-2023
Accepted on 28-10-2023

Ultrasound is free of ionizing radiation and first line imaging recommended in young children with first episode of UTI and those presenting with recurrent UTI.[3,6,7] 20% children have anomalies of urinary tract 75% of which get picked up on ultrasound.[6,7]

Voiding cystourethrogram (VCUG) also known as micturating cystourethrogram (MCUG) is indicated in children with first febrile UTI, in those having abnormality detected on renal and bladder ultrasound, atypical bacteria on culture, complicated UTI or renal scarring. It is ideal to grade thevesicoureteral reflex and to detect posterior urethral valves (PUV).[3,7]

Intravenous pyelography (IVP), Tc-99m Dimercaptosuccinic Acid (DMSA) scan and CT/ MRI intravenous pyelography are other imaging modalities which are performed when indicated.[7]

Our study aims to look for radiological findings in the children with urinary tract infection and to determine the importance of doing imaging in the children with UTI. It will help us to address the common issues of younger children not getting proper treatment due to lack of proper and timely diagnosis of the underlying pathology which can lead to serious and detrimental consequences.

MATERIALS AND METHODS

The study was carried out in Radiology and Pediatric Departments, Niazi Medical & Dental College. Niazi Welfare Teaching Hospital Sargodha from 1st January, 2023 to 31st July 2023. The sample size was determined by using single population proportion formula from Open Epi version 3.01 and from the previous literature which showed prevalence of8%[1].The sample size of 114 was calculated using95% confidence interval, 5% margin of error and prevalence of 8%.[1] Urine sample was collected under 3 months of age by suprapubic aspiration method. In older children urine was collected by clean catch method or via catheter in catheterized children. All children and neonates having Urine Routine Examination (R/E) proven UTI were enrolled. All the children with symptoms and signs of urinary tract infections like fever, vomiting, lethargy, feeding problem, abdominal pain, failure to thrive, dysuria, hematuria and urinary incontinence were included. Children having

any dysmorphism or syndromic features, meningomyelocele, cerebral palsy, neurodegenerative disorders were excluded.

Data for this study were collected retrospectively from the Hospital Management Information System (HMIS), specifically focusing on Urine R/E and Urine culture results. Clinical signs and symptoms of urinary tract infections, radiological findings, and the history of recurrent UTI, as well as any complications arising from UTI, were documented using separate questionnaires. Children with more than 105 cell counts on urine R/E were considered to have a UTI. Urine cultures were performed in children who experienced a second UTI after receiving treatment for the first episode or those with a history of repeated UTI episodes that showed evidence of reflux. Furthermore, ultrasound examinations were conducted for all children who tested positive for UTI in their urine R/E results. MCUG was carried out for children with a history of recurrent UTI, detection of atypical bacteria on blood culture, or indications of hydronephrosis and hydroureter as observed on ultrasound. In cases where congenital anomalies, strictures, scars, or stones were suspected in the urinary tract, IVP was performed. Data was analyzed using SPSS-27.0. Statistical significance was determined at $p<0.05$.

RESULTS

There were 52.6% males and 47.4% females presenting with UTI. Fever was most prevalent clinical symptom, observed in 57.0% of all the cases, followed by abdominal pain 31.6% of cases, while vomiting was present in 16.7% of patients and failure to thrive is reported in 12.3% (Table 1).

Majority of patients (70.2%) had normal study results and the majority were among 1-5 years of age. Hydronephrosis and hydroureter was predominant finding in children below 1year of age. Cystitis was mainly present in females (16.7%) and mainly older children from 6-10 years of age. Unilateral hydronephrosis was mainly reported in males (66.7%) and majority of them were older children 11-15 years of age with frequency of 55.6% in that age group. Normal ultrasound study was reported in 65% males and 75.9% females and predominantly in children between 1-5 years of age (31.3%) [Table 2].

In terms of recurrent UTIs, 9.6% of patients had a history of recurrent UTIs. Urine cultures were performed among children who had recurrent UTIs. Among the urine culture reports E. coli was frequently identified pathogen followed by Enterobacter. For MCUG, a small percentage had normal findings (0.9%), and reflux was observed in 1.8% of cases, while in the majority of cases (97.4%), MCUG was not done. In the case of DMSA scans, 0.9% showed normal results, with the majority (99.1%) not undergoing DMSA scans. These additional diagnostic findings provide insights into the history of UTIs and the use of imaging techniques in the study population (Table 3).

Table 1: Demographic and clinical parameters of patients

Parameter	Age groups (years)				p-value
	<1	1-5	6-10	11-16	
Gender					
Male	23.30%	21.70%	28.30%	26.70%	0.69
Female	16.70%	29.60%	29.60%	24.10%	
Symptoms					
Fever	21.50%	29.20%	21.50%	27.70%	0.24
Vomiting	42.10%	15.80%	15.80%	26.30%	0.05
failure to thrive	71.40%	21.40%	7.10%	0.00%	<0.001
Abdominal pain	5.60%	25.00%	44.40%	25.00%	0.01
Edema	16.70%	50.00%	33.30%	0.00%	0.36
Dysuria	12.50%	12.50%	37.50%	37.50%	0.34
Hematuria	0.00%	0.00%	42.90%	57.10%	0.07
Urinary Urgency	0.00%	8.30%	41.70%	50.00%	0.04
Urinary incontinence	0.00%	0.00%	60.00%	40.00%	0.2
Urinary retention	100.00%	0.00%	0.00%	0.00%	0.007
Diarrhea	37.50%	37.50%	6.30%	18.80%	0.05
Pyrexia of unknown origin	0.00%	25.00%	50.00%	25.00%	0.38
Sepsis	100.00%	0.00%	0.00%	0.00%	<0.001

Table 2: USG findings in all selected patients

Ultrasonography Report	%
Normal study	70.2
Hydronephrosis and hydroureter	1.8
Cystitis	14.9
Calculi	2.6
Unilateral hydronephrosis	7.9
Fused renal ectopia	0.9
PUJ obstruction	0.9
Horse shoe kidney	0.9

Table 3: MCUG and DMSA

Imaging studies	%
MCUG	
Normal	0.9
Reflux	1.8
Not Done	97.4
DMSA	
Normal	0.9
Not Done	99.1

DISCUSSION

Urinary tract infection in children are common and they should be diagnosed and treated promptly so as to prevent complications like renal scarring and chronic kidney disease.[8] The prevalence of UTI varies according to the age of the child being more common in infants, toddlers and then adolescents[9]. In infancy UTI are more frequent in boys than girls.[10]

In our study males and females were equally affected similar to study done by Tullus et al[11], while in another study done in Pakistan by Rehman et al[8], affected females were reported to be 90.4%. According to Rehman et al[8] fever was present in 91% cases whereas according to our results fever was present in 57% of all cases.

Among children below 1 year of age signs and symptoms of urinary tract infection are unspecified. While Leung et al, reported that pyrexia of unknown origin is most common in children below 2 years of age, whereas in older children fever, pain abdomen, dysuria, urinary frequency and urgency are seen.[12]

The frequency of febrile UTI was higher in males in our study while in study done by Daniel et al, the frequency of febrile UTI in females was much higher, and children with febrile UTI were among younger age group.[10] They reported fever as main symptom (63.4%). The symptoms specific to urinary tract infection like pain abdomen, dysuria, hematuria was present in 16.4% cases. Nonspecific symptoms of UTI like loss of appetite (17.9%), abdominal pain (14.2%), vomiting (11.3%), loose stools (11.3%) and lethargy (6.7%) were present in younger age group[10]

PUJ obstruction and hydronephrosis can present throughout childhood, abdominal pain, hematuria, abdominal mass, renal stones and urinary tract infections are their common presenting complaints.[13]

Sutyandi et al reported cystitis, hydronephrosis andhydroureter as their main findings and their frequencies were higher when compared to our results being 19.2%, 42.1% and 11.5% respectively.[14]

Notably, our study identified a subset of patients (9.6%) with a history of recurrent UTIs[15]. This finding underscores the clinical significance of recognizing recurrent UTIs as they can impact the health and quality of life of affected children. The diagnostic imaging results, particularly the MCUG and DMSA scans, reveal important insights[16]. While a small percentage of patients exhibited reflux and normal findings, there was a notable proportion where these imaging modalities were not conducted (97.4% for MCUG and 99.1% for DMSA).[17-19] This suggests the need for a risk-stratified approach to imaging in pediatric UTIs, aligning with current guidelines and minimizing unnecessary radiation exposure.[20-22]

Microbial culture results highlighted the presence of pathogens like E. coli and Enterobacter. These findings emphasize the importance of targeted antibiotic therapy and the need to monitor antimicrobial resistance patterns.[23-25] In considering the broader context, the study's results should be seen as a contribution to the existing body of knowledge on pediatric UTIs, allowing for comparative analyses with other studies.[25-27] Nevertheless, the study does have limitations, including its relatively small sample size and potential selection bias, which may affect the generalizability of the findings. Future research in this field should aim for larger-scale investigations and longitudinal studies to further elucidate the complexities of pediatric UTIs and guide evidence-based clinical practices.

CONCLUSION

The diagnosis and management of pediatric UTIs, underscoring the importance of early detection, individualized treatment, and evidence-based guidelines. It contributes valuable insights to the field, while also recognizing the need for further research to enhance our understanding of this prevalent pediatric condition. The suggestion is to evaluate all children presenting with UTI by ultrasonography and the already established guidelines regarding imaging in UTI in children should be reconsidered.

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This article may be cited as: Ahmad I, Niazi AB, Razzaque J, Ikram M, Munir M, Andrabi WI: Clinical Spectrum and Radiological Evaluation of Urinary Tract Infections in Children. Pak J Med Health Sci, 2023;18(11): 172-174.