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Research Article

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Prevalence and Antibiogram of Urinary Tract Infections in Patients Attending Hospitals in Minna, Niger State.

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Abstract

Urinary Tract Infections (UTIs), one of the most common bacterial infections, have become the frequent nosocomial infections and are frequently associated with catheterization. The study was carried out to assess the prevalence and antibiogram of UTIs in patients attending hospitals in Minna. One hundred and fifty seven patients were screened for the presence of significant bacteriuria. Samples were inoculated on Cystine Lactose Electrolyte Deficient agar, blood agar, and MacConkey agar for analysis. Bacterial identification was based on standard culture and biochemical characteristics procedure. Antimicrobial susceptibility profile of isolates was carried out by Kirby Bauer's disc diffusion method. Significant bacteriuria was observed in 96/157 (61.15%) ($P > 0.05$). UTI was more common in among patients within age groups between 20 and 29 years. The most commonly isolated species from patients was *Escherichia coli* followed by *Klebsiella pneumoniae*. Variation in antimicrobial susceptibility pattern was observed in all isolates. Streptomycin (95.06%) was the most effective drug against Gram negative uropathogens. Susceptibility rates of Gram positive isolates were very low. Multidrug resistance exists among uropathogens in this study population. Regular surveillance and enhanced antibiotic stewardship should be encouraged in the study area.

Keywords: Urinary tract infection (UTI), Uropathogens, Antibiotics, Patients, Urine

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Introduction

Urinary tract infection (UTI), which is attributed to the existence as well as the increase of microbes anywhere in the urinary tract, is possibly among the commonest bacterial infection (Theodore, 2007; Okonko *et al*., 2009). Although UTIs occur in all age groups including men and women, clinical research suggests that the total occurrence of UTI is advanced in women. The female urethra structurally is found less effective for preventing the bacterial entry. It may be due to the proximity of the genital tract and urethra and adherence of urothelial mucosa to the mucopolysaccharide lining (Akortha and Ibadin, 2008). According to Arul *et al*. (2012), the other main factors which make females more prone to UTI are pregnancy and sexual activity. In pregnancy, the physiological increase in plasma volume and decrease in urine concentration leads to the development of glycosuria in up to 70% women which, in the end, leads to bacterial growth in urine.

The biological connection with the female urethra towards the vagina causes it to be predisposed to shock/pain in the course of sexual activity. This increases the risk of urethra contamination as the bacteria could be pushed into the urethra during intercourse and also microbes becoming massaged in the urethra through to the bladder in the course of child delivery (Ebie *et al*., 2001; Kolawole *et al*., 2009). Okonko *et al*. (2009) reported that the use of diaphragm also causes UTI as it pushes against the urethra and makes the urethra unable to drain the bladder completely. The urine that remains within the bladder is usually very likely to permit the development of microbes which ultimately causes UTI (American Academy of Family Physicians, 2004; National Kidney and Urologic Diseases Information Clearinghouse, 2005). More than 50% of women of all ages encounter no less than one episode of UTI at some point of their lifetime and between 20% and 40% of women can have recurrent episodes. About 20% of all UTIs occur in men (Griebling, 2007).

The emergence of antibiotic resistance in the management of UTIs is a serious public health problem particularly in the developing world where apart from high poverty level, ignorance and poor hygiene practices, as well as high prevalence of fake and spurious drugs of questionable quality in circulation are evident (Abubakar, 2009). In Nigeria, a growing rate of resistance to antibiotics of organisms isolated from urine has been observed (Jombo *et al*., 2008; Aboderin *et al*., 2009). Antibiotics are readily available in Nigeria as drugs bought over the counter and can be obtained easily without a prescription from medical personnel. Thus self medication, a common practice among Nigerians has been documented as a major contributor to development of antibiotic resistance (Omigie *et al*., 2009), especially where access to medical facility is not available.

Materials and methods

Study area

The study was carried out in the microbiology laboratory of the Department of Microbiology, Federal University of Technology, Minna, Niger State, Nigeria. Midstream urine (MSU) samples were collected from patients at five different hospitals (General Hospital, Ibrahim Badamasi Babangida (IBB) Specialist Hospital, Top Medical Centre, Bay Hospital and Imani Specialist Hospital and Diagnostic Centre) in Minna. The duration of the study was from June to December, 2013.

Study Population

Urine samples of 157 patients comprised of 61 males and 96 females, who attended the outpatient departments of five hospitals with symptoms of UTI, were included in the study. The patients on antibiotic therapy were excluded from the study.

Sample Collection

Freshly voided midstream urine sample (10ml) was collected from patients in a wide mouth sterile container after cleansing the genitals. All patients were well instructed on how to collect sample aseptically prior to sample collection to avoid contaminations from urethra. Verbal informed consent was obtained from all patients prior to specimen collection. Approval was sought and obtained from the Research/Ethics Committee of the hospitals and informed consent obtained from the patients before the commencement of the research. The specimens were labeled, transported to the laboratory immediately and analyzed.

Sample Processing

A loopful (0.01ml) of well mixed un-centrifuged urine was streaked on to the surface of blood agar, MacConkey agar and cysteine lactose electrolyte deficient (CLED) medium. The plates were incubated aerobically at 37°C for 24 hours and counts were expressed as colony forming units per milliliter (cfu/ml). A count of $\geq 10^5$ cfu/ml was considered significant to indicate UTI (Cheesbrough, 2010).

Identification of Pure Isolates

Identification of bacterial isolates was done on the basis of their cultural, morphological and biochemical characteristics. Gram negative bacteria were identified by the standard biochemical tests (Foxman and Brown, 2003) and Gram positive microorganisms were identified with the corresponding laboratory tests: catalase, coagulase, and mannitol test for *Staphylococcus aureus* (Andreua *et al*., 2005). Identified and pure isolates were maintained in nutrient agar slants and incubated at 37^{o}C for 24 hrs.

Antimicrobial Susceptibility Testing

Isolates were tested for antimicrobial susceptibility testing by the standard Kirby Bauer's disc diffusion method (Bauer *et al*., 1966). Standard inoculum adjusted to McFarland 0.5 was swabbed on Mueller Hinton agar and was allowed to soak for 3 minutes. After that antibiotic multi-discs were placed on the surface of media and pressed gently. Mueller Hinton agar plates were then incubated at 37^{o}C for 24 hours. After 24 hours the inhibition zones were measured and interpreted by the recommendations of clinical and laboratory standards (Clinical and Laboratory Standards Institute, 2013). The following antibiotic discs were used for the isolates: tetracycline (25µg), gentamicin (10µg), levofloxacin (5µg), ofloxacin (5µg), ciprofloxacin (5µg), pefloxacin (5µg), erythromycin (10µg), sulfamethoxazole-trimethoprim (Septrin) (30µg), ampicillin and cloxacillin (Ampiclox) (50µg), ceftriaxone (30µg), streptomycin (30µg), amoxicillin and clavulanic acid (augmentin) (30µg), cefalexin (10µg), ampicillin (30µg), peflacine (10µg) and nalidixic acid (30µg).

Statistical Analysis of Data

The data were analyzed using Chi-square (χ^2) test. Chi-square test was applied to test whether differences between values are significant. P values < 0.05 were considered as statistically significant. All statistical tests were performed using Statistical Package for Social Sciences (SPSS) software (version 20).

Results

The overall prevalence of UTI in both male and female patients was found to be 61.15%. A total of 96 urine samples showed significant bacterial growth which comprised of 29 (30.20%) samples from males and 67 (69.79%) from females. These results indicated that the prevalence of UTI was higher in female patients than in males (P > 0.05). UTI was more common in the age groups between 20 and 29 years followed closely by age groups between 30 and 39 years (Table 1).

Table 1: Prevalence of UTI in Relation to Age and Sex

Age groups (Years)	Total No. of Subjects	Sex				Total (%) Positive
		Male		Female		
		No. Examined	No. (%) Positive	No. Examined	No. (%) Positive	
0-9	13	7	1 (14.29)	6	3 (50)	4 (4.17)
10-19	13	5	2 (40.00)	8	6 (75)	8 (8.33)
20-29	58	11	5 (45.45)	47	29 (61.70)	34 (35.41)
30-39	49	25	13 (52.00)	24	20 (83.33)	33 (34.38)
40-49	16	9	5 (55.56)	7	6 (85.71)	11 (11.46)
50-59	4	2	1 (50.00)	2	2 (100)	3 (3.13)
≥ 60	4	2	2 (100)	2	1 (50)	3 (3.13)
Total	**157**	**61**	**29 (30.21)**	**96**	**67 (69.79)**	**96 (100)**

χ^2=0.572; df=4; P=0.96

A total of 96 bacterial uropathogens made up of 81 (84.38%) Gram negative and 15 (15.63%) Gram positive were isolated from positive urine samples. Escherichia coli was found the dominant bacteria among all isolated uropathogens with the prevalence rate of 53.13% (Figure 1). The second most prevalent isolate was Klebsiella pneumoniae (26.95%) followed by Staphylococcus aureus (7.29%), Proteus mirabilis (5.21%), Enterobacter spp. (5.21%), Citrobacter freundii (5.21%), Coagulase negative Staphylococcus (5.21%), Enterococcus faecalis (3.13%) and Pseudomonas aeruginosa (2.08%). No statistically significant variation (P > 0.05) was found among the isolates (Table 2). Out of 81 Gram negative bacteria, 25 (30.86%) were isolated from males and 56 (69.14%) were from female patients. Only 4 (26.67%) Gram positive bacteria were isolated from male and 11 (73.33%). were isolated from female patients.

Table 2: Frequency of Isolation of Organisms in Relation to Sex

Bacterial Pathogens	Male (%)	Female (%)	Total (%)
Escherichia coli	16 (20)	35 (43.75)	51 (53.13)
Klebsiella pneumonia	5 (25)	8 (40.00)	13 (26.95)
Pseudomonas aeruginosa	0 (0.00)	2 (11.11)	2 (2.08)
Enterobacter spp.	3 (50)	2 (33.33)	5 (5.21)
Citrobacter freundii	1 (16.67)	4 (66.67)	5 (5.21)
Proteus mirabilis	0 (0.00)	5 (29.41)	5 (5.21)
Staphylococcus aureus	1 (14.29)	6 (85.71)	7 (7.29)
CoNS*	2 (20)	3 (27.27)	5 (5.21)
Enterococcus faecalis	1 (25)	2 (50.00)	3 (3.13)
Total	**29 (30.21)**	**67 (69.79)**	**96 (100)**

*CoNS-Coagulase Negative *Staphylococcus*
χ^2=2.5; df=6; P=0.83

The antimicrobial susceptibility pattern of Gram negative uropathogens isolated from patients against 10 antimicrobial agents is shown in Table 3. The susceptibility profile of *E. coli* isolated was 100% (ofloxacin, peflacine, ciprofloxacin and streptomycin, respectively), 100% and 100% 50.98% (amoxicillin-clavulanic acid and gentamicin, respectively), 49.20% (cefalexin), 19.61% (nalidixic acid), 47.06% (sulfamethoxazole-trimethoprim) and 00% (ampicillin). *K. pneumoniae* isolated had a susceptibility pattern of 76.92% (ofloxacin), 61.54% (peflacine), 100% (ciprofloxacin), 00% (amoxicillin-clavulanic acid), 61.54% (gentamicin), 100% (streptomycin), 61.34% (cefalexin), 46.15% (nalidixic acid), 76.98% (sulfamethoxazole-trimethoprim) and 00% 00% (ampicillin).

The susceptibility profile of *Ps. aeruginosa* isolated was 00% for all the antibiotics used. The susceptibility profile of *Enterobacter* spp. isolated was 100% (ofloxacin), 60% (peflacine and ciprofloxacin, amoxicillin-clavulanic acid, sulfamethoxazole-trimethoprim and gentamicin), 30% (cefalexin), 20% (nalidixic acid), 00% (ampicillin). *C. freundii* had a susceptibility profile of 40% (ofloxacin, peflacine and ciprofloxacin), 00% (amoxicillin-clavulanic acid, gentamicin, cefalexin and sulfamethoxazole-trimethoprim respectively), 100% (streptomycin), 20% (nalidixic acid) and 50% (ampicillin). *P. mirabilis* had a susceptibility profile of 100% (ofloxacin and ciprofloxacin respectively), 40% (peflacine, gentamicin, sulfamethoxazole-trimethoprim and cefalexin), 00% (amoxicillin-clavulanic acid and nalidixic acid respectively), 60% (streptomycin) and 50% (ampicillin).

Table 3: Antimicrobial Susceptibility Pattern of Gram Negative Uropathogens (no space for table)

Antimicrobial Agents	Organisms (No.) (%)						Total (%)
	***E. coli* (51)**	***K. pneumoniae* (13)**	***Ps. aeruginosa* (2)**	***Enterobacter spp.* (5)**	***C. freundi* (5)**	***P. mirabilis* (5)**	
OFX	51 (100)	10 (76.92)	0 (00)	5 (100)	2 (40)	5 (100)	73 (90.12)
PEF	51 (100)	8 (61.54)	0 (00)	3 (60)	2 (40)	2 (40)	66 (85.19)
CPX	51 (100)	13 (100)	0 (00)	3 (60)	2 (40)	5 (100)	74 (91.35)
AU	26 (50.98)	0 (00)	0 (00)	3 (60)	0 (00)	0 (00)	29 (35.80)
CN	26 (50.98)	8 (61.54)	0 (00)	3 (60)	0 (00)	2 (40)	39 (48.15)
S	51 (100)	13 (100)	0 (00)	5 (100)	5 (100)	3 (60)	77 (95.06)
CEP	25 (49.02)	8 (61.34)	0 (00)	2 (40)	0 (00)	2 (40)	37 (45.68)
NA	10 (19.61)	6 (46.15)	0 (00)	1 (20)	1 (20)	0 (00)	18 (22.22)
SXT	24 (47.06)	10 (76.98)	0 (00)	3 (60)	0 (00)	2 (40)	39 (48.15)
PN	0 (00)	0 (00)	0 (00)	0 (00)	5 (100)	0 (00)	5 (6.17)

Key: OFX: Ofloxacin; PEF: Reflacine; CPX: Ciprofloxacin; AU: Amoxicillin and Clavulanic acid; CN: Gentamicin; S: Streptomycin; CEP: Cefalexin; NA: Nalidixic acid; SXT: Sulfamethoxazole-trimethoprim; PN: Ampicillin

The susceptibility pattern of Gram positive uropathogens is shown in Table 4. The isolates showed low levels of susceptibility (<60%) to streptomycin (20%), gentamicin (13.33%), ofloxacin (13.33%), levofloxacin (6.67%), pefloxacin (6.67%) and the third generation cephalosporin, ceftriaxone (6.67%). All the strains were resistant to tetracycline, ampicillin and cloxacillin (ampiclox) and erythromycin.

Table 4: Antimicrobial Susceptibility Pattern of Gram positive Isolated Uropathogens

Antimicrobial agents	Bacterial Uropathogens (No.) (%)			Total (%)
	***S. aureus* (7)**	**CoNS* (5)**	***E. feacalis* (3)**	
T	0 (00)	0(00)	0 (00)	0 (00)
G	0 (00)	1(20)	1 (33.33)	2 (13.33)
LEV	0 (00)	1(20)	0 (00)	1 (6.67)
OF	0 (00)	1(20)	1 (33.33)	2 (13.33)
CIP	1(14.92)	2 (40)	0 (00)	3 (20)
LPF	0 (00)	1 (20)	0 (00)	1 (6.67)
E	0 (00)	0 (00)	0 (00)	0 (00)
AX	0 (00)	0 (00)	0 (00)	0 (00)
CEF	0 (00)	1 (20)	0 (00)	1 (6.67)
S	0 (00)	1 (20)	2 (66.67)	3 (20)

Discussion

Bacterial infection of the urinary tract is one of the common causes for seeking medical attention (Kebira *et al*., 2009). Efficient management of patients suffering from bacterial UTIs commonly relays on the identification of the type of microorganisms that caused the disease as well as the choice of a valuable antibiotic agent to the organism in question.

In this study, the prevalence of UTI was 61.15%. This is inconsistent with the reports of similar UTI studies by Ebie *et al*. (2001) and Oladeinde *et al*. (2011) who recorded 35.3% and 39.7% respectively. Omonigho *et al*. (2001) recorded a much lower prevalence rate of 22.3%. It is on documentation that different prevalence rates have been reported by some authors (Onifade *et al*., 2005; Obiogbolu *et al*., 2009; Shirishkumar *et al*., 2012) stating prevalence rates of 71.6%, 58.0%, 54.0% and 46.5%, respectively.

Significant bacteriuria occurred more in females (64.95%) than males (35.05%) which corresponds with other findings which revealed that the frequency of UTI is greater in females as compared to males (Oladeinde *et al*., 2011; Rajalakshmi and Amsaveni, 2012; Sood and Gupta, 2012) as shown in Table 1. UTI is more frequent in females than in males, during their youth age and adulthood (Asinobi *et al*., 2003; Tambeka *et al*., 2006; Shaifali *et al*., 2012). The factor of this rising occurrence of UTI in young age females is associated with the proximity of their urethral opening to the anus and the female urethra is shorter than the male's, providing bacteria easier access to the bladder. About 50-80% women experience urinary tract infection at least once or twice in their lives (Khan *et* al., 2013). High sexual activity, the use of a diaphragm with spermicide, childbirth, menopause are also other predisposing factors to infection (Phipps *et al*., 2006; Dielubenza and Schaeffer, 2011) and a record of frequent UTIs (Aiyegoro *et al*., 2007; Okonko *et al*., 2009). The length of the urethra, the dried environment surrounding the meatus, and the antibacterial properties of prostatic fluid contribute to a lower rate of UTI in males (Abubakar, 2009).

The results of this study, as shown in Table 2, indicated that the etiologic pathogens of UTIs mainly belong to Gram negative enteric bacteria (84.38%). *E. coli* (53.13%) was found to be the most prevalent Gram negative bacteria in the positive urine samples of UTI. This agrees well with previous studies conducted in Minna, Niger State (Adabara *et al*., 2012) and other parts of the country (Ehinmidu, 2003; Aiyegoro *et al*., 2007, El-Mahmood, 2009; Pondei *et al*., 2012) but contrasts the reports of Ehinmidu *et al*. (2003) and Aboderin *et al*. (2009) in which *Ps. aeruginosa* and *K. pneumoniae* were recorded respectively as the major bacteria in UTI. These result is not correlate with other reports in which *Ps. aeruginosa* was reported as the second most common bacterial isolate in UTI studies in India (Tambeka *et al*., 2006) and Lafia, Nigeria (Kolawole *et al*., 2009); however, these results correlates with Haghi-Ashteiani *et al*. (2007) in which *K. pneumoniae* was reported as the second most frequently isolated organism in UTI. Other research works on UTI in other parts of the world also reports that *E. coli* and *K. pneumoniae* are the commonest urinary pathogens in UTI (Bano *et al*., 2012; Prakash and Saxena, 2013).

Streptomycin was the most effective drug (90.56%) against Gram negative uropathogens isolated. Ofloxacin was active against 90.12% of the isolates. Other antibiotics which were effective against the isolates are ciprofloxacin and reflacine. Nwadioha *et al*. (2010) also recorded a high susceptibility (>80%) of UTI bacterial isolates to ciprofloxacin. The high rate of resistance to ampicillin, nalidixic acid and amoxicillin-clavulanic acid (augmentin) observed in this study may echo the fact that these are the commonly prescribed antibiotics in the hospital and also the most easily obtainable in the community without prescription.

Even though diverse studies in several parts of the globe and in different parts of the same country found dissimilar resistance rates to different drugs over time (Zalmanovici *et al*., 2010; Raza *et al*., 2011), it is imperative that attention be paid to local resistance patterns since these have the greatest impact on care. These variations in susceptibility may be due to the treatment practice in different localities as inappropriate exposure to antibiotics leads to the development of resistance (Iregbu and Nwajiobi-Princewill, 2013). The strict application of infection control measures remains the cornerstone for nosocomial infection prevention and control of resistance, surveillance and appropriate duration of antibiotic therapy and adjustment of dosages. Emphasis should be placed on these practices in hospital settings (Chakupurakal *et al*., 2010). Albeit susceptibility pattern in this study stresses the need for *in-vitro* susceptibility reports prior to commencement of antibiotic therapy, it must not be forgotten that *in-vitro* antimicrobial susceptibility reports serve only as guide and that conditions *in-vivo* may be quite different.

Conclusion

This study has shown that the overall prevalence of UTI in MInna, Niger State, Nigeria is 61.15%. This study has also shown that *Escherichia coli* is the most frequent pathogen. Standard antibiotic analysis and antibiotic stewardship practice will help bring to a minimum or complete elimination the surge of resistance and improve care.

There is day by day change in sensitivity pattern and it varies from one place to another. Uropathogens are gaining resistance at an amplified rate to commonly used antimicrobials as revealed in this and other studies. Treatment of UTIs in the study area should be guided by the results of antibiotic susceptibility pattern of isolated organisms rather than on universal guidelines.

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