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Bacterial Isolates from the Urine of Women in Ilorin and their Antibiotic Susceptibility Patterns.

I. Funsho Abdul* and Boaz A. Onile**
Departments of *Obstetrics & Gynaecology and **Medical Microbiology, University of Ilorin Teaching Hospital, P.M.B. 1339, Ilorin, Kwara State, Nigeria.

Abstract

Context: *Urinary tract infections (UTI) are commonly encountered in women and, often, antibiotics are prescribed before bacteriological results are available. There is therefore a need to determine empirical antibiotics suitable in such situations.*

Objective: *The aims of the study were to identify the pathogens causing UTI in pregnant and non-pregnant women, determine their antimicrobial sensitivity patterns and suggest appropriate empirical antimicrobial agents for use in such patients.*

Study Design and Setting: *A cross-sectional study at the Department of Obstetrics and Gynaecology, University of Ilorin Teaching Hospital, Ilorin, Nigeria.*

Methods: *Urine samples of women suspected to have UTI were sent for microscopy, culture and sensitivity tests. The results were analyzed and the differences between the results of pregnant and non-pregnant patients were assessed, using the chi-square test.*

Results: Escherichia coli *was the predominant cause of UTI in both groups of women.* Staphylococcus aureus *(0.05>p>0.01),* Proteus *species (0.05>p>0.01) and* Pseudomonas *(0.05>p>0.01) were more likely to be isolated in non-pregnant women. Sultamicillin, azithromycin, nitrofurantoin, nalidixic acid, gentamycin and cotrimoxazole demonstrated 'good' to 'very good' effectiveness against the organisms. The more recent, expensive antibiotics like ofloxacin, ciprofloxacin, ceftriaxone and cefuroxime demonstrated 'excellent' effectiveness against the organisms. Antibiotics were generally more effective in clearing UTI in pregnancy.*

Conclusions and Recommendation: *Antibiotics for empirical treatment of UTI in this environment should be those with good to excellent activities as listed above. Consideration should be given to the severity of the infection, drug safety in pregnancy and cost-effectiveness in making the appropriate choice for each patient.*

Key Words: Bacteria; Susceptibility; Urinary Tract Infection; Women. [Trop J Obstet Gynaecol, 2001, 18: 61-65]

Introduction

Urinary tract infections (UTI) are common in women, with the incidence ranging from 5 to 20% [1]: This high incidence is as a result of the proximity of the vagina and urethral orifice to the anus which makes them susceptible to colonization by enteric bacteria [1,2,3,4,5]. The infections range from simple urethritis through cystitis and pyelitis to pyelonephritis. They are more common during pregnancy, labour and the puerperium because of mechanical factors that obstruct urinary flow, causing stasis and promoting bacterial invasion of the urinary tract [2,3,6].

Recent reports have shown that frequent use of broad-spectrum antibiotics has made the bowel commensals to acquire resistance to many antimicrobial agents. These resistance properties are easily transferred between bacteria of different genera through plasmids and other means [7,8,9]. Other reports have shown that the bacteriology of UTI has changed over time, with an increasing presence of gram-positive cocci such as staphylococci and some gram-negative organisms like *Klebsiella* becoming more frequently isolated, even in community acquired UTI, separate and apart from its usual association with hospital-acquired infections [10, 11,12].

Many times, UTI present acutely or in places remote from reliable laboratories. Empirical antibiotic therapies are often instituted in such situations. It is for this reason that the prevalence of the causative organisms and their antimicrobial sensitivity patterns need to be known, so that appropriate antibiotics will be used. The aims of the study were to identify the bacterial pathogens causing UTI in pregnant and non-pregnant women, determine their antimicrobial sensitivity patterns and suggest appropriate empirical antimicrobial agents for use in such patients.

Correspondence: *Dr. I.F. Abdul, Department of Obstetrics & Gynaecology, University Teaching Hospital, P.M.B. 1339, Ilorin, Nigeria.*
e-mail: *abdul@ilorin.skannet.com*

Materials and Methods

Mid-stream samples of 'clean-catch' urine specimens of women presenting with symptoms suggestive of UTI either at the Antenatal or the Gynaecological Clinic, University of Ilorin Teaching Hospital, Ilorin Nigeria, were sent for bacteriological evaluation between January 1997 and December 1997. All patients who were on antibiotics before or at the time of presentation were excluded from the study. Also excluded were patients who previously had urinary tract infection treated in the six months before presentation.

Trained nurses supervised collections of specimen and samples were then sent immediately to the laboratory to prevent multiplication of organisms before examination[13]. A standard platinum loop was used to administer approximately 0.025ml of uncentrifuged urine on to cysteine-lactose-electrolyte-deficient (CLED) media and MacConkey agar plates. After overnight aerobic incubation at 37 °C, samples were identified to species and their antimicrobial sensitivities tested using Stoke's disc diffusion technique [14].

The laboratory results were analysed separately for pregnant and non-pregnant women. The aims of the study was to identify pathogens of UTI in pregnant and non-pregnant women, determine their antimicrobial sensitivity patterns, suggest appropriate empirical antibiotics for the bacteria isolated and compare results between pregnant and non pregnant women. The chi-square test was used to determine significant differences between the two groups of women in the prevalence and the antimicrobial sensitivity patterns of the organisms isolated.

Results

Three hundred and eighteen (318) samples were sent for processing and subsequent analysis during the study period. One hundred and thirteen (113) samples showed significant growth, which amounted to 35.5% of the samples. Pregnant women accounted for 59 (52.2%), while non-pregnant women accounted for 54 (47.8%) of the isolates.

Table 1 shows the prevalence of the various organisms isolated. *Escherichia coli* was the commonest isolated organism, accounting for 43.4 % of cases. It was present in almost equal amounts among the pregnant and the non-pregnant women. Other organisms isolated in order of frequency were *Streptococcus faecalis* (15.9%), *Klebsiella* (12.4%), *Staphylococcus aureus* (10.6%), *Proteus* species (9.7%) and *Pseudomonas* (8.0%). It should be noted, however, that the prevalence of *Staphylococcus aureus*, *Proteus* species and *Pseudomonas* in non-pregnant patients was much higher than in pregnant patients. This difference was statistically significant ($0.05>p>0.01$).

Table 1

Frequency of Isolation of Various Bacterial Pathogens in Urine

Organism	Pregnant Patients *No. (%)*	Non-Pregnant Patients *No. (%)*	Total *No. (%)*	*p*
E. Coli	28 (47.5)	21 (38.9)	49 (43.4)	NS
Strep faecalis	11 (18.6)	7 (13.0)	18 (15.9)	NS
Klebsiella	9 (15.3)	5 (9.3)	14 (12.4)	NS
Staph aureus	4 (6.8)	8 (14.8)	12 (10.6)	< 0.05
Proteus sp	4 (6.8)	7 (13.0)	11 (9.7)	< 0.05
Pseudomonas	3 (5.1)	6 (11.1)	9 (8.0)	< 0.05
Total	**59** (100)	**54** (100)	**113** (100)	

NS = *Not Significant*

The antimicrobial susceptibility pattern of pregnant patients is shown in Table 2. The isolates showed varying degrees of resistance to the antimicrobial agents tested. The antibiotics penicillin, ampicillin, cloxacillin, tetracycline and chloramphenicol showed very low effectiveness (less than 20%). Some other, relatively cheap, drugs like cotrimoxazole, nalidixic acid, nitrofurantoin and gentamycin as well as azithromycin showed acceptable good to very good antimicrobial activities. Excellent antimicrobial activities were however observed with ofloxacin, ciprofloxacin, cefuroxime and ceftriaxone.

Table 3 presents the antimicrobial sensitivity pattern of the isolates from non-pregnant patients. The results were similar to the pattern found among pregnant patients, except that the organisms were generally slightly more resistant. Comparisons of the efficacies of the drugs between pregnant and non-pregnant patients are displayed in Table 4. The difference was statistically significant only in the case of gentamycin, which was more effective for pregnant patients ($0.05>p>0.001$).

Table 2

Susceptibility Pattern of Pregnant Patients' Urinary Isolates

Drug	*E Coli*		*Strept faecalis*		*Klebsiella*		*Staph aureus*		*Proteus Sp*		*Pseudomonas*		Total.	
	No. Tested	% Sens	No Tested	% Sens	No Tested	% Sens	No Tested	% Sens	No Tested	% Sens	No Tested	% Sens	No Tested	% Sens
P	8	0	5	0	5	0	8	12.5	3	0	3	0	32	3.1
A	20	10	8	12.5	8	0	8	12.5	7	0	4	0	55	7.3
CX	19	15.8	8	15	7	14.3	6	50	8	0	6	0	54	16.7
SAM	22	50	6	66.7	8	25	5	60	5	40	4	25	50	46
E	13	15.4	7	42.8	5	20	5	60	5	0	3	0	38	23.7
AZM	13	61.5	6	66.7	3	33.3	3	100	3	33.3	2	0	30	70
T	6	2	3	0	2	0	3	33.3	3	0	2	0	19	15.8
C	11	18.2	4	25	3	0	8	25	3	0	3	0	32	18.8
S	6	33.3	2	0	3	33.3	3	66.7	5	20	2	0	21	28.7
G	20	75	8	62.5	5	60	4	75	5	60	4	50	46	67.4
OFX	22	81.8	8	75	6	50	5	60	4	50	3	66.7	48	81.2
CIP	19	84.2	7	100	6	50	5	100	5	80	4	50	46	89.1
CXM	19	100	8	100	6	100	5	80	6	83.3	4	100	48	95.8
CRO	18	94.4	9	100	7	85.7	5	100	6	83.3	4	100	49	93.9
COT	16	56.3	5	60.0	3	33.3	6	100	5	60	3	0	38	57.9
NIT	13	76.9	6	66.7	4	50	3	66.7	4	75	3	33.3	33	69.7
NAL	10	70	5	60	3	66.7	3	66.7	4	75	3	33.3	28	64.3

Key : P: Penicillin; A: Ampicillin; CX: Cloxacillin; SAM: Sultamicillin; E: Erythromycin; AZM: Azithromycin; T: Tetracycline; C: Chloramphenicol; S: Streptomycin; G: Gentamycin; OFX: Ofloxacin; CIP: Ciprofloxacin; CXM: Cefuroxime; CRO: Ceftriaxone; COT: Cotrimoxazole; NIT: Nitrofurantoin; NAL: Nalidixic acid. *Sens*: SENSITIVITY

Table 3

Susceptibility Pattern of Non-Pregnant Patients' Urinary Isolates

Drug	*E Coli*		*Strept faecalis*		Klebsiella		*Staph aureus*		*Proteus Sp*		*Pseudomonas*		Total.	
	No Tested	% Sens	No Tested	% Sens	No Tested	% Sens	No Tested	% Sens	No Tested	% Sens	No Tested	% Sens	No Tested	% Sens
P	7	0	5	0	4	0	7	28.5	3	0	2	0	28	3.6
A	17	23.5	7	14.3	6	0	5	0	3	0	2	0	40	5
CX	14	0	3	0	2	0	3	66.7	2	0	0	0	24	8.3
SAM	18	44.4	5	40	3	33.3	4	75	3	0	2	0	35	40
E	5	0	4	25	3	0	3	100	2	0	3	0	20	20
AZM	11	27.3	6	33.3	2	0	3	66.7	4	25	2	0	26	61.5
T	5	20	3	0	3	0	2	0	1	0	1	0	15	6.7
C	9	22.2	6	16.7	4	0	4	50	3	0	2	0	28	17.9
S	8	25	5	20	5	20	5	40	2	0	0	0	25	24
G	18	66.7	6	66.7	6	50	4	0	4	50	2	50	40	55
OFX	17	88.2	7	85.7	5	80	4	75	3	100	3	66.7	39	79.5
CIP	19	94.7	6	83.3	6	83.3	3	100	4	75	3	33.3	41	85.4
CXM	20	95	6	100	5	80	4	75	4	75	3	100	42	90.5
CRO	19	89.5	7	85.7	4	100	4	100	4	75	3	66.7	41	87.8
COT	16	62.5	5	60	4	50	4	25	3	33.3	2	0	34	50
NIT	15	66.7	6	66.7	3	33.3	3	66.7	3	66.7	2	50	32	68.8
NAL	14	64.3	5	80	5	40	4	50	3	33.3	1	100	32	59.4

Key : P: Penicillin; A: Ampicillin; CX: Cloxacillin; SAM: Sultamicillin; E: Erythromycin; AZM: Azithromycin; T: Tetracycline; C: Chloramphenicol; S: Streptomycin; G: Gentamycin; OFX: Ofloxacin; CIP: Ciprofloxacin; CXM: Cefuroxime; CRO: Ceftriaxone; COT: Cotrimoxazole; NIT: Nitrofurantoin; NAL: Nalidixic Acid. *Sens*: SENSITIVITY

Discussion

The 35.5% rate of significant bacteriuria reported in this study is far higher than rates reported in other studies [1,2,5]. It may however be due to the fact that the rate obtained in this study was based on a study population with clinical suspicion of UTI. The commonest organism isolated was *Escherichia coli*. This finding conforms to the generally observed trend the world over [1,2,14,15], but put to question the validity of some recent reports which tend to give *Klebsiella* predominance [10,11,12]. The fact that *Klebsiella* ranked second in this study will however support the notion that it is an emerging force in urinary tract infections. It was equally present in both the pregnant and the non-pregnant patients. The findings of significant difference in the presence of *Staphylococcus aureus*, *Proteus* species and *Pseudomonas* in non-pregnant patients confirms the aetiopathogenesis of urinary tract infections in them, which will include nosocomial infections [10,11,12], as against pregnant women who are more likely to have hitherto normal commensals isolated [2], the pregnancy having caused structural and functional changes that promote development of UTI [2,3].

Table 4

Comparison of the Efficacy of Antimicrobials Between Pregnant and Non-Pregnant Patients

Anti-Microbial Agent	Percentage Effectiveness		
	Pregnant	Non-Pregnant	*p*
Penicillin	3.1	3.6	NS
Ampicillin	7.3	5	NS
Cloxacillin	16.7	8.3	NS
Sultamicillin	46	40	NS
Erythromycin	23.7	20	NS
Azithromycin	70.0	61.5	NS
Tetracycline	15.8	6.7	NS
Chloramphenicol	18.8	17.9	NS
Streptomycin	28.7	24	NS
Gentamycin	67.4	55	0.05>p>0.01
Ofloxacin	81.2	79.5	NS
Ciprofloxacin	89.2	85.4	NS
Cefuroxine	95.8	90.4	NS
Ceftriaxone	93.9	87.8	NS
Cotrimoxazole	57.9	50	NS
Nitrofurantoin	69.7	68.8	NS

NS = *Not Significant*

The increasing presence of gram-positive organisms, *Streptococcus faecalis* and *Staphylococcus aureus* [16], should be borne in mind when choosing anti-microbials for UTI in women. The two microbes have poor susceptibility to the common, cheap antibiotics except cotrimoxazole and to a limited extent cloxacillin for *S. aureus*. The prominent gram-negative organisms found in non-pregnant patients – *Pseudomonas* and *Proteus* species - were resistant against all easily available antibiotics except gentamycin. This should also be borne in mind in the choice of antibiotics for UTI in non-pregnant women. Nalidixic acid, nitrofurantoin, ofloxacin, ciprofloxacin, cefuroxime and ceftriaxone are also drugs of choice. [3,14,17].

Generally speaking, organisms isolated from pregnant patients were more susceptible to antimicrobial agents, even though this was only statistically significant in the case of gentamycin. This however supports the theory that more drugs will be delivered to the urinary tract in pregnancy because of the increased renal blood flow in pregnancy. From the foregoing, the drugs of choice for empirical therapy in cases of urinary tract infections in women will include gentamycin, sultamicillin, cotrimoxazole, nitrofurantoin, nalidixic acid, ofloxacin, ciprofloxacin, cefuroxime and ceftriaxone. The use of cotrimoxazole, nitrofurantoin, nalidixic acid, ofloxacin and ciprofloxacin is contraindicated for all or part of pregnancy [18]. However, cotrimoxazole and nitrofurantoin have enjoyed widespread use in pregnant patients especially at mid-trimester [1,3,15,17].

In conclusion, there is evidence that *Escherichia coli* is still the commonest aetiological agent of UTI in women in this environment, but *Klebsiella* is gaining prominence. The notorious gram-negative organisms like *Pseudomonas* and *Proteus* species are more likely to be the cause of UTI in non-pregnant patients. Gentamycin has been shown in this study to be very effective against organisms isolated from pregnant patients, but it's use should be restricted to situations where the benefits outweigh the risks of teratogenicity in the fetus, like in cases of resistance to other drugs or where other useful drugs are not available. The other more expensive drugs are useful but the choice must be balanced between safety, cost effectiveness and availability. Another study that will compare *in vitro* and *in vivo* effectiveness of the antimicrobials is desirable.

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