MERIT RESEARCH JOURNALS
www.meritresearchjournals.org

Merit Research Journal of Medicine and Medical Sciences (ISSN: 2354-323X) Vol. 8(1) pp. 001-006, January, 2020
Available online http://www.meritresearchjournals.org/mms/index.htm

Original Research Article

Prevalence of Urinary Tract Infection among Children attending Khartoum State Hospitals

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Abstract

Urinary tract infection is the most common serious bacterial infection causing illness in infants and children; it accounted for 10% of all febrile illnesses in children. It is more common in preterm babies (4-25%) than term ones (1%). In early life, it is more common in males than females then decline rapidly in the prepubertal life girls experienced more episodes of UTIs than males, 8% compared to 20% respectively. The prevalence rates of UTI varied by age, gender, race, and circumcision status. Uncircumcised male infants less than 3 months of age and females less than 12 months of age had the highest baseline prevalence of UTI. This study conducted to determine prevalence of Urinary Tract Infection among Children attending Khartoum State hospitals. Cross-sectional prevalence study of 200 samples of mid-stream urine was collected from children attending three hospitals in Khartoum state. A demographic questionnaire were collected and urine samples were tested microbiologically by standard procedures. Kirby-Bauer technique was performed for testing commonly used antimicrobial agents by measuring susceptibility of the isolated organisms according to NCCLS guidelines. The growth of clinical isolates ≥10^4 CFU/ml of urine samples represent significant bacteriuria was representing 58 (29%), for insignificant growth 19 (9.5%) and 123 (61.5%) no bacterial growth. Among children age (2-16 years) presenting with sign and symptoms of UTI, the overall prevalence in females 33.6% [38/113] and among males 23% [20/87]; while 17 circumcised male and 3 uncircumcised male had UTI. The most common uropathogens isolated were *Escherichia coli* (44.8%), *Staphylococcus aureus* and *Klebsiella Spp* (20.7%) for each and *Enterococcus facials* (6.9%). The susceptibility to antimicrobial was high for impenem (96.56%), amikacin (94.8%), gentamycin and nitrofurontoin (75.8% & 74.1%) respectively but low for cefotaxime 29.31%, ceftazidime (24.13%), Amoxyclave and tetracycline (13.8%) each. A high prevalence rate of UTI among children shows a notable correlation between microbiology findings and clinically-suspected UTI in some Khartoum state district hospitals. Circumcision among boy tend to decrease the incidence of UTI, the rate of UTI in uncircumcised boys are more prone to UTI. The antibiotics commonly used in UTIs are less effective by 55.17% e.g.: ciprofloxacin. Since the present study was a short-time study, regular monitoring is required to establish reliable information about resistance pattern of urinary pathogens among children for optimal empirical therapy.

Keywords: Prevalence, Urinary Tract Infection, Children, Antimicrobial susceptibility, Sudan, Khartoum Hospitals

INTRODUCTION

UTI among children it accounted for 10% of all febrile illnesses in children, which is a major public health problems and second to infection of the respiratory tract among children. Bacterial infections are serious problems to the successful treatment of the UTI resulting in complications sometimes as the sequelae of untreated UTI in children lead to chronic atrophic pyelonephritis and renal failure to fatal sepsis occur in low-income and middle-income countries (Mohamed et al., 2014). Most UTIs in children result from ascending infections, although hematogenous spread may be more common in the first 12 weeks of life (Alper and Curry, 2005). Both anatomic and physiologic factors put children at risk of developing UTI; which is occur more often in girls, because of their urethras are shorter and closer to the anus. This make it easier for bacteria to enter the urethra, urinary obstruction, Vesicoureteral reflux (VUR), neurogenic bladder which is the improper storage of urine in bladder and improper emptying of urine from bladder, and uncircumcised boys (Alper and Curry, 2005).

The common bacterial pathogens responsible for urinary tract infections are gram-negative bacteria (90%) like *Escherichia coli, Klebsiella species, Proteus mirabilis, Pseudomonas aeruginosa, Acinetobacter, and Serratia.* while only 10% of the cases are triggered gram positive bacteria which include *Enterococcus, Staphylococcus Species* mainly *S.aurues, and Streptococcus agalactiae*. Furthermost UTIs in children are mono-microbic, frequently due to y *Escherichia coli* (60 to 80 % of cases), Proteus (more common in boys and in children with renal stones), *Klebsiella, Enterococcus*, and coagulase negative *Staphylococci* (Alper and Curry, 2005).

In virtually all cases, there is a need to start empirical treatment before the final microbiological results are available since the emergence of antimicrobial-resistant clinical isolates, there have been reports of increasing rate of infection by multi-drug resistant bacteria has established itself as the common cause UTI of nosocomial as well as community acquired infection. So, in this study, we determined the bacteriological profile of UTI infections among children and their antimicrobial susceptibility patterns across the demographic data. Further, we also studied the incidence of UTI among Uncircumcised boys.

MATERIALS AND METHODS

A descriptive cross-sectional study which had been conducted during period from February to June 2018.Three hospitals in Khartoum (Gafar Ibn Auf Specialized Children Hospital, Yastabshiron Hospital, and Soba University Hospital). A total of 200 clean catch midstream urine samples were collected from children who had symptoms and/or signs suggestive of UTI in sterile universal containers and questionnaires were filled. Children taking antibiotics at the time of taking samples were excluded from our calculations for the prevalence.

The samples collected were examined microscopically for pus cells and casts. The samples were also processed using standard microbiological procedures. All the urine samples were cultured immediately on Cystine lactose electrolytes deficient (CLED) media by 0.01 ml standard loop method and incubated at 37°C overnight. The culture plate's results were interpreted as being significant, insignificant and no growth. A growth of $\geq 10^4$ colony forming units/mL was considered as significant bacteriuria. The isolated organism was identified by routine microbiology methods from the samples showing significant bacteriuria. The Kirby-Bauer technique was carried out for antimicrobial susceptibility testing and interpretations of bacterial isolates to common antibiotics used for UTI in children irrespective to the hospital antibiotic policy (MacKie and McCartney's).

Data analysis

Statistical analysis data was tabulated and analyzed using the version 21-Statistical Package for Social Sciences (SPSS) software was presented as frequencies. Chi-square analysis (χ^2) was used in findings on comparison of positively UTI cases according to individual characteristics. Evaluations were carried out at 95% confidence level and $P < 0.05$ was considered statistically significant.

RESULT

Out of 200 urine samples; (58/200; 29%) children had significant growth, while (19/200; 9.5%) insignificant growth of a single bacterial uropathogen thus fulfilling the criteria for UTI and (123 {61.5%}) no growth. Urine cultures were positive, 38 out of 113 (33.6%) female had UTI, while 20 out of 87 (23%) male had UTI. Whereas statistical analysis revealed that there was a significant relationship between circumcised boy and the prevalence of UTI $P = 0.036$ [17 out of 83 circumcised male had UTI and 4 uncircumcised male 3 had UTI]. On the other hand, we have considered various risk factors that might play a role in escalating UTI such as gender, age, Resident social class, Mother Education status and Mother employment status (Table 1). Circumcision status of boys had positive and statistically significant relationships with UTI ($P = 0.0113$, $X^2=6.4067$).

Of the 58 significant urine cultures gram negative bacteria were responsible for (42/58; 72.4%) of UTIs cases in comparison to gram positive bacteria which

Table 1. Multivariate logistic regression of risk factors (Demographic characteristics) for the prevalence of UTI in male and female patients (N=200)

Demographic characters	Prevalence of UTI (%)		Total	P value	X2
	Positive No. n= 58	Negative No. n=142			
Gender					
Female	38 (33.6%)	75 (66.4%)	113		2.7026
Male	20 (23%)	67 (77%)	87	0.1001	
Age (years)					
2-5Yrs	26(28.8%)	64(71.2%)	90		
6-10Yrs	19(30.6%)	43(69.4)	62	0.920	0.1677
11-16Yrs	13(27%)	35(73%)	48		
Circumcision status					
Circumcised boy	17(20%)	66(80%)	83	0.0113*	6.4067
Uncircumcised boy	3(75%)	1(25%)	4		
Resident social class					
Low social class	5(35.7%)	9(64.3%)	14		
Medium social class	44(30.5%)	100(69.5%)	144	0.439	1.6451
High social class	9(21.4%)	33(78.6%)	42		
Mother Education status					
Illiterate	4(66.6%)	2(33.4%)	6		
Secondary school or less	17(34.7%)	32(65.3%)	49	0.056	5.7601
University school or more	37(25.5%)	108(74.5%)	145		
Mother employment status					
Employed	20(26.3%)	56(73.7%)	76	.5125	0.4289
House wife	38(30.6%)	86(69.4%)	124		

*P. value less than 0.05 was considered statistically significant.

Table 2. Overall antimicrobial sensitivity pattern of isolated uropathogen

Antibiotic disc		Susceptibility test	
	No. tested	Sensitive, n (%)	Resistant, n (%)
Amikacin	58	55 (94.8%)	3 (5.2%)
Amoxicillin*	55	0 (0%)	55 (100%)
Ampicillin*	55	0 (0%)	55 (100%)
Amoxyclav*	55	8 (14.5%)	47 (85.5%)
Cefotaxime	58	17 (29.3%)	41 (70.7%)
Ceftazidime	58	14 (24.1%)	44 (75.9%)
Ceftriaxone	58	16 (27.6%)	42 (72.4%)
Cefuroxime	58	18 (31.0%)	40 (69.0%)
Cefixime	58	17 (29.3%)	41 (70.7%
Ciprofloxacin	58	32 (55.2%)	26 (44.8%)
Clindamycin*	55	12(21.8%)	43 (78.2%)
Gentamycin	58	44 (75.9%)	14 (24.1%)
Imipenem	58	56 (96.6%)	2 (3.4%)
Nitrofurontoin	58	43(74.1%)	15 (25.9%)
Norfloxacin	58	10 (17.2%)	48 (82.8%)
Co-Trimoxazole*	55	21 (38.2%)	34 (61.8%)
Tetracycline*	55	8 (14.6%)	47(85.4%)
Vancomycin**	16	11 (68.8%)	5 (31.2%)
Erythromycin**	16	4 (25.0%)	12 (75.0%)

*Antibiotics disc not recommended for pseudomonas spp, ** Antibiotic disc used for gam positive bacteria only

were (16/58; 27.6%). The relative prevalence of uropathogens isolated from mid-stream urine samples the majority were *Escherichia coli* (26/58; 44.8%), followed by *Staphylococcus aureus* and *Klebsiella species* (12/58; 20.7%) for each. Other isolates were *Enterococcus faecalis* (4/58; 6.8%), *Pseudomonas*

Table 3. Individual uropathogens isolate sensitivity to various antibiotics disc of studied children attending three hospitals in Khartoum city (N=200)

Antibiotic disc	Susceptibility pattern by isolate, %											
	E. coli n=26		*Kleb .spp* n=12		*S. aureus* n=12		*E. faecalis* n=4		*Ps. Aeruginosa* n=3		*P. mirabilis* n=1	
	S	R	S	R	S	R	S	R	S	R	S	R
Amikacin	96.2%	3.8%	100%	0%	91.7%	8.3%	66.7%	33.3%	100%	0%	100%	0%
Amoxicillin*	0%	100%	0%	100%	0%	100%	0%	100%	-	-	0%	100%
Ampicillin*	0%	100%	0%	100%	0%	100%	0%	100%	-	-	0%	100%
Amoxyclav*	0%	100%	0%	100%	41.7%	58.3%	66.7%	33.3%	-	-	0%	100%
Cefotaxime	19.2%	80.8%	0%	100%	66.7%	33.3%	33.3%	66.7%	66.7%	33.3%	100%	0%
Ceftazidime	19.2%	80.8%	0%	100%	50%	50%	0%	100%	66.7%	33.3%	100%	0%
Ceftriaxone	15.4%	84.6%	0%	100%	66.7%	33.3%	33.3%	66.7%	66.7%	33.3%	100%	0%
Cefuroxime	15.4%	84.6%	0%	100%	83.3%	16.7%	33.3%	66.7%	66.7%	33.3%	100%	0%
Cefixime	19.2%	80.8%	0%	100%	66.7%	33.3%	33.3%	66.7%	66.7%	33.3%	100%	0%
Ciprofloxacin	65.4%	34.6%	16.7%	83.3%	50%	50%	100%	0%	66.7%	33.3%	100%	0%
Clindamycin*	15.4%	84.6%	0%	100%	58.3%	41.7%	33.3%	66.7%	-	-	0%	100%
Gentamycin	80.8%	19.2%	41.7%	58.3%	83.3%	16.7%	100%	0%	100%	0%	100%	0%
Imipenem	100%	0%	91.7%	8.3%	100%	0%	100%	0%	100%	0%	100%	0%
Nitrofurontoin	84.6%	15.4%	25%	75%	91.7%	8.3%	100%	0%	66.7%	33.3%	100%	0%
Norfloxacin	26.9%	73.1%	0%	100%	0%	100%	33.3%	66.7%	33.3%	66.7%	100%	0%
Co-Trimoxazole*	41.75	58.3%	0%	100%	83.3%	16.7%	0%	100%	-	-	0%	100%
Tetracycline**	12.5%	87.5%	8.3%	91.7%	16.7%	83.3%	33.3%	66.7%	-	-	100%	0%
Vancomycin**	-	-	-	-	70%	30%	50%	50%	-	-	-	-
Erythromycin**	-	-	-	-	30%	70%	0%	100%	-	-	-	-

*Antibiotics disc not recommended for pseudomonas spp, ** Antibiotic disc used for gam positive bacteria only, S= Sensitive, R= resistant.

aeruginosa (3/58; 5.2%), and *Proteus mirabilis* (1/58; 1.7%).

Antimicrobial sensitivity: in vitro susceptibility testing showed high sensitivity to impenem, amikacin, gentamycin, nitrofurontoin and ciprofloxacin (Table 2). However, resistance to several antibiotics was also observed; only a small portion of isolates were sensitive to norfloxacin, amoxicillin clavulinate, co-trimoxazole , amoxicillin, ceftazidime and none were sensitive to ampicillin and amoxicillin (0%). Whereas Individual isolate susceptibility testing of isolated uropathogens from 58 patients and gram-positive uropathogens represent (5/16; 31.2%) resistant to vancomycin (table 3).

DISCUSSION

The overall prevalence of UTI in our study population was 29%. In accordance with ranging of UTI among children age (<2-16 years) from 5% to 14.2% compared to reported prevalence in developed countries [23[3] and 33[4]] the prevalence of UTI is higher. However in largely in lineagreement with 20.3% [25] and 29.3% [40][5] reported in East Africa. This might be due to considerable regional variation in the prevalence of UTI in the developing countries depending on location and populations setting. Since the UTI is the 3rd most common infection experienced by children after respiratory and gastro-intestinal infections. However, the UTI symptoms include abdominal pain, back pain, dysuria, frequency, new-onset incontinence, but none of these symptoms alone is sufficient to establish UTI diagnosis in verbal children.

The prevalence of UTI is higher in females 38 (33.6%) than males20 (23%), this might be clarified by the anatomical structure differences between the two sexes as the female had a shorter urethra than male. These results come to an agreement with study conducted by Kirtilaxmi et al. (2015) and Pouladfar et al. (2017), in that is female has incidence of UTI higher than male. Prevalence of UTI corresponding to age groups has been also observed; this difference suggests

that age is one of the risk factor associated with UTI as the high incidence of UTI amongst the preschooler's children age group (2-5 years) might be due to poor toilet and hygiene habits mainly at child daycare. An observation from Sudan showed that 74% of affected children with UTI were less than 5 years. 74% of them were below 5-years of age (Ali and Osman, 2009).

The high incidence of UTI amongst the uncircumcised boy 75%in the current study is comparable with that reported by Nader sheikh (Nader et al., 2008). Since the circumcision tends to decrease the frequency of UTI by 10-20 fold; which prevalence of UTI varied by circumcision status of boys, uncircumcised boy have highest baseline prevalence of UTI than circumcised boy because moisture can trapped between penis and foreskin, which create and ideal environment for bacteria of male how are uncircumcised.

Among the uropathogens isolated 72.4% gram-negative bacteria while only 27.6% of the cases are caused by gram-positive bacteria which principally significant bacteriuria. The highest prevalence of gram-negative bacteria in this study is in accordance with that reported by (Merga et al., 2018; Samuel, 2016; Mirzarazi et al., 2013). Despite study differs from findings reported by previous author (Nwokocha et al., 2014).

Moreover, Escherichia coli was the most predominant uropathogen with 44.8% this can be explained by the Escherichia coli is most abundant bacteria in GIT. Followed by Staphylococcus aureus and Klebsiella Spp 20.7%, Enterococcus facials 6.9%, Pseudomonas aeruginosa 5.2% and Proteus mirabilis 1.7%. This finding agree with study done by Kirtilaxmi et al. (2015), Pouladfar et al. (2017), Majida et al. (2015), Vele Echeverri et al. (2014), and Rezaee and Abdina (2015) while disagree with Mohamed et al. (2014).

Furthermore, we assessed the relationship between UTI and various demographic variables like age, gender, Resident social class mother's education and employment status there was no significant difference (p value >0.05). Throughout childhood the risk of UTI was 8% for girls and 2% for boys according to department of urology/university of Wisconsin education module number 7 of Pediatric Urinary Tract Infection (www.urology.wisc.edu/education/module_7_pediatric_uti .pdf (2016). The Incidence of UTI is bimodal; highest during the first year of life and peaking again during adolescence, in our study there is no statistically significant difference between age group and UTI, this results agree with Nader et al. (2008).

Since antibiotics are given empirically, it is necessary to assess the distribution and susceptibility of the microorganisms in each case. In addition, there should be a periodic re-evaluation for UTI treatment policies in children. The results also revealed that among seventeen antibiotics used for susceptibility test; impenem was the most effective antibiotics (96.6%) followed by amikacin (94.8%) and gentamycin (75.9%). This might be due to the fact that impenem, amikacin and gentamicin are not offered astablets form and its unavailability by self-prescription in the community, that may minimized the chance to abuse. Also *P.aeruginosa* had highest resistant to norfloxacin (66.7%), and highest susceptibility to impenem (98.2%), and gentamycin (73.7%), amikacin (94.9%) , The drug susceptibility profile of uropathogens obtained in the present study was similar with the findings by Kirtilaxmi et al. (2015), and Pouladfar et al. (2017). Gram positive isolates with highest resistant to antibiotics ampicillin (100%), amoxicillin(100%), and susceptibility to impenem (98.2%), and gentamycin (73.7%), amikacin (94.9%), nitrofurontoin (91.7%) ,this result strongly contradicts with the findings reportedby (Kirtilaxmi et al., 2015), (Pouladfar et al., 2017), and (Madhi et al., 2018).

Klebsiella spp isolates in this study showed more resistance than *E. coli* isolates. The major difference was observed for gentamicin and amikacin; *E. coli* isolates showed low resistance to ciprofloxacin and tetracycline, while *Klebsiella* isolates showed high resistance to these agents despite being sensitive for many years (Kiffer et al., 2007).

On the other hand, a high degree of resistance was observed in *Enterococcus faecalis*, were resistant to ampicillin, amoxicillin, amoxyclave, erythromycin and co-trimoxazoleby 100% and by 66.7% to cephalosporin's antimicrobials. While the emergence of vancomycin resistant among gram-positive isolates was 31.2% (50% *E. faecalis* and 30% *S. aureus*), that due to over-prescription, inadequate dosage of these antibiotics used during self-medication in our community is likely to be a factor contributing to the development of resistant strains.

CONCLUSION

The overall prevalence of UTI is 29% in the study area among children attending refer clinic with age range from 2-15 years, and more prevalent among in female than male. Circumcision tend to decrease the incidence of UTI, the rate of UTI in uncircumcised boys are more prone to UTI. The most frequently isolated uropathogen were Gram-negative organisms. E. coli was the commonest organisms isolated followed by *Klebsiella spp* and *S. aureus* which are the principal urinary pathogen. Data presented in this study indicate that antibiotics commonly used for the treatment of UTIs in children are less effective. Since this was a cross-sectional study and time limited. Further regular studies is need to reliable information about prevalence of UTI among children and the resistance pattern of urinary pathogens for optimal empirical therapy.

Ethical consideration

Approval to carry out research was obtained from the

Sudan Ministry of Health-research and Ethics Committee, University Medical sciences and technology-faculty of graduate studies- department of medical microbiology. Written informed consent was obtained from parents of the children who fit for inclusion in the study.

ACKNOWLEDGEMENTS

We do acknowledge the effort of all MLS staff workers, teachers and colleagues at UMST for being there for me wherever in deeded.

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