

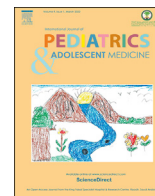
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International Journal of Pediatrics and Adolescent Medicine

journal homepage: <http://www.elsevier.com/locate/ijpam>

Original article

E. coli versus Non-*E. coli* Urinary Tract Infections in Children: A Study from a Large Tertiary Care Center in Saudi Arabia

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ARTICLE INFO

Article history:

Received 4 January 2021

Received in revised form

22 April 2021

Accepted 17 May 2021

Available online 21 May 2021

Keywords:

Urinary tract infections

Pediatrics

*E. coli*Non-*E. coli*

ABSTRACT

Background: While *Escherichia coli* (*E. coli*) is the most common uropathogen implicated in urinary tract infections (UTIs) in children, some studies have found that there are different characteristics between different uropathogens in children. The aim of this study was to compare *E. coli* and non-*E. coli* UTIs in children with respect to their demographic data, predisposing factors, and imaging results.

Methodology: A retrospective chart review was done in children during their first admission with urine culture confirmed UTI in a tertiary care center. We divided patients into *E. coli* and non-*E. coli* groups according to urine culture results.

Results: Out of 202 children with their first admission for a culture-proven UTI, pathogens other than *E. coli* accounted for 24.3% of UTIs. *Klebsiella pneumoniae* was the most common non-*E. coli* pathogen, followed by *Pseudomonas aeruginosa* and *Enterococcus* species. Non-*E. coli* UTIs were significantly more common in male subjects, younger children, and children with a past history of UTI or who had received antibiotics prior to admission. In addition, higher rates of abnormalities on renal ultrasound and VCUG were found with non-*E. coli* organisms.

Conclusion: There is a significant difference in demographic and imaging findings in children with non-*E. coli* UTIs. These findings may impact the work-up and treatment of UTIs in the pediatric population.

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1. Introduction

Urinary tract infections (UTIs) are common infections in children. UTIs are treatable infections, and local antimicrobial resistance patterns are important to appropriately treat these infections. In a recent local study, we found that *Escherichia coli* (*E. coli*) was the predominant uropathogen causing community-acquired UTIs in children, accounting for approximately 75% of all cases [1]. Another published local study showed that the rate of antimicrobial resistance to common uropathogens is increasing for which

differentiating between these pathogens would help choosing the appropriate empirical antimicrobial coverage [2].

While our study and others have shown that *E. coli* is the most common uropathogen, there are very limited local data that compare characteristics of different uropathogens. To understand these characteristics is of importance as it impacts the management of UTIs. One study from a university hospital in Jeddah, Saudi Arabia, found that non-*E. coli* UTIs were significantly more common in children with abnormal renal ultrasound findings [3]. Two recent studies from Korea showed that uropathogens other than *E. coli* were increasingly associated with high-grade vesicoureteral reflux (VUR) [4,5]. A European study also reached the same findings with the risk of high-grade VUR being 26% in the presence of non-*E. coli* bacteria versus only 3% in the presence of *E. coli* bacteria [6]. A study from USA showed that febrile infants with enterococcal UTIs had a higher frequency of genitourinary abnormalities than that of

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Peer review under responsibility of King Faisal Specialist Hospital & Research Centre (General Organization), Saudi Arabia.

Table 1
Comparison of Demographic and Clinical Features of *E. coli* and non-*E. coli* UTIs in Children.

Characteristic	<i>E. coli</i> (n = 153)	Non- <i>E. coli</i> (n = 49)	p-value
Male gender (n)	20	20	<0.0001
Age (years ± SD)	5.20 ± 0.28	3.72 ± 0.48	0.01
Past history of UTI (n, %)	53 (34.6)	27 (55.1)	0.012
Received antibiotics prior to admission (n, %)	38 (24.8)	22 (44.9)	0.011
Urine WBC ≥5 (n, %)	140 (91.5)	47 (95.9)	0.530
Negative urine nitrate (n, %)	85(55.56)	24(48.98)	0.510
Negative urine leukocyte esterase (n, %)	17 (11.1)	5 (10.2)	1.000
Abnormal renal ultrasound (n, %)	70 (48.3)	30 (66.7)	0.008
Abnormal VCUG (n, %)	63(51.7)	33(76.7)	0.01
Length of stay ≤7 days (n, %)	96 (62.8)	23 (46.9)	0.042

infants with gram-negative UTIs [7]. Two regional studies both from Israel also focused on characteristics of different uropathogens in children. One study found that UTIs caused by non-*E. coli* pathogens had a significant association with younger age of the child, previous use of antibiotics, and anomalies of the urinary tract [8]. Another study of community-acquired UTIs found that uropathogens other than *E. coli* caused 40% of UTIs and were more common in boys, those with underlying renal tract abnormalities, and those who had received recent antibiotics [9].

The objectives of this study were to compare the demographic characteristics, radiological abnormalities, and other predictors of *E. coli* and non-*E. coli* UTIs in children in a tertiary care center in Saudi Arabia.

2. Material and methods

We conducted a retrospective chart review of all admissions of UTIs in children aged 0–14 years in King Abdulaziz Medical City, Riyadh. Data for patients admitted from 2006 to 2012 were included. Children were excluded from the analysis if they had hospital-acquired UTIs or if they had underlying urogenital abnormalities, chronic renal failure, or were immunosuppressed. We defined a UTI as the presence of both a positive urinalysis (pyuria/bacteriuria) and a positive urine culture result of ≥10,000 cfu/mL in an appropriately obtained specimen. For younger children, we considered urine cultures collected by catheterization or by suprapubic aspirate to be appropriate specimens in line with international guidelines. Patients with positive urine cultures obtained from bag collection were excluded from data collection and analysis.

Data analysis was done using SAS statistical software. Significant differences were identified at p-value <0.05. The ethics approval for the study was obtained from King Abdullah International Medical Research Center (KAIMRC) (Ref # RRSC/251/2012).

3. Results

Two hundred and two children with their first hospital admission for a UTI were included in the study with female patients who accounted for 162 patients (80.2%). One hundred and fifty-three UTIs (75.7%) were caused by *E. coli*, whereas 49 (24.3%) were caused by pathogens other than *E. coli*. The most common non-*E. coli* pathogen was *Klebsiella pneumoniae*, followed by *Pseudomonas aeruginosa*, *Enterococcus* species, *Enterobacter cloacae*, *Proteus mirabilis*, and *Citrobacter freundii*.

Non-*E. coli* UTIs were much more common in male subjects ($p < 0.0001$) and in younger children ($p = 0.01$). There was also a significant association with prior use of an antibiotic and previous history of UTI ($p = 0.011$ and 0.012 , respectively). There were no statistically significant differences in urinalysis finding between *E. coli* and non-*E. coli* uropathogens. In children with UTIs caused by non-*E. coli* pathogens, abnormalities in renal ultrasound and VCUG

were seen in 66.7% and 76.7% of patients, respectively, both significantly higher than in *E. coli* UTIs ($p = 0.008$ and $p = 0.01$, respectively). A higher frequency of children with *E. coli* UTIs had a length of stay of 1 week or less than that of non-*E. coli* UTIs (Table 1).

4. Discussion

In this study, we present local data that compare characteristics of *E. coli* vs. non-*E. coli* community-acquired UTIs in children. Several factors were found to be associated with UTIs caused by non-*E. coli* uropathogens, including male sex, patients with a prior history of UTI, and patients receiving antibiotics prior to admission. Children with non-*E. coli* UTIs had higher rates of abnormalities on renal imaging.

Our finding of non-*E. coli* UTIs being more common in boys is consistent with other studies [8,9]. One factor that increases the risk of non-*E. coli* UTI in boys is the presence of renal anomalies [9]. We also observed that history of UTI and recent antibiotic use were also significant risk factors for non-*E. coli* UTIs. Previous antibiotic use is known to be a risk factor for increase in antimicrobial resistance.

Consistent with the previously cited studies [3–9], we found that children with non-*E. coli* UTIs had significantly increased rates of abnormalities on renal ultrasound (like hydronephrosis, prominence or fullness of renal pelvis, renal scar, etc.) and VUR as compared to children with *E. coli* UTIs. This could be explained by the loss of the host defense mechanism in patients with renal anomalies that might make them more vulnerable to the less virulent organisms [10].

While some recent studies [11–13] have suggested differences in urinalysis results with different uropathogens, we did not observe these differences. This may be due to the relatively small sample size in our study. We also found that children with non-*E. coli* UTIs tend to have a longer length of stay as compared to *E. coli* UTIs. This is expected as non-*E. coli* UTIs may require broader antibiotic coverage with no available oral options for certain organisms.

We present one of the first studies done in the gulf region that compare *E. coli* vs. non-*E. coli* UTIs in children and compared many demographic data and investigations between the 2 groups. We were strict in our definition of UTI to capture true UTIs. This study was limited by being a single center retrospective study. In addition, our study included data only up to the year 2012.

5. Conclusions

In summary, non-*E. coli* UTIs are more common in boys and are associated with a higher risk of renal ultrasound abnormalities and VUR. Our findings support that children with non-*E. coli* UTIs need renal tract imaging. Further research is needed to conclude whether broadening empiric antibiotic coverage is needed in boys admitted with community-acquired UTIs and whether differences in urinalysis results are found with different uropathogens.

Author statement

Dr. Abdullah Al Nafeesah made substantial contributions to data collection, data analysis, and drafting of the manuscript. Dr. Khaled Al Fakeeh conceived the study and made substantial contributions to the study design and data interpretation. Dr. Syed Chishti made substantial contributions to data collection. Dr. Tahir Hameed conceived the study, made substantial contributions to study design, data collection, data interpretation, and was involved in drafting of the manuscript.

Ethical statement

Regarding our manuscript "***E. coli* versus non-*E. coli* Urinary Tract Infections in Children: a Study from a Large Tertiary Care Center in Saudi Arabia**," before starting our study, we obtained ethical approval from King Abdullah International Medical Research Center (Ref # RRSC/251/2012).

Thank you for considering our manuscript in the International Journal of Pediatrics and Adolescent Medicine, and we look forward to your favorable response regarding publication of our study.

Declaration of competing interest

None.

Acknowledgments

We would like to thank KAIMRC for statistical support.

Visual abstract

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijpam.2021.05.002>.

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