J Ped Nephrol
Journal of Pediatric Nephrology
Autumn 2022. Volume 10. Number 4

Original Article

Clinical Spectrum of Recurrent Urinary Tract Infections in Children

Asma Wani[1], Mohd Ashraf[2*], Nisar Ahmed Wani[3], Suhail Ahmed Naik[1], Syed Ashiq Nisar Andrabi[1], Waseem Shafi Sheikh[1]

1. Department of Pediatrics, Govt Medical College Srinagar, Kashmir, India.
2. Department of Pediatric Nephrology, Govt Medical College Srinagar, Kashmir, India.
3. Department of Pediatric Radiology, Govt Medical College Srinagar, Kashmir, India.

Use your device to scan and read the article online

Citation Wani A, Ashraf M, Wani NA, Naik SA, Andrabi SAN, Sheikh WS. Clinical Spectrum of Recurrent Urinary Tract Infections in Children. Journal of Pediatric Nephrology. 2022; 10(4):175-179. https://doi.org/10.22037/jpn.v10i4.41116

doi https://doi.org/10.22037/jpn.v10i4.41116

Article info:
Received: 02 Feb 2022
Accepted: 29 Feb 2022
Publish: 01 Dec 2022

Corresponding Author:
Mohd Ashraf
Address: Mohd Ashraf, Department of Pediatric Nephrology, Govt Medical College Srinagar, Kashmir, India.
E-mail: aashraf05@gmail.com

ABSTRACT

Background and Aim: Urinary tract infection (UTI), is a common bacterial infection in pediatric group, can be easily diagnosed, but its recurrence can indicate underlying serious anatomical defects of the urogenital tract, leading to acute morbidity and chronic medical condition, such as hypertension and renal insufficiency.

Objective: To know the clinical spectrum and the frequency of recurrent UTI among children visiting our hospital.

Methods: This prospective study was conducted during the period from April 2020 to March 2021, in the department of pediatrics and pediatric nephrology, Governmental Medical College, Srinagar. All children aged between 6 months to 18 years presenting with a history of recurrent urinary tract were included in the study. A detailed history, relevant clinical examination, and the ultrasonography of kidney ureters and bladder (USG KUB) followed by voiding cystourethrography (VCUG), were carried out and subsequently analyzed.

Results: A total of 38 patients with recurrent UTI were evaluated during one year. The commonest age group was 6 months to 2 years (68%), with female preponderance (F: M 3.2:1). Urine culture grew *E. coli* in 95% of patients, while USG abnormalities and the presence of vesicoureteral reflux (VUR) on voiding cystourethrography (VCUG) were seen in 14 patients (36%).

Conclusion: Recurrent UTI are common between 6 months to 2 years, and E coli is the most common cause. Children with the past history of UTI seem more predisposed to have another E.coli-associated UTI.

Keywords: Children, Urine culture, Urinary tract infection (UTI), Vesicoureteral reflux

Introduction

UTI is one of the most common bacterial infections among children with an occurrence rate of 8.4% in girls and 1.7% in boys in the first 6 years of life [1]. The frequency of UTI recurrence is 30% according to published research [2, 3]. UTI and its possible recurrence may be the first symptom of some serious underlying congenital anomaly of the kidneys and urinary tract (CAKUT), of which vesicoureteral reflux (VUR) is the most prevalent. It is an established fact that VUR is associated

J Ped Nephrol
Journal of Pediatric Nephrology

with an increased risk of recurrent UTI and renal scarring [4, 5]. However, other factors, such as bladder and bowel dysfunction (BBD), and poor immunity may play a crucial role in the recurrence of UTI [6-8]. Transient damage to the kidneys and hospitalization rates occurs in about 40% of children with UTI [9], while permanent damage can occur in about 5% even following a single infection [10]. Due to the paucity of data regarding the occurrence of recurrent UTI among children in this geographical area, the present study was conducted.

Materials and Methods

This study was conducted between March 2020 and February 2021 in children aged 6 months to 18 years presenting with fever ≥100.4F without any localizing sign (s), or those referred to a pediatric nephrology outpatient clinic. By definition, recurrent UTI was considered by the presence of a positive urine culture report plus clinical features two or more weeks after the termination of therapy for the first UTI [11]. All children with human immunodeficiency virus, congenital immunodeficiencies, sickle cell disease, neurogenic bladder

and paralytic syndromes, chronic renal disease, renal calculi, and central nervous system malformation were excluded. USG kidneys and voiding cystourethrography (VCUG) were performed on all children. On the USG of Kidneys ureters and bladder, an anteroposterior pelvic diameter >10 mm was defined as hydronephrosis, and a diameter of 7–10 mm was defined as mild dilatation of the upper urinary tract. VUR was graded as I to V based on VCUG. [12].

Based on history and physical examination, a clinical diagnosis of suspected UTI, or recurrent UTI was made. The urine samples were collected in sterile containers and sent for dipstix, microscopy, culture, and sensitivity within 1 hour of sample collection. In the age group of 6 months to 2 years, urine was collected by either supra-pubic aspiration or through transurethral catheterization, and in >2 years transurethral catheterization or clean catch midstream urine collection method was employed. Urine was refrigerated, if not plated within one hour. Ten to 15 mL of urine was centrifuged at 2000 rpm for 5 minutes and a wet preparation of the sediment was examined using a×40 objective microscope. The presence of any bacteria per high power field (HPF) and pyuria (more than 5 white blood cells [WBCs] per high power field [HPF]) was regarded as significant and suggestive of UTI, and urine was sent for culture and sensitivity. After 24 hours of incubation under aerobic conditions at 30°C, bacterial colony growth was assessed. All plates were incubated at 30°C and examined for growth according to microbiological protocols for two days. A positive result was obtained according to the diagnosis criteria for UTI as shown in Table 1.

Results

A total of 38 patients with recurrent UTI were evaluated in one year. The most common age group involved was between 6 months to 2 years (68%), with female preponderance (F:M 3.2:1). *E.coli* was the most common organism isolated, while USG abnormalities and the presence of VUR on micturating cystourethrogram (MCUG) were observed in 14(36%) each. Grade III-IV VUR was the most common grade 6(42%) observed VUR. Table 2 presents the detailed characteristic of the patients:

Table 1. Urinary tract infection (UTI) diagnosing criteria in children [13].

Collection Method	Colony Count (CFU/mL)	Probability of Infection (%)
Supra-pubic aspiration (SPA)	Any growth	>99%
Trans-urethral catheterization	$>10^5$	95%
	10^4–10^5	Infection likely
Clean-catch midstream void	$>10^4$ (boy)	Infection more likely
	$\geq10^5$ (girl) (3 specimens)	95%
	$\geq10^5$ (girl) (2 specimens)	90%
	$\geq10^5$ (girl) (1 specimen)	80%

CFU: Colony-forming units.

Statistical analysis

Data were entered in a Microsoft Excel spreadsheet, numbers and percentages were calculated and relevant interpretations were drawn when required.

Discussion

From short-term morbidity to permanent kidney damage, UTI is associated with variables, such as age, gender, race, and circumcision status, which are believed to alter the risk of its recurrence. In the present study, the male-female ratio was 1: 3.2, and children aged 2-8 years were the most commonly affected which is consistent with the published literature.

We observed 36 patients (95%) had UTI due to colonization of *E. coli,* while one patient (2.5%) grew Enterococcus and Klebsiella each in their urine cultures. Despite protocolized management and careful follow-up, UTIs relapsed in 7(18%) of children, which was quite similar to the study conducted by Hannula et al. [14]. The preponderance of *E. coli* among the studied population implies that these children were predisposed more to *E. coli* infection than any other organism. This is similar to the observations made by Alberici et al. [15], where *E. coli* was isolated from 84% of patients with UTI. Fimbriae of *E. coli* help it to adhere to the uroepithelium, even in the presence of adequate urine flow, which is the main defense of the urinary tract against UTI [16]. Since we excluded the patients associated with major congenital anomalies of kidneys and urinary tract with higher numbers of organisms other than *E. coli*, a pattern is quite similar to the observations of Alberici et al. [15].

The possibility that one UTI may predispose to another UTI, due to defective urothelium repair of a previously affected child, requires more robust studies. Despite recurrent UTI, we did not encounter deterioration of renal functions, which is quite similar to the Swedish population-based study that found no significant deterioration in renal function in patients with a history of childhood UTI. However, UTI recurrence rates dropped significantly after surgical intervention, which is similar to the observations made by Williams et al. in their systematic review [17], where febrile UTI recurrences dropped but did not achieve a reduction in the risk of new renal injury. In a few meta-analyses comparing surgical correc-

Table 2. Patient characteristics of studied population

Variables	Characteristic of Patients	No. (%)
Age	6 months-2 years	26(68.5)
	2 years	12(31.5)
Gender	Male	9(23.7)
	Female	29(76.3)
Blood pressure	Normal	32(84)
	High	6(16)
Past history of UTI	2 or <2	8
	>2	3
Organism isolated	*E-Coli*	36(94.7)
	Klebseilla	1(2.6)
	Proteous	
	Staphylococcus	
	Pseudomonas	
	Enterococcus	1(2.6)
	Other	

J Ped Nephrol
Journal of Pediatric Nephrology

Variables	Characteristic of Patients	No. (%)
Vesicoureteral reflux grade	I-II	3(7.8)
	III-IV	6(15.8)
	V	5(13.1)
USG-KUB	Normal	24(63.1)
	Abnormal	14(36.9)
	HDN	7(36.9)
	Dilated ureter	4(10.5)
	Trabeculated bladder	-
	Renal Hypo-dysplasia	-
	Solitary kidney	1(2.6)
	Ureterocele/diverticula	1(2.6)
	Duplex system	1(2.6)
Surgical intervention	Ureteral transplantation	3(7.8)
	Unilateral nephrouretrectomy	1(2.6)

Abbreviations: UTI: Urinary tract infection; USG-KUB: Ultrasonography of kidney, ureter, and bladder; HDN: Hemolytic disease of the newborn.

tion of VUR to antimicrobial prophylaxis only, the risk of non-febrile UTI recurrence or renal scar formation did not differ significantly between the surgical and medical groups. Nevertheless, it is essential here to mention that the surgical ureteric reimplantation has a success rate of 97%–99% [18] for correcting primary VUR, while combined surgery plus antibiotic prophylaxis reduced the risk of recurrent febrile UTI by 57% compared to antibiotics alone [17]. Patients with more than 2 recurrent UTIs had higher BP, proved by 24-hour ambulatory BP, who underwent surgical intervention and were put on calcium channel blockers till the last follow-up. This is similar to the observations made by Jacobson et al. and Goonasekaera et al. [19, 20], but not consistent with the study by Wennrstom et al. who did not report any difference in BP [21].

Limitations: Since it is a smaller study, our findings cannot be generalized, b) we did not have long-term follow-up, c) no comment exists on nuclear imaging reports of the recurrent UTI patients.

Conclusion

Recurrent UTI is common between 6 months to 2 years, and *E. coli* is the most common cause. Children with a history of UTI seem more predisposed to have another UTI with *E. coli*.

Ethical Considerations

Compliance with ethical guidelines

No ethical considerations are considered in this research

Funding

This research did not receive any grant from funding agen-cies in the public, commercial, or non-profit sectors.

Authors' contributions

All authors equally contributed to the preparation of this article.

Conflict of interest

The authors declare no conflict of interest.

References

[1] Hellström A, Hanson E, Hansson S, Hjälmås K, Jodal U. Association between urinary symptoms at 7 years old and previous urinary tract infection. Arch Dis Child. 1991; 66:232-4. [DOI:10.1136/adc.66.2.232] [PMID] [PMCID]

[2] Winberg J, Bergström T, Jacobsson B. Morbidity, age and sex distribution, recurrences and renal scarring in symptomatic urinary tract infection in childhood. Kidney Int Suppl. 1975 Aug;4:S101-6. [PMID]

[3] Panaretto KS, Craig JC, Knight JF, Howman Giles R, Sureshkumar P, Roy LP. Risk factors for recurrent urinary tract infection in preschool children.J Paediatr Child Health. 1999; 35:454-9. [DOI:10.1046/j.1440-1754.1999.355417.x] [PMID]

[4] Bisset GS, III, Strife JL, Dunbar JS. Urography and voiding cystourethrography: Findings in girls with urinary tract infection. AJR Am J Roentgenol. 1987; 148:479-2. [DOI:10.2214/ajr.148.3.479] [PMID]

[5] Gleeson FV, Gordon I. Imaging in urinary tract infection. Arch Dis Child. 1991; 66:1282-3. [DOI:10.1136/adc.66.11.1282] [PMID] [PMCID]

[6] Shaikh N, Hoberman A, Wise B, Kurs-Lasky M, Kearney D, Naylor S et al. Dysfunctional elimination syndrome: Is it related to urinary tract infection or vesicoureteral reflux diagnosed early in life? Pediatrics. 2003; 112:1134-7. [DOI:10.1542/peds.112.5.1134] [PMID]

[7] Svanborg C. Urinary tract infections in children: Microbial virulence versus host susceptibility. Adv Exp Med Biol. 2013; 764:205-10. [DOI:10.1007/978-1-4614-4726-9_17] [PMID]

[8] Ragnarsdóttir B, Svanborg C. Susceptibility to acute pyelonephritis or asymptomatic bacteriuria: Host-pathogen interaction in urinary tract infections. Pediatr Nephrol. 2012; 27:2017-9. [DOI:10.1007/s00467-011-2089-1] [PMID]

[9] Craig JC, Irwig LM, Knight JF, Sureshkumar P, Roy LP. Symptomatic urinary tract infection in preschool Australian children. Journal of Paediatrics & Child Health 1998; 34(2):154-9. [DOI:10.1046/j.1440-1754.1998.00190.x] [PMID]

[10] Coulthard MG, Lambert HJ, Keir MJ. Occurrence of renal scars in children after their first referral for urinary tract infection. BMJ. 1997; 315:918-9. [DOI:10.1136/bmj.315.7113.918] [PMID] [PMCID]

[11] Conway PH, Cnaan A, Zaoutis T, Henry BV, Grundmeier RW, Keren R. Recurrent urinary tract infections in children: Risk factors and association with prophylactic antimicrobials. JAMA. 2007; 298:179-86. [DOI:10.1001/jama.298.2.179] [PMID]

[12] Heikel PE, Parkkulainen KV. Vesico-ureteric reflux in children. A classification and results of conservative treatment. Ann Radiol. 1966; 9(1):37-40. [PMID]

[13] Saadeh SA, Matto TK. Managing urinary tract infections. Paediatr Nephrol. 2011; 26:1967-76. [DOI:10.1007/s00467-011-1801-5] [PMID] [PMCID]

[14] Hannula A, Venhola M, Renko M, Pokka T, Huttunen NP, Uhari M. Vesicoureteral reflux in children with suspected and proven urinary tract infection. Pediatr Nephrol. 2010; 25(8): 1463-9. [DOI:10.1007/s00467-010-1542-x] [PMID]

[15] Alberici I, La Manna A, Pennesi M, Starc M, Scozzola F, Nicolini G et al. First urinary tract infections in children: The role of the risk factors proposed by the Italian recommendations. Italian recommendations. Acta Paediatrica. 2018; 108(3):544-50. [DOI:10.1111/apa.14506] [PMID]

[16] Morello W, La Scola C, Alberici I, Montini G. Acute pyelonephritis in children. Pediatr Nephrol. 2016; 31(8):1253-65. [DOI:10.1007/s00467-015-3168-5] [PMID]

[17] Williams G, Hodson EM, Craig JC. Interventions for primary vesicoureteric reflux. Cochrane Database Syst Rev. 2019; 2(2):CD001532. [DOI:10.1002/14651858.CD001532.pub5]

[18] Venhola M, Huttunen NP, Uhari M. Meta-analysis of vesicoureteral reflux and urinary tract infection in children. Scand J Urol Nephrol. 2006; 40:98-102. [DOI:10.1080/00365590500499529] [PMID]

[19] Jacobson SH, Eklo¨f O, Eriksson CG, Lins LE, Tidgren B, Winberg J. Development of hypertension and uraemia after pyelonephritis in childhood: 27 year follow up. BMJ. 1989; 299(6701):703-6. [DOI:10.1136/bmj.299.6701.703] [PMID] [PMCID]

[20] Goonasekera CD, Shah V, Wade AM, Barratt TM, Dillon MJ. 15-year follow-up of renin and blood pressure in reflux nephropathy. Lancet. 1996; 347(9002):640-3. [DOI:10.1016/S0140-6736(96)91201-5] [PMID]

[21] Wennerstrom M, Hansson S, Hedner T, Himmelmann A, Jodal U. Ambulatory blood pressure 16-26 years after the first urinary tract infection in childhood. J Hypertens. 2000; 18:485-91. [DOI:10.1097/00004872-200018040-00019] [PMID]