Childhood Urinary Tract Pathogens and Antibiotic Susceptibility Seen at Gusau, Nigeria

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ABSTRACT

Introduction: Urinary tract infection (UTI) is an important cause of morbidity and long term complications in children. To decrease morbidities associated with UTI, prompt diagnosis and early initiation of appropriate antibiotics is recommended. We aimed to identify the prevalent bacterial pathogens causing UTI in children seen at Yariman Bakura Specialist Hospital (YBSH), Gusau as well as the antibiotic susceptibility and resistance patterns.

Methodology: A descriptive- retrospective- study of bacterial pathogens isolated from the urine of children aged 0-15 years with urinary tract infections over an 18 month period. Laboratory register of urine culture results was reviewed and relevant information which included age, sex, bacterial isolate, antibiotic susceptibility and resistance were retrieved.

Results: A total of 103 bacteria were isolated over the study period, there were no mixed infections. Of these, 53 (51.5%) isolates were found in males. Children under five years constituted 48.5%. Commonest isolates were *Escherichia coli* (40.8%), *Citrobacter freundii* (10.7%) and *Streptococcus pyogenes* (9.7%). The isolates were susceptible to gentamicin, ofloxacin and nitrofurantoin. The isolates were found to be highly resistant to ceftazidime, cefuroxime and ceftriaxone but least resistant to nitrofurantoin.

Conclusion: *Escherichia coli, Citrobacter freundii* and *Streptococcus pyogenes* were the commonest isolates. Genticin, ofloxacin, nitrofurantoin and ciprofloxacin were the antibiotics the isolates had greater susceptibility. These antibiotics may be used empirically, but we recommend that all suspected cases of UTI should have a urine culture and sensitivity pattern determined for appropriate treatment.

Keywords*: Urinary Tract Infection, Isolates, Sensitivity, Resistance*

INTRODUCTION

Urinary tract infection (UTI) is an important cause of morbidity and long term complications such as hypertension, failure to thrive and end-stage renal disease in children.[1] Delay in initiation of treatment with appropriate antibiotic may lead to development of renal scars.[2] In order to decrease morbidities associated with UTI, prompt diagnosis and early initiation of appropriate antibiotics in such children is recommended.[3]

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Empiric antibiotic treatment after collecting urine specimens for culture and sensitivity in a suspected UTI case is appropriate. Selection of antibiotic of choice should be based on the pattern of isolated urinary pathogens and their antimicrobial sensitivities in the local environment.[3]

Gram negative organisms, particularly *E. coli* are commonly associated with UTI in children in developing countries.[4] Reports from different parts of Nigeria have also shown *Escherichia coli* to be a common urinary isolate.[4,5,6] However, recent studies from some parts of the country have shown a new trend in the bacterial isolates of UTI. While reports from Benin[2] and Maiduguri[7] have shown *Escherichia coli* to be the most common urinary isolate, *Klebsiella* predominated in studies from Ibadan[5] and Abakiliki.[8]

In Tanzania,[9] *E. coli* and *Klebsiella pneumonia* were reported to be the commonest organisms. Tanzania Similar organisms were also found to be the commonest in Jordan.[10] However, Gram positive organisms, which include *Staphylococcus aureus*, *Staphylococcus epidermidis* and *Staphylococcus faecalis* have also been reported as pathogens in UTI.[9,10]

Results are reported as the activity of individual drugs against the isolated organism; categorized by one of the following terms: susceptible (earlier term: sensitive), intermediate and resistant.[11] Studies have also shown that the antimicrobial resistance rates of urinary pathogens is on the increase.[1,3,6,8] In the past, ampicillin, cotrimoxazole and tetracycline were the commonly used to treat UTI. These organisms have now developed resistance to first line antibiotics and other drugs such as gentamicin, ceftriaxone and cefuroxime are currently used to treat UTI.

Urine specimen can be reliably obtained by supra pubic aspiration, catheterisation or as a mid stream catch. A pure growth of e"10^5 colony forming units per ml from midstream urine sample or growth of any number of uropathogen from urine obtained by supra pubic aspiration was considered as significant bacteriuria.[3]

There is no reported study in Gusau that evaluated urinary tract pathogens and their antimicrobial susceptibility and resistance patterns in children with symptomatic UTI so as to guide empiric antibiotic choice and prompt treatment. Against this background, this study was carried out to identify the prevalent bacterial pathogens causing UTI in children seen at Yariman Bakura Specialist Hospital (YBSH), Gusau as well as the antibiotic susceptibility and resistance patterns.

MATERIALS AND METHODS

This study was conducted at the YBSH, Gusau, Zamfara State in North Western Nigeria. This was a descriptive retrospective study of bacterial pathogens isolated from the urine of children aged 0-15 years with urinary tract infections seen in our hospital (both inpatients and outpatients) over an 18 month period. Laboratory register of urine culture was reviewed and relevant information which includes age, sex, bacterial isolate, antibiotic susceptibility and resistance were retrieved.

The urine samples were all collected in sterile bottles. Samples in children younger than 2 years of age are usually collected in our hospital using urinary catheter; supra pubic aspiration and sometimes mothers were taught how to catch mid-stream urine for sample collection especially on out patients. In older children urine sample is usually collected as midstream specimen.

In our hospital, first line antibiotics for UTI are not commonly tested as studies from developing countries have suggested that urinary tract pathogens are often resistant in-vitro to the commonly prescribed antibiotics, including ampicillin, cotrimoxazole and chloramphenicol.[4]

The urine samples were inoculated unto plates of cystine lactose electrolyte deficient (CLED) medium and blood agar and incubated aerobically at 37°C for 24 hours within one hour of collection at the laboratory. Urine samples that yielded e"10^5cfu/ ml of bacteria were considered as significant bacteriuria. The bacterial isolates were further identified based on their characteristic colony morphology, gram stain reaction and biochemical tests using standard techniques.[12] Mixed growths of more than two species in a single urine sample were considered as contaminants and were disregarded.

The antibiotic sensitivity patterns of the bacterial isolates were determined by the disc diffusion method in accordance with the National Committee for Clinical Laboratory Standards.[13] Two types of antibiotic multidiscs (Abtek) containing the following antibacterial agents were used. The first disc contain ceftriaxone 30 µg, cefuroxime 30 µg,

ceftazidime 30 µg, gentamicin 10 µg, augmentin (clavulanate potentiated amoxicillin) 30 µg, ofloxacin 5 µg, erythromycin 5 µg and cloxacillin 5 µg. In the second disc, erythromycin and cloxacillin were replaced by nitrofurantoin 300 µg and ciprofloxacin 5 µg. The discs were used based on availability in the hospital. Antimicrobial sensitivity was reported as resistant, intermediate and susceptible, however, in data analysis we merged intermediate and resistant into one category.

For quality assurance, control strains are used and control zone diameters are regularly checked.

Ethical approval for the study was obtained from the ethical committee of the Yariman Bakura Specialist Hospital, Gusau.

The data obtained were analysed using the Statistical Package for the Social Sciences (SPSS) software version 17.0. Descriptive statistics was used to describe the frequency of continuous variables.

RESULTS

A total of 103 bacteria were isolated over the study period, there was no mixed infections. There was slight male preponderance with 53 (51.5%) isolates while 50 (48.5%) were isolated in females, giving a male: female ratio of 1.06:1.

Majority of the isolates were seen in children between 0-5 years with 50(48.5%), followed by 6-10 years age group with 42(40.8%) and the least was seen in 11-15 years age range with 11(10.7%).

The predominant bacteria isolated was *Escherichia coli* which accounted for 40.8%, followed by *Citrobacter freundii* with 10.7% and *Streptococcus pyogenes* with 9.7% as shown in table 1 below.

Escherichia coli was predominant in females as against *Citrobacter freundii* which was commoner in males. The number of isolated bacteria according to gender is shown in table 1 below.

Most of the isolates were susceptible to gentamicin, followed by ofloxacin and nitrofurantoin. The isolates were not susceptible to cloxacillin as shown in table 2. Antibiotic resistance of the isolates were found to be more to ceftazidime, followed by cefuroxime and ceftriaxone. The bacterial isolates were found to be least resistant to nitrofurantoin.

Only gentamicin was found to be effective against over 70% of the strains of *Staphylococcus aureus, Staphylococcus saprophyticus, Morganella morgagni and Proteus spp* as shown in table 3.

TABLE 1: Distribution of bacterial isolates according to gender

Bacteria	Male	Female	Total (%)
Escherichia coli	17	25	42(40.8)
Citrobacter freundii	8	3	11(10.7)
Streptococcus pyogenes	4	6	10(9.7)
Proteus spp	6	1	7(6.8)
Providencia	3	3	6(5.8)
Staphylococcus aureus	4	*2*	6(5.8)
Klebsiella spp	3	1	4 (3.9)
Staphylococcus epidermidis	1	3	4(3.9)
Staphylococcus saprophyticus	3	1	4(3.9)
Morganella morgagni	1	2	3(2.9)
Enterobacter spp	1	1	2(1.9)
Serratia spp	0	10	1(1.0)
Salmonella typhi	1		1(1.0)
Streptococcus pneumoniae	0	1	1(1.0)
Pseudomonas spp	1	1	1(1.0)
Total	**53**	**50**	**103(100.0)**

TABLE 2: Antibiotic susceptibility and resistance pattern of the isolates

Antibiotic	Susceptible no (%)	Resistant no (%)	Not tested
Gentamicin	65(63.1)	38(36.9)	0(0.0)
Ofloxacin	51(49.5)	52(50.5)	0(0.0)
Nitrofurantoin	36(35.0)	27(26.2)	40(38.8)
Ciprofloxacin	33(32.0)	30(29.1)	40(38.8)
Ceftriaxone	22(21.4)	81(78.6)	0(0.0)
AugmentinCefuroxime	21(20.4)10(9.7)	82(79.6)93(90.3)	0(0.0)0(0.0)
Erythromycin	10(9.7)	32(32.0)	61(59.2)
CeftazidimeCloxacillin	9(8.7)4(3.9)	94(91.3)38(36.9)	0(0.0)61(59.2)

no= number, %= percentage

TABLE 3: Bacterial isolates and their antibiotic susceptibility pattern

Total Bacterial isolates (no)	GEN	CTZ	CAZ	CRX no (%)	ERY	CLX	OFL	AUG	NIT	CIP
E.coli (42)	26(61.9)	11(26.2)	3(7.1)	2(4.8)	4(9.5)	0(0.0)	20(47.6)	6(14.3)	17(40.1)	12(28.6)
C. freundii (11)	5(45.5)	2(18.1)	0(0.0)	1(9.0)	1(9.0)	1(9.0)	5(45.5)	2(18.1)	2(18.1)	2(18.1)
Strep. pyogenes(10)	5(50.0)	2(20.0)	1(10.0)	2(20.0)	1(10.0)	2(20.0)	6(60.0)	5(50.0)	2(20.0)	2(20.0)
Proteus spp (7)	5(71.4)	1(14.3)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	5(71.4)	1(14.3)	3(42.3)	3(42.3)
Staph. aureus (6)	5(83.3)	1(16.7)	0(0.0)	1(16.7)	1(16.7)	1(16.7)	1(16.7)	1(16.7)	1(16.7)	2(33.3)
Providencia spp (6)	3(50.0)	1(16.7)	2(33.3)	0(0.0)	1(16.7)	0(0.0)	4(66.7)	2(33.3)	2(33.3)	2(33.3)
Serratia spp (1)	1(100.0)	1(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)
Salmonella typhi (1)	1(100.0)	1(100.0)	1(100.0)	0(0.0)	0(0.0)	0(0.0)	1(100.0)	1(100.0)	0(0.0)	0(0.0)
Strep. Pneumonae (1)	1(100.0)	0(0.0)	0(0.0)	1(100.0)	0(0.0)	0(0.0)	1(100.0)	1(100.0)	1(100.0)	1(100.0)
Pseudomonas spp (1)	1(100.0)	0(0.0)	1(100.0)	0(0.0)	0(0.0)	0(0.0)	1(100.0)	0(0.0)	0(0.0)	0(0.0)
Total (103)	65(63.1)	22(21.4)	9(8.7)	10(9.7)	10(9.7)	4(3.9)	51(49.5)	21(20.4)	36(35.0)	33(32.0)

no= number %=percentage
GEN=Gentamicin CTZ=Ceftriaxone CAZ=Ceftazidime CRX=Cefuroxime ERY=Erythromycin CLO=Cloxacillin OFL= Ofloxacin CIP= Ciprofloxacin
AUG= Clavulanate potentiated amoxicillin (Augmentin) NIT=Nitrofurantoin

DISCUSSION

We found a slight male preponderance in this study which is similar to what was observed in Enugu[3] and Zaria;[14] however, most studies have found a female preponderance.[2,8,15] The reason may be explained by the fact that we only looked at culture-confirmed UTI not children that had presumptive diagnosis of UTI. Children under the age of five years were predominant in this study, similar to what was observed in Benin[2] and Abakaliki.[8]

In this study, *Escherichia coli, Citrobacter freundii, Streptococcus pyogenes and Proteus spp* were the commonest bacterial pathogens isolated in the urine. These isolates apart from *Escherichia coli* have not been reported to be common isolates.[2,3,8,9,16-18]

Escherichia coli was reported to be the commonest bacterial isolate in Benin,[2] Enugu,[3] Tanzania,[9] Jordan,[10] Port Harcourt,[16] Turkey,[17] Ethiopia[18] and in Zaria.[19] It was also found to be common isolate in Ibadan[5] and Abakaliki.[8] We found *Escherichia coli* to be commoner in females than males as was seen in Enugu.[3] This can be explained by the proximity of female urethra to the anus thereby encouraging contamination and ascent of faecal flora into the urinary tract.[3]

Even though *Staphylococcus aureus* is a frequent contaminant of urine sample, it was found to be a cause of UTI in this study, similar to what has been reported by other investigators.[3,9,14,18]

We found only one isolate of *Streptococcus pneumoniae* in a female child. However, it is not

commonly considered an agent of urinary tract infections although it has been found to be a potential UTI-causing pathogen in children with urinary tract abnormalities.[20] Case reports of *Streptococcus pneumoniae* confirmed UTI have been published.[20] The study being retrospective could not identify if the child has associated urinary tract abnormalities.

Salmonella typhi was a rare bacterial isolate, similar to what was found in Zaria.[14] This may be due to the fact that it is a rare cause of UTI in children as it is associated with structural abnormalities of the urinary tract.[14]

The greatest antibiotic susceptibility to the isolated organisms were seen with gentamicin, ofloxacin, nitrofurantoin and ciprofloxacin. Susceptibility of urinary tract isolates to gentamicin, quinolones, and cephalosporins has been previously documented in other studies in Nigeria[3,2,5,8,9] and other elsewhere.[10,14] However, in this study; the isolates were not highly susceptible to cephalosporins. Reason may be explained by the fact that oral cephalosporins are now readily available and oral forms are now abused hence risk of drug resistance; as they may have been taken by the patients before presenting to the hospital.

In this study, a high susceptibility rate was recorded for gentamicin, nitrofurantoin and ofloxacin against *Escherichia coli* which was found to be the commonest bacterial isolate. The susceptibility of these drugs was however suboptimal as only gentamicin had a susceptibility of >50%, therefore they cannot be dependent on alone for empiric treatment of UTI in Gusau without a urine culture and sensitivity.

Gentamicin was found to be active against most of the bacterial isolates. Variable susceptibility rates to this drug by different urinary isolates have been reported from different centres.[2,3,6, 8,19,21]

The flouroquinolones were found to have variable susceptibility rates against the pathogens as was observed in other studies.[2,3,6,8,10,17,21] This may be due to their increasing use in the treatment of infections in children.

The greatest antibiotic resistance of the isolates were found with cephalosporins (ceftriaxone and cefuroxime) and clavulanate potentiated amoxicillin. This may be due to the fact that they are now commonly prescribed for both in- and out patients for various infections. Nitrofurantoin and ciprofloxacin were the antibiotics with the least resistant isolates. Nitrofurantoin is not routinely used in management of infections in children; hence it is less likely to be abused and unlikely for organisms to develop resistance. Urinary tract isolates have been found to be susceptible to nitrofurantoin in Enugu[3] and Ibadan.[5]

Knowledge of the susceptibility pattern and appropriate antibiotic use would help reduce morbidity from UTI as well as decrease the rate of drug resistance. It is desirable for constant evaluation of the antibiotic susceptibility and resistance patterns of UTI pathogens of commonly used antibiotic in hospitals to be carried out from time to time.

In conclusion, *Escherichia coli, Citrobacter freundii* and *Streptococcus pyogenes* were the commonest organisms cultured in the urine of children at YBSH, Gusau. Genticin, ofloxacin, nitrofurantoin and ciprofloxacin were the antibiotics with the highest susceptibility pattern to the isolated organisms. These antibiotics may be used empirically, but we recommend that all suspected cases of UTI should have a urine culture and sensitivity pattern determined for appropriate treatment.

LIMITATION

The limitation from this study may be from improper sample collection as not all mothers may have abided to instructions given to them which may have resulted in the urine culture yielding bacterial pathogens that do not commonly cause urinary tract infections. The study being retrospective only looked at laboratory result and did not consider the possibility of prior antibiotic use which may have contributed to antibiotic resistance.

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