https://doi.org/10.29309/TPMJ/2024.31.06.8123

The Professional Medical Journal
www.theprofesional.com
2024, Volume, 31 Issue, 06

ORIGINAL ARTICLE

Etiologies of first time urinary tract infection in pediatric population in tertiary care hospital Karachi.

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Article Citation: Indra, Anjum M, Naeem B, Hanif M, Kumar V, Akram M. Etiologies of first time urinary tract infection in pediatric population in tertiary care hospital Karachi. Professional Med J 2024; 31(06):868-873. https://doi.org/10.29309/TPMJ/2024.31.06.8123

ABSTRACT… Objective: To determine the etiology of first time urinary tract infection (UTI) among children presenting at a tertiary care hospital of Karachi, Pakistan. **Study Design:** Cross-sectional study. **Setting:** Department of Pediatrics, National Institute of Child Health, Karachi. **Period:** December 2022 to May 2023. **Methods:** Children of either gender, aged between 2 months to 12 years, and having UTI for the first time were analyzed. Medical history was obtained and socio-demographic as well as clinical characteristics were noted. Relevant clinical evaluation, laboratory parameters, ultrasonographic findings and etiological pattern were noted. **Results:** In a total of 138 children, 84 (60.9%) were girls. The mean age was noted to be 3.42±2.41 years. The mean duration of symptoms was 11.51±4.27 days. The most frequent presenting symptoms were fever, painful micturation, and abdominal pain, reported by 105 (76.1%), 88 (63.8%), and 64 (46.4%), respectively. The most frequent structural renal abnormalities were internal echos in bladder, unilateral mild hydronephrosis, and bilaterial moderate hydronephrosis, noted in 38 (27.5%), 15 (10.9%), and 14 (10.1%) children, respectively. Escherichia coli, Klebsiella spp., Pseudomonas spp., and others found in 74 (53.6%), 36 (26.1%), 22 (15.9%), and 6 (4.3%), respectively. **Conclusion:** The microbial analysis demonstrated a predominant role of Escherichia coli, followed by Klebsiella spp. and Pseudomonas spp. in causing UTIs for the first time in children.

Key words: Escherichia coli, Fever, Hydronephrosis, Micturation, Urinary Tract Infection.

INTRODUCTION

Urinary tract infection (UTI) ranks as the second most frequent bacterial infection in infants and young children, posing a significant health concern.[1] Approximately 3% of girls and 1% of boys will experience a UTI by the age of 11.[2] In adolescence and young adulthood, females are at a more than threefold increased risk of developing UTIs compared to males. The incidence rate of UTIs stands at around 7% among febrile infants without other identifiable causes.[3] Over the past few decades, clinicians have delved into various aspects of UTIs, including their associations with malignant and chronic hypertension, as well as chronic renal failure following chronic pyelonephritis.[4]

Swift and effective antimicrobial therapy administered in the early stages of UTIs in children plays a crucial role in minimizing renal damage and mitigating associated consequences like renal and chronic hypertension.[5,6] Gram-negative enteric bacteria stand out as the most frequently identified pathogens in UTIs. Given the heightened susceptibility of children's kidneys to scarring and lasting renal impairment, UTIs have the potential to lead to enduring medical issues, including delayed onset hypertension and the gradual progression of renal dysfunction. This underscores the critical importance of prompt intervention to prevent long-term complications arising from UTIs in the pediatric population.[7,8]

The typical diagnostic approach for UTI relies on quantitative urine culture. In addition to this, urinalysis involves a microscopic examination of urine for leukocytes and bacteria, a dipstick test for urinary leukocyte esterase, and assessment of

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Article received on: 21/11/2023
Accepted for publication: 03/02/2024

urinary nitrite levels, which can aid in supporting the UTI diagnosis.[7] Diagnostic imaging plays a crucial role in identifying risk factors associated with long-term adverse outcomes stemming from the infection, including renal parenchymal involvement, malformations, and vesicoureteral reflux (VCR).[8-10] Common imaging procedures conducted following an infant's initial UTI often encompass ultrasonography, dimercaptosuccinic acid scanning, and voiding cystourethrogram. However, the extent of imaging has been a topic of debate within the medical community. Clarifying the optimal scope of diagnostic imaging after the first UTI remains a pertinent consideration in the broader discourse on UTI management.[11,12]

The pervasive heterogeneity seen in the pathology as well as clinical characteristics of pediatric urinary tract infections merits a thorough investigation and analysis of pathogens, etiologies, prognostic factors and outcomes associated with such cases. The viability of the prognostic factors identified in the literature has not been tested much in our population, nor has there been any undertaking aimed towards delineating such population specific prognostic factors and outcomes. This study aimed to bridge this gap in knowledge. The objective of this study was to determine the etiology of first time UTI among children presenting at a tertiary care hospital of Karachi, Pakistan.

METHODS

This cross-sectional study was conducted between July 2023 and December 2023 at the Department of Pediatrics, "National Institute of Child Health", Karachi, Pakistan. Approval from the "Institutional Ethical Review Board" was secured before initiating the study, ensuring adherence to ethical guidelines (IERB-28/2022, dated 31-10-2022). The sample size estimation was performed using the Epi Info sample size calculator, considering a confidence interval of 95%, a margin of error of 5%, and a reported frequency of structural abnormalities in children with UTI of 36%.[13] The calculated sample size using these parameters was determined to be 138. A non-probability convenient sampling technique was employed for participant selection. The inclusion criteria encompassed children of both genders, aged between 2 months and 12 years, experiencing their first UTI based on positive urine culture findings. Exclusion criteria involved children with a prior history of UTI or those diagnosed with neurological diseases. To ensure ethical conduct, written and informed consents were obtained from the parents or guardians of the enrolled children.

The definition of UTI in this study aligned with the guidelines set forth by the "American Academy of Pediatrics (AAP)". A UTI was identified by the presence of pyuria and/or bacteriuria on urinalysis, along with a minimum bacterial colony-forming unit (CFU) count of 50,000 per mL of a uropathogen, as determined through the quantitative culture of a properly collected urine specimen.[14] This meticulous definition aimed to ensure the accuracy and specificity of the diagnosis, providing a robust foundation for the subsequent analyses and interpretations in the study.

Among children fulfilling inclusion criteria, medical history was obtained and socio-demographic as well as clinical characteristics were noted. Adherence to exclusion criteria was strictly observed. Ultrasound was performed by consultant radiologist having at least 5 years of experience. The imaging protocol also included evaluating of structural abnormalities. The presence of renal swelling was also noted. A data recording proforma was formulated for systematic documentation of the data.

Data analysis was done using IBM-SPSS Statistics, version 26.0. Mean and standard deviation were calculated for quantitative variables like age, duration of UTI and left and right kidney size. Frequency and percentages were calculated for gender, renal swelling, fever, vomiting, diarrhea, abdominal pain, flank pain, hematuria, and structural abnormalities.

RESULTS

In a total of 138 children, 84 (60.9%) were girls and 54 (39.1%) boys, representing a girls to boys ratio of 1.6:1. The mean age was noted to

be 3.42±2.41 years, ranging between 3 months to 9 years. The mean duration of symptoms was 11.51±4.27 days, ranging between 5 to 21 days. Table-I is showing the detailed distribution of gender, age and duration of symptoms.

Characteristic		Frequency (%)
Gender	Boys	54 (39.1%)
	Girls	84 (60.9%)
Age	2 months to 1 years	38 (27.5%)
	>1 year to 5 years	53 (38.4%)
	>5 years to 12 years	47 (34.1%)
Duration of UTI	≤1 week	37 (26.8%)
	>1 week	101 (73.2%)

Table-I. Characteristics of children (n=138)

The most frequent presenting symptoms were fever, painful micturation, and abdominal pain, reported by 105 (76.1%), 88 (63.8%), and 64 (46.4%), respectively. Reported frequency of most frequent presenting symptoms and complaints are shown in Figure-1. Descriptive details of ultrosonographic and laboratory findings are shown in Table-II.

VCUG findings revealed normal findings in 108 (78.3%) children while VUR grad-2, and VIR grade 3 were the most frequent VCUG abnormalities reported in 10 (7.2%) children each. Dimercapto succinic acid (DMSA) scan of left kidney revealed fair and poor functioning in 14 (10.1%), 10 (7.2%) children respectively, while remaining 114 (82.6%) children had normal functioning of left kidney as per DMSA scan. DMSA scan of right kidney showed fair functioning in 14 (10.1%) children whereas remaining 124 (89.9%) children had normal functioning of right kidney as per DMSA scan findings. The most frequent structural renal abnormalities were internal echos in bladder, unilateral mild hydronephrosis, and bilaterial moderate hydronephrosis, noted in 38 (27.5%), 15 (10.9%), and 14 (10.1%) children respectively (figure-2). In terms of etiological agents revealed on the basis of positive urine culture findings were E. coli, Klebsiella spp., Pseudomonas spp., and others found in 74 (53.6%), 36 (26.1%), 22 (15.9%), and 6 (4.3%), respectively.

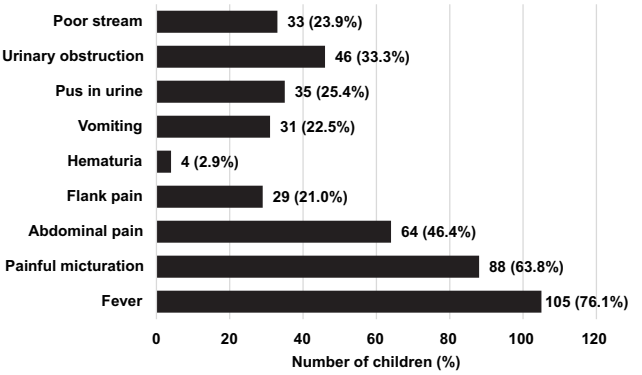

Figure-1. Frequency of presenting symptoms and complaints (n=138)

Parameters		Mean±SD	Minimum	Maximum
Ultrasonographic findings	Left kidney length (cm)	6.72±0.92	4.78	8.24
	Left kidney width (cm)	3.33±0.70	1.90	4.20
	Right kidney length (cm)	6.81±0.75	4.70	8.32
	Right kidney width (cm)	3.44±0.63	2.00	4.44
	Left kidney renal volume (ml)	24.46±5.61	15	36
	Right kidney renal volume (ml)	26.06±6.11	15	42
Laboratory findings	Hemoglobin (g/dl)	11.17±0.80	9.0	12.3
	Total leukocyte count (x1000/mm)	16.73±17.95	4.8	98.0
	Platelets (10^9/L)	348.74±108.32	152	645
	Urea (mg/dl)	32.93±21.45	12	117
	Serum Creatinine (mg/dl)	0.81±0.66	0.20	2.8
	Sodium (mEq/L)	134.70±6.95	128	160
	Potassium (mmol/L)	4.29±0.49	3.1	5.2
	Chlorine (mEq/L)	102.64±7.65	92	132

Table-II. Descriptive analysis of ultrosonographic and laboratory findings (n=138)

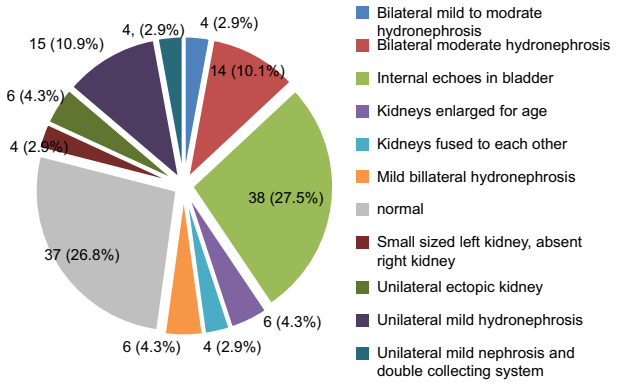

Figure-2. Frequency of structural renal abnormalities (n=138)

DISCUSSION

In this study encompassing 138 children, a notable gender disparity was evident, with 60.9% girls and 39.1% boys, yielding a girls-to-boys ratio of 1.6:1. This observation aligns with existing literature that often reports a higher incidence of urinary tract infections (UTIs) in girls, attributed to anatomical factors such as a shorter urethra, making them more susceptible to ascending infections.[16,17] Additionally, behavioral and hygiene practices may contribute to the gender-based variation.

The mean age of 3.42±2.41 years in the study cohort falls within the typical age range reported for pediatric UTIs. We also noted that 65.9% children were aged below or equal to 5 years of age. A study done by Lu et al from China found the median age of the children with UTIs to be 2 years. Moreover, the same study documented that 60% of children had disease onset at age between 4 years.[18] The prevalence of UTIs in the relatively younger pediatric age groups can be associated with factors like incomplete bladder emptying, inefficient hygiene practices, and exposure to potential pathogens in daycare or school settings. The duration of symptoms in this study ranging from 5 to 21 days underscores the importance of prompt diagnosis and intervention, as prolonged symptoms may lead to complications such as renal scarring.

Fever emerged as the most prevalent symptom in 76.1% of cases, followed by painful micturition (63.8%) and abdominal pain (46.4%). These findings resonate with the classic presentation of pediatric UTIs, where nonspecific symptoms like fever often prompt further investigation. The high incidence of painful micturition and abdominal pain emphasizes the potential involvement of the lower urinary tract and kidneys. Such clinical manifestations underscore the importance of thorough clinical evaluation in suspected cases. The literature reports that most children with UTIs present with fever and it is challenging to distinguish fever as pointing towards UTIs due to its non-specific nature.[19,20]

The etiological agents identified through positive urine cultures, including E. coli (53.6%), Klebsiella spp. (26.1%), Pseudomonas spp. (15.9%), and others (4.3%), align with global trends. E. coli remains the predominant pathogen (ranging between 53-80%), often attributed to its colonization in the perineal area and ascending migration into the urinary tract.[21-23] Regional and temporal variations in pathogen prevalence could be explored through comparisons with studies conducted in different populations and time frames.

This study provides valuable insights into the clinical, demographic, and microbiological aspects of first-time UTIs in pediatric patients in Karachi, Pakistan. The gender distribution, age range, and prevalent symptoms align with established patterns, while imaging studies shed light on structural abnormalities and renal health. These findings underscore the multifaceted nature of UTIs in children, emphasizing the need for tailored approaches in diagnosis, management, and preventive strategies to optimize outcomes in this vulnerable population. Several inherent limitations characterize this study, primarily stemming from its nature as a single-center investigation with a relatively modest sample size. The reliance on a single center introduces a potential limitation in terms of the generalizability of the findings, as the study's outcomes may not be broadly representative of diverse populations or settings. The specific characteristics and demographics of the study site may influence the results, limiting the broader applicability of the

conclusions. We were unable to record outcomes in the current set of children.

CONCLUSION

The microbial analysis demonstrated a predominant role of Escherichia coli, followed by Klebsiella sp. and Pseudomonas, in causing UTIs for the first time in children. The information generated from this research has implications for clinical decision-making, guiding healthcare professionals in the diagnosis, management, and preventive strategies for pediatric UTIs in the local context.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

SOURCE OF FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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2	Misbah Anjum	Concept and Designing, Responsible for data.	
3	Bilquis Naeem	Proof reading, Critical Revisions.	
4	Muhammad Hanif	Data collection, Proof reading.	
5	Vijay Kumar	Data collection, Literature review.	
6	Marium Akram	Data analysis, Discussion.	