Valley International Journals
Open Access Journal

International Journal Of Medical Science And Clinical Inventions
Volume 3 issue 4 2016 page no. 1742-1750 e-ISSN: 2348-991X p-ISSN: 2454-9576
Available Online At: http://valleyinternational.net/index.php/our-jou/ijmsci

Profile Of Children's Urinary Tract Infection, Evaluation Of Risk Factors And Review Of The Literature

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Abstract:
It is important to indicate the distribution and alteration of the factors of urinary tract infections in children and of the resistance ratios according to years and to probe the accompanying risk factors. In this study, the records of Microbiology Laboratory and Pediatric Clinic of İzmir Menemen State Hospital were searched retrospectively. In the course of the study, 10^5 cfu/ml and single microorganism growth were taken under evaluation in urine cultures. A total of 2669 urine cultures were evaluated; in 456 of them (17%) significant growth was detected in terms of urinary tract infection. 275 (60%) of the samples with reproduction belonged to girls and 181 (40%) of them belonged to boys. Escherichia coli was the most commonly reproduced microorganism in 64% patients. Klebsiella spp. was determinant in %16 patients, Proteus spp. in %8 patients , Enterococcus spp. in %5 patients, Pseudomonas aeruginosa in %3 patients, Staphylococcus aureus in %2 patients, Coagulase Negative Staphylococcus in %2 patients. In E.coli strains, 66% resistance was detected to ampicilline, 16% to amoxicilline clavulanate, 28% to ampicilline/sulbactam, 14% to ceftazidime, 25% to ceftriaxone, 6% to nitrofurantoine, 6% to phosphomisine, 0% to imipenem, 29% to trimethoprim sulfamethoxazole, 23% to gentamicine. Ampicillin was the antibiotic against which the highest resistance was determined by 100% for Klebsiella spp. and by 71% for Proteus spp. In the childhood urinary tract infections, more resistance to ampicillin, ampicillin/sulbactam, gentamicin and TMP-SMX, frequently preferred as the first option, was found than the others. During this study period, the resistance to meropenem and imipenem was not found in childhood group. ESBL positive Gram negative bacteria rate was 69/456 (15%). A total of 59 of them were E.coli, 10 of them were Klebsiella spp.
Today, nitrofurantoin, aminoglycosides are the antibiotics that can still be suggested in empirical treatment due to the low resistance. Yet, the continuation of the antibiotic treatments started empirically must be decided again after the culture and susceptibility test results reported by microbiology laboratory are interpreted, as suggested in guides.

Key Words: Pediatric urinary tract infections, antibiotic resistance, risk factors

Introduction

Urinary Tract Infections (UTI) are frequent clinical pictures in the first five years in childhood (1). As the factor can be bacteria, viruses or fungi can cause them (2). Both anatomic and some disorders that can happen functionally pave the way for the formation of infections in urinary tract (3). The reflux or stone in the urinary tract are examples of functional disorders that pave the way for UTI. One of the reasons that increase the prevalence in urinary tract infections in children is the deficiency of hygiene in genital region (4, 5). Also, swimming pools not being hygienic enough is another risk factor for each age group. In children with chronic constipation problem, more frequent infections can happen in urinary tract because of long accumulation of urine in the bladder (5).

A total of 2669 urine culture tests of children examined in microbiology laboratory of our hospital in January 2014-November 2015 were probed for the profile of active microorganisms, their antibiotic susceptibility and determination of risk factors.

Material and method

The patients included in the study are 0-18 aged patients who applied to pediatric polyclinic of our hospital in January 2014- November 2015. A total of 803/2669 reproduction was detected in urine samples, including samples more than one taken at different times from the same patient. In the examination made considering one reproduction result of each patient, 275 of 456 patients detected reproduction in urine culture were females; 181 of them were males and 52 of them were under the age of 1;

DOI: 10.18535/ijmsci/v3i4.1

404 of them were over the age of 1. The number of patients followed with the diagnosis of vesicoureteral reflux (VUR) was 13 (%2.85).

Clean urine samples taken as mid-stream in childhood and collected into drainage bag in infants were added into 5% sheep blood agar and Eosine Methylene Blue agar (Salubris, Turkey), and bacterial growth was evaluated after incubated for 18-24 hours at 37 °C. A positive culture was defined as follows: growth of a single urinary tract pathogen with at least > 10^5 colony-forming units (CFU)/mL in urine specimens. After the reproducing bacteria were completed by looking at gram stain, catalase, coagulase, oxidase tests through traditional methods and by using API 20E (BioMérieux, France) bacteria identification kit, antibiotic susceptibility tests were performed through disk diffusion method in compliance with the methods of "The Clinical and Laboratory Standards Institute" (CLSI). (6). Extended spectrum beta lactamase (ESBL) producing organisms were screened and confirmed according to the method suggested by the CLSI (6).

Results

A total of 2669 urine cultures were examined during the two-year following period. Reproduction took place in 456 (17%) of the samples. Of the samples with reproduction, 275 (60%) were taken from females, 181 (40%) from males. The number of reproduction according to gender are in Table 1. The average age of the patients was 60 ± 24 months (1-180 months). A total of 52 of the cases (11%) were under 12 months age, 404 of them (89%) were over 12 months age. Of the 13 (2.9%) children with VUR, 6 were female, 7 were male patients. *E.coli* was the most commonly reproduced microorganism in 292 (64%) patients. *Klebsiella spp* was active in 72 (16%) patients, *Proteus spp* was active in 36 (8%) patients, *Enterococcus spp.* was active in 24 (5%) patients, *Pseudomonas aeruginosa* was active in 13(3%) patients, *Staphylococcus aureus* was active in 9 (2%) patients, Coagulase Negative *Staphylococcus* was active in 10 (2%) patients. The resistance rates to antibiotics of the most common Gram positive bacteria in urine cultures were given in Table 2, Gram negative bacteria were given in Table 3.

Ampicillin resistance was found to be very high in gram negative enteric bacteria. In *E.coli* strains, 66% resistance was found to ampicillin, 16% to amoxicillin clavulanat, 28% to ampicillin/sulbactam, 14% to ceftazidime, 25% to ceftriaxone, 6% to nitrofurantoin, 6% to phosphomycine, 0% to imipenem, 29% to trimethoprim/sulphamethoxazol, 23% to gentamicine. ESBL positive Gram negative bacteria rate was 69/456 (15%). A total of 59 of them were *E.coli*, 10 of them were *Klebsiella* spp.

Table 1. Distribution of the microorganisms by gender

	Male	Female	**Total**
E. coli	127 (%43)†	165 (%57)	292 (%64)
Klebsiella spp.	28 (%39)	44 (%61)	72 (%16)
Proteus spp.	21 (%58)	15 (%42)	36 (%8)
P.aeruginosa	4 (%30)	9 (%70)	13 (3)
Enterococcus spp.	11 (%46)	13 (%54)	24 (5)
S.aureus	4 (%44)	5 (%56)	9 (2)
CNS	6 (%60)	4 (%40)	10 (2)
Total	**181 (%40)**	**275 (%60)**	**456 (%100)**

† growth number

CNS: Coagulase negative Staphylococcus

DOI: 10.18535/ijmsci/v3i4.1

Table 2. Resistance rates of Gram positive microorganisms obtained in urine cultures against various antibiotics

	Enterococcus spp	*S.aureus*	CNS
	n=24	n=9	n=10
Penicillin	%46	%78	%81
Clindamycin	-	%11	%15
Eritromicin	%48	%44	%40
Vancomycin	%0	%0	%0
Cefoxitine	-	%44	%53
Linezolid	-	%6	%0
Gentamicin High Level	%41	-	-
TMP/SMX	-	%16	%8
Gentamicin	-	%16	%7
Fosfomycin	%20	-	-
Nitrofurantoin	%0	-	-
Ampicillin	%26	-	-

TMP-SMX:Trimethoptim-sulfamethoxazole

Table 3. Resistance rates of Gram negative microorganisms obtained in urine cultures against various antibiotics

	Escherichia coli	*Klebsiella spp.*	*Proteus spp.*	*P.aeruginosa*
	n=292	n=72	n=36	n=13
Ampicillin	193/292 %66	72/72 %100	26/36 %71	-
Amoxycillin/clavulanate	47/292 %16	18/72 %25	5/36 %15	-
Ampicillin/sulbactam	82/292 %28	28/72 %39	10/36 %28	-
Phosphomicine	18/292 %6	16/72 %22	11/36 %31	-
Gentamicin	67/292 %23	19/72 %26	8/36 %23	1/13 %8
Imipenem	0/292 %0	9/72 %13	1/36 %3	0/13 %0
Meropenem	0/292 %0	6/72 %8	0/36 %	0/13 %0
Nitrofurantoin	18/292 %6	12/72 %17	13/36 %36	-
Cefepime	-	-	-	3/13 %25
Ceftazidime	41/292 %14	8/72 %11	6/36 %18	2/13 %16
Ceftriaxone	73/292 %25	12/72 %16	0/36 %0	4/13 %33
TMP-SMX	85/292 %29	17/72 %23	15/36 %41	-
Piperacillin/Tazobactam	-	-	-	1/13 %7

TMP-SMX:Trimethoptim-sulfamethoxazol

DOI: 10.18535/ijmsci/v3i4.1

Discussion

Urinary tract infections are frequent and important infectious diseases in children. 5-6% of infections in children evaluated because of fever are caused by UTIs (7). At the first step of UTI, there comes the colonization of periurethral region with enteric pathogens. These enteric bacteria start to hold on to mucosa thanks to their virulence properties and the process of inflammatory response comes out, there can be spread in the course of time and infection can spread towards bladder and kidney (8).VUR, neuromuscular dysfunction, mixion disorder, constipation, bladder neck stenosis, presence of catheter facilitate, familial and genetic predispositions facilitate UTI development (9). It is reported that there is also familial and genetic susceptibility (10-13). The possibility to develop severe complications increases in the presence of anatomic disorders and in repeating infections (14). In acute pyelonephritis cases, VUR was detected by 25-40% with the help of kidney scintigraphy (15, 16). The possibility to develop renal scar in these patients was reported to be 15%. The data in which renal scar development rate was detected as 37.1% in children with VUR and as 14.3% in children without VUR are the results of a newly made research in Turkey (17). Peru et al. did not detect a significant difference in VUR prevalence between three groups (acute pyelonefritis, afebrile UTI, afebrile recurrent UTI) a with the study they carried out in 642 pediatric patients with UTI.

While scar development triggers hypertension, chronic pyelonefritis paves the way for end-stage kidney failure. In order to be successful in the treatment of urinary tract infection and its complications, it is important that early diagnosis should be made and treatment for pathogenesis should be started. There are approaches stating the importance of early intervention of the first doctor for accurate diagnosis and treatment, as there are less aggressive approaches (18). The reason for this is that the possibility of renal parenchymal defects development is 3-15% in the first 2 years after being diagnosed UTI (19).

In the studies carried out on this subject, it is observed that acute phase renal involvement gets decreased but scar formations cannot be prevented through proper and correct antibiotic treatment started in the first 24 hours after the symptoms occur (20). Renal inflammatory changes were seen in 57% of 278 infants in this study. Renal defect was detected by 75% in patients for whom antibiotic treatment got started in the 4th day or later. This rate was 41% in the group for whom it got started within 24 hours since the start of fever. Again in the same study, acute inflammatory changes were reported to be encountered more commonly in the presence of high degree VUR. Jacobson et al. reported that among patients who had renal scarring from pyelonephritis during childhood, 23 percent developed hypertension and 10 percent developed end-stage renal disease (21).

Recently–made studies show that UTI is determined by 7% in children of 2-24 months of age and 8% in children of 2-18 years of age (22, 23). Occurrence rate varied widely depending on age, sex, and race. Also, UTI rate is determined to be lower in circumcised boys (1, 24, 25) considering the last data reported by CDC, 8% of girls and 2% of boys suffer UTI until the age of 7. One of the most important bacteria having been isolated is *E.coli* by 85% (24). In order to make the diagnosis according to the guides taken as a basis by CDC, it is doubtful that Leucocyte Esterase determined by urineanalysis is positive and more than five leucocyte is seen in each field that is the presence of pyuria, and significant reproduction in the culture test required in its follow up (at least 50,000 CFU s/mL of a single uropathogen from urine) is obligatory to make the exact diagnosis (24).

The guides updated about laboratory examinations to be performed with mid-stream urine samples and the usage of imaging methods in a correct manner and at a correct time are loadstars especially for repetitive UTI (22). In a study that included 199 urine culture, initial and late samples were compared. When using a cutoff value of at least 10.000 colony forming units/ml, late samples were superior to the initial ones in reducing contamination of urine cultures (26).

DOI: 10.18535/ijmsci/v3i4.1

Urine concentrations of interleukin-8 (IL-8) is a noninvasive marker for VUR in infants. IL-8 is produced by epithelial cells of the renal tract in response to inflammatory stimuli. Elevated urine IL-8 levels in VUR and renal scarring have already been reported to increase during acute UTI (27). Gökçe et al. was reported that children with VUR have a high urine IL-6 concentration, and children with RPS have a high urine IL-8 concentration (28).

The reports and collections carried out in this field indicate that there are similar bacterial reproduction rates for each geographical region but antibiotic susceptibility rates are changeable due to regional differences (29-32).

Urinary culture results of 524 pediatric patients were assessed in India, and reproduction was detected in 186 of them (35.4 %) (33). The rate of VUR was 18/186 in the cases with reproduction (9.7%) and 4/338 in the cases without reproduction (1.2%). 69% of the reproduction cases were boys and 31% of them were girls. *E.coli* is at the first rank with 68.3% among all Gram negative bacteria that reproduced, *Enterococcus faecalis* became the most common one among Gram positive bacteria with 65.3% (33).

In preschool and school children bactriuria incidence was 0.7-1.9% in girls and 0.02-0.04% in boys (34). After the first infection, there is the risk of recurrence of UTI in 20-30% of boys and 40-60% of girls (24). Febril stated that UTI is one of the most common severe bacterial infections in small children and its prevalence ranges in 4.1-7.5% (24). Although urinanalysis (leukocyte esterase, nitrite, white blood cells detection) foreshadows UTI at the beginning and its sensitivity is over 73%, the specificity of it cannot pass over 80% (22, 35). The isolation of the factor by having culture antibiogram and monitoring susceptibility results are necessary for correct preferences to be able to be made in treatment and prophylaxis.

It is reported that during neonatal and infancy periods, 79% of UTI is caused by *E.coli*, 7% by *Klebsiella* spp, 7% by *Pseudomonas* spp, 4% by *Proteus* spp (36). Although *E.coli* is the factor in the great majority of the infections in preschool and schooling periods, *Staphylococcus* spp is held responsible together with *E.coli* in pre-puberty period. ESBL positive *E.coli* and *Klebsiella* spp are isolated in and increasing frequency in UTI (1, 36). In our study, ESBL positive Gram negative bacteria rate was determined to be 69/456 (15%) in compliance with the findings of Turkey and other countries (37-40).

Increased rates of *E.coli* resistance have made amoxicillin a less acceptable choice for treatment, and studies have found higher cure rates with trimethoprim/sulfamethoxazole (22). Other treatment options include amoxicillin/clavulanate and cephalosporins. Guidelines from the American Academy of Pediatrics recommend limiting fluoroquinolone therapy to patients with UTIs caused by multidrug-resistant, Gram-negative bacteria, especially *P.aeruginosa* (41). Ciprofloxacin is approved by the U.S. Food and Drug Administration for complicated UTIs and pyelonephritis attributable to *E. coli* in patients one to 17 years of age.

Low dose long-term antibiotic prophylaxis is indicated in children with VUR or other anatomic malformations having high risk in terms of renal scar development and in children having suffered two urinary tract infection attacks in six months but having no anatomic malformations (42). In a randomized controlled trial of children with mild to moderate vesicoureteral reflux, it was found that prophylactic antibiotics for 12 months following a febrile UTI did not reduce the risk of subsequent UTI (43).

Used prophylactic antibiotic should provide high urine concentration with low serum level and should have minimum effects on faecal flora and should be cheap and well tolerated. High prophylactic doses trigger antibiotic resistance. The medications effective in preventing repetitive urinary tract infection, which are used in prophylactic treatment, and in which resistance strains are low, become prominent as second- or third-generation cephalosporins, amoxicillin/clavulanate, or nitrofurantoin, trimethoprim/sulfametaksazol. Although the period of time of prophylactic antibiotic treatment is debatable, it is suggested that prophylactic antibiotic administration should be continued for 1-2 years in the cases with VUR, 3-6

DOI: 10.18535/ijmsci/v3i4.1

months in cases with recurrent urinary tract infection but without anatomic malformation (44).

Besides, it is reported that single dose or single daily oral antibiotic treatments are less effective and thus are not suggested (45-47). There are studies defending that low-dose long-term antibiotic prophylaxis is proper in children with VUR or other anatomic malformations having high risk in renal scar development an in children having urinary tract infection more than 2 in 6 months but without anatomic malformation. Used prophylactic antibiotic should provide high urine concentration with low serum level and should have minimum effects on faecal flora and should be cheap and well tolerated (48). Because high prophylactic doses increase antibiotic resistance, it can cause harm rather than benefit.

Through the use of this, the study findings are promising about the fact that intravesical administrations to be performed with substances such as glycosaminoglycan (GAG), heparin can be preventive from UTI (49, 50). GAG layer prevents bacteria from binding surface epithelium cells. Also, GAGs are thought to play a role in excitement of immune system by promoting leukocyte activation and behavior in infected tissues (51). After the treatment, its preventive effect lasting for months can be explained with these functions of its. In a study in which intravesical heparin 40.000 U was given once a week for 6 weeks to 18 adult women with recurrent UTI history, the number of infections had 6 months ago and 6 months after the administration were recorded (52).

In conclusion, the recognition of risk factors for UTI in children may enable proper management of these patients and empirical antibiotic selection should be based on knowledge of the local prevalence of bacterial organisms and antibiotic sensitivities, because resistance patterns may vary in different regions.

References

1. Shaikh N, Morone NE, Bost JE, Farrell MH. Prevalence of urinary tract infection in childhood: A meta-analysis. Pediatr Infect Dis J 2008; 27(4): 302-8.
2. Elder JS. Urologic disorders in infants and children. In: Behrman RE, Kliegman RM, Jenson HB, editors. Nelson textbook of pediatrics. 17th ed. Philadelphia, PA: W. B. Saunders; 2004. p. 1785e90.
3. Steven L. Chang, MD, Linda D. Shortliffe, MDT. Pediatric Urinary Tract Infections. Pediatr Clin N Am 2006; 53: 379–400.
4. American Academy of Pediatrics; Committee on Quality Improvement, Subcommittee on Urinary Tract Infection. Practice parameter: The diagnosis, treatment, and evaluation of the initial urinary tract infection in febrile infants and young children. Committee on Quality Improvement. Pediatrics 1999; 103(4 Pt 1):843-52.
5. Vera Loening-Baucke. Urinary Incontinence and Urinary Tract Infection and Their Resolution With Treatment of Chronic Constipation of Childhood. Pediatrics. 1997, 100 (2) 228-232; DOI: 10.1542/peds.100.2.228.
6. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing: 24th informational supplement. Document M100eS24. Wayne, PA: CLSI; 2014.
7. Bagga A. Urinary tract infections: evaluation and treatment. Indian J Pediatr 2001; 68 (3): 40-5.
8. Mak RH, Kuo HJ. Pathogenesis of urinary tract infection: an update 2006; 18(2):148-152. doi: 10.1097/01.mop.0000193276.39495.0d
9. Hari P, Mantan M, Bagga A. Management of urinary tract infections. Indian J Pediatr. 2003; 70(3):235-9.
10. WJ Hopkins DT Uehling, and DS Wargoski. Evaluation of a familial predisposition to recurrent urinary tract infections in women. American Journal of Medical Genetics 1999; 83(5): 422–424.

DOI: 10.18535/ijmsci/v3i4.1

11. CM Stauffer, van der Weg B, Donadini R, Ramelli GP, Marchand S, and Bianchetti MG. Family history and behavioral abnormalities in girls with recurrent urinary tract infections: a controlled study. Journal of Urology, 2004; 171 (4): 1663–1665.
12. Scholes D, Hooton TM, Roberts PL, Stapleton AE, Gupta K, and Stamm WE. Risk factors for recurrent urinary tract infection in young women. Journal of Infectious Diseases. 2000; 182 (4): 1177–1182.
13. Ertan P, Berdeli A, Yilmaz O, Gonulal DA, and Yuksel H. LY96, UPKIB Mutations and TLR4, CD14, MBL Polymorphisms in Children with Urinary Tract Infection. The Indian Journal of Pediatrics 2011; 78 (10): 1229–1233.
14. Shah G, Upadhyay J. Controversies in the diagnosis and management of urinary tract infections in children. Paediatr Drugs 2005; 7(6):339-46.
15. Dura Trave T, Gonzalez Montero R, Juste Ruiz M, Gonzalez de Dios J, Carratala Marco F, Moya Benavent M, Verdu Rico J, Caballero Calpena O. [Usefulness of renal scintigraphy in the assessment of the first febrile urinary infection in children] Anales Espanoles de Pediatria. 1997; 47: 378–382.
16. Westwood ME, Whiting PF, Cooper J, Watt IS, Kleijnen J. Further investigation of confirmed urinary tract infection (UTI) in children under five years: a systematic review. BMC Pediatrics. 2005; 5: 2. doi:10.1186/1471-2431-5-2.
17. Peru H, Bakkaloglu SA, Soylemezoglu O, Buyan N, Hasanoglu E. The relationship between urinary tract infections and vesicoureteral reflux in Turkish children. Int Urol Nephrol 2009; 41(4): 947-51. doi: 10.1007/s11255-008-9420-1.
18. White B. Diagnosis and treatment of urinary tract infections in children. Am Fam Physician 2011; 83(4): 409-15.
19. Dick PT, Feldman W. Routine diagnostic imaging for childhood urinary tract infections: a systematic overview. J Pediatr 1996; 128(1): 15–22.
20. Doganis D, Siafas K, Mavrikou M, Issaris G, Martirosova A, Perperidis G, Konstantopoulos A, Sinaniotis K. Does early treatment of urinary tract infection prevent renal damage? Pediatrics. 2007; 120(4):e922-8. Epub 2007 Sep 17.
21. Jacobson SH, Eklöf 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): 703–706.
22. American Academy of Pediatrics, Subcommittee on Urinary Tract Infection, Steering Committee on Quality Improvement and Management; Roberts KB. Urinary tract infection: Clincal practice guideline for diagnosis and management of the initial UTI in febrile infants and children 2 to 24 months. Pediatrics 2011; 128(3): 595-610.
23. Stein R, Dogan HS, Hoebeke P, et al. Urinary tract infections in children: EAU/ESPU guidelines. Eur Urol 2015; 67:546.
24. http://www.cdc.gov/getsmart/community/for-hcp/outpatient-hcp/pediatric-treatment-rec.html, 2016.03.13.
25. Singh-Grewal D, Macdessi J, Craig J. Circumcision for the prevention of urinary tract infection in boys: a systematic review of randomised trials and observational studies. Arch Dis Child. 2005; 90(8):853-8. Epub 2005 May 12.
26. Megged O, Zilberstein L, Ben Shalom E, Erlichman M. Contamination of urinary cultures in initial-stream versus later-stream urine in children undergoing bladder catheterization for the

DOI: 10.18535/ijmsci/v3i4.1

diagnosis of urinary tract infection. Eur J Emerg Med. 2016 Mar 4.

27. Galanakis E, Bitsori M, Dimitriou H, Giannakopoulou C, Karkavitsas NS, Kalmanti M. Urine interleukin-8 as a marker of vesicoureteral reflux in infants. Pediatrics 2006; 117(5):e863-7. Epub 2006 Apr 3.
28. Gokce I, Alpay H, Biyikli N, Unluguzel G, Dede F, Topuzoglu A**.** Urinary levels of interleukin-6 and interleukin-8 in patients with vesicoureteral reflux and renal parenchymal scar. Pediatr Nephrol. 2010; 25(5): 905-12. doi: 10.1007/s00467-009-1396-2.
29. White B. Diagnosis and treatment of urinary tract infections in children. Am Fam Physician 2011; 83(4): 409-15.
30. Joan L Robinson, Jane C Finlay, Mia Eileen Lang, Robert Bortolussi. Urinary tract infection in infants and children: Diagnosis and management. Canadian Paediatric Society. Paediatr Child Health 2014; 19(6): 315-19.
31. Tamma PD, Sklansky DJ, Palazzi DL, et al. Antibiotic susceptibility of common pediatric uropathogens in the United States. Clin Infect Dis 2014; 59:750.
32. Alberici I, Bayazit AK, Drozdz D, et al. Pathogens causing urinary tract infections in infants: a European overview by the ESCAPE study group. Eur J Pediatr 2015; 174:783.
33. Gupta P, Mandal J, Krishnamurthy S, Barathi D, Pandit N. Profile of urinary tract infections in paediatric patients. Indian J Med Res 141, April 2015, pp 473-477.
34. The Kelalis-King-Belman. Textbook of Clinical Pediatric Urology, Fifth Edition. 2007 Informa Healthcare UK Ltd. Ed: Steven G. Docimo.
35. Tunga M, Şen TA, Aktepe OC, Altındiş M. The comparision of rapid diagnostic laboratory tests to results of urine culture in children with suspicion of urinary tract infection. Türk Pediatri Arşivi 2002 37: 150-155.
36. Tratselas A, Iosifidis E, Ioannidou M, et al. Outcome of urinary tract infections caused by extended spectrum ß-lactamase producing Enterobacteriaceae in children. Pediatr Infect Dis J 2011; 30(8): 707-10.
37. Degnan LA, Milstone AM, Diener-West M, Lee CKK. Extended-Spectrum Beta-Lactamase Bacteria From Urine Isolates in Children. The Journal of Pediatric Pharmacology and Therapeutics : JPPT. 2015; 20(5): 373-377. doi:10.5863/1551-6776-20.5.373.
38. Wu C-T, Lee H-Y, Chen C-L, Tuan P-L, Chiu C-H. High prevalence and antimicrobial resistance of urinary tract infection isolates in febrile young children without localizing signs in Taiwan. Journal of Microbiology, Immunology and Infection 2016; 49(2): 243-8.
39. Kizilca O, Siraneci R, Yilmaz A, et al. Risk factors for community-acquired urinary tract infection with ESBL-producing bacteria in children. Pediatr Int 2012; 54: 858-862.
40. Çoban B, Ülkü N, Kaplan H, Topal B, Erdoğan H, Baskın E. Five-year assessment of causative agents and antibiotic resistances in urinary tract infections. Turkish Archives of Pediatrics 2014; 49(2): 124-129. doi:10.5152/tpa.2014.1505.
41. Committee on Infectious Diseases. The use of systemic fluoroquinolones. Pediatrics 2006; 118(3): 1287–92.
42. Wald ER. Vesicoureteral reflux: the role of antibiotic prophylaxis. Pediatrics 2006; 117(3): 919–22.
43. Montini G, Rigon L, Zucchetta P, et al.; IRIS Group. Prophylaxis after first febrile urinary tract infection in children? A multicenter, randomized, controlled, noninferiority trial. Pediatrics 2008; 122(5): 1064–71.

DOI: 10.18535/ijmsci/v3i4.1

44. Williams GJ, Wei L, Lee A, Craig JC. Long-term antibiotics for preventing recurrent urinary tract infection in children. Cochrane Database Syst Rev 2006; (3):CD001534.

45. Pennesi M, Travan L, Peratoner L, et al. Is antibiotic prophylaxis in children with vesicoureteral reflux effective in preventing pyelonephritis and renal scars? A randomized, controlled trial. Pediatrics 2008; 121:e1489.

46. Roussey-Kesler G, Gadjos V, Idres N, et al. Antibiotic prophylaxis for the prevention of recurrent urinary tract infection in children with low grade vesicoureteral reflux: results from a prospective randomized study. J Urol 2008; 179:674.

47. Hoberman A, Keren R. Antimicrobial prophylaxis for urinary tract infection in children. N Engl J Med 2009; 361:1804.

48. Roberts KB, AAP Subcommittee on Urinary Tract Infection. Antimicrobial prophylaxis for children with vesicoureteral reflux. N Engl J Med 2014; 371:1071.

49. Ablove T, Patankar M, Seo S. Prevention of recurrent urinary tract infections by intravesical administration of heparin: a pilot study. Therapeutic Advances in Urology. 2013;5(6):303-309. doi:10.1177/1756287213504804.

50. Bassi PF, Costantini E, Foley S, Palea S. Glycosaminoglycan Therapy for Bladder Diseases: Emerging New Treatments. European Urology Supplements 2011; 10: 451–9.

51. Gandhi NS, Mancera RL. The structure of glycosaminoglycans and their interactions with proteins. Chem Biol Drug Des. 2008 Dec;72(6):455-82. doi: 10.1111/j.1747-0285.2008.00741.x.

52. Ablove T, Patankar M, Seo S. Prevention of recurrent urinary tract infections by intravesical administration of heparin: a pilot study. Therapeutic Advances in Urology. 2013; 5(6): 303-309. doi:10.1177/1756287213504804.

DOI: 10.18535/ijmsci/v3i4.1