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Full Length Research Paper

Antimicrobial susceptibility of some quinolone antibiotics against some urinary tract pathogens in a tertiary hospital, Yola, Adamawa State, Nigeria

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Antibiotic resistance is an increasing threat to life and morbidity and mortality. UTIs are greater when caused by drug-resistant microorganisms. A total of 250 urine samples were collected and out of these, some 143 different strains of bacteria which were isolated, showed positive bacterial growth. Among the different uropathogens, 53 (37.1%) were obtained from male subjects, while the remaining 90 (62.9%) were from female subjects. Of the 143 bacterial isolates obtained, gram negative bacteria had the highest frequency of occurrence with 91 (63.6%) than gram positive bacteria with 52 (36.4 %). The organisms isolated were *Escherichia coli* 37 (25.9%), *Staphylococcus aureus* (17.5%); *Enterococcus faecalis* (15.4 %), *Klebsiella aerogenes* (14.7%), *Klebsiella pneumoniae* (5.6%), *Proteus vulgaris* (11.4%) species 8 (10%); *Pseudomonas aeruginosa* 7 (4.9%), *Staphylococcus saprophyticus* (4.5 %) and *P. Proteus mirabilis* 2 (1.4%) in order of ranking. The susceptibility of the isolates to the quinolone antibiotics were assessed using the disc diffusion method. Among the gram-negative bacteria, *P. aeruginosa* was less susceptible with a profile of (71.4%) to ciprofloxacin, ofloxacin (42.9%), pefloxacin (57.1%), and sparfloxacin (42.9 %), but no activity for nalidixic acid. The susceptibility pattern followed similar trend for the other gram-negative bacteria. Among the gram-positive bacteria, *S. aureus* was least sensitive with a profile of 64.0% for ciprofloxacin, ofloxacin (56.0%), pefloxacin (52.0%), Sparfloxacin (52.0%) and nalidixic acid (8.0%). The quinolone antibiotics were still effective against the uropathogens, but should be reserved for only complicated UTIs to avoid the development of resistance.

Key words: Resistance, morbidity, mortality, susceptible, uropathogens.

INTRODUCTION

Urinary tract infection is a broad term that encompases both the asymptomatic microbial colonization and symptomatic infection with invasion and inflammation of the urinary tract structures (Fluit et al., 2000; Santo et al., 2007). It is a common type of bacterial infection occurring both in the community and hospital settings, including acute and long care hospital patients (El-Astal, 2004; Mordi and Erah, 2006). Hospital acquired infections are often caused by antibiotic-resistant strains (Tice, 1999).

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UTI affects people of all ages from neonates to geriatrics and accounting for reasonably high health care expenditure (Clarridge et al., 1998; Tice, 1999). The acquisition of antibiotic-resistant pathogens as commensals is the first step in the pathogenesis of resistant bacteria. Pathogenesis of UTI involves complex interactions between an organism, the environment and the potential host (Savas et al., 2006; Santo et al., 2007). Uropathogenic bacteria have become globally pervasive and reports of serious and rapidly progressive fatal infections due to virulent enteric and environmental pathogens have alarmed health care professionals (Boyle-Vavra et al., 2003). Although fungi and viruses are occasional etiological agents, UTIs are predominantly caused by

facultative anaerobes. The most common bacteria implicated as causative agents of UTI generally originate in the intestine and include but not limited to *E. coli*, which is responsible for 85 - 90% of infections in the ambulatory and 50% of nosocomial infections (Clarridge et al., 1998). Other bacteria are *Pseudomonas* spp, *Streptococcus* spp, *Proteus* spp., *Klebsiella* spp., *Staphylococcus* spp, *Neisseria gonorrhoea*, *Chlamydia trachomatis*, *Candida* spp, *Mycoplasma* (Hryniewicz et al., 2001; Kurutepe et al., 2005). The range of species isolated has increased over the years, possibly as a result of changing medical interventions. UTIs are usually treated with various antibiotics including the quinolone antibiotics and micro-biological testing may not always be necessary, because in most cases, urine culture and susceptibility testing cost more than the antibiotic treatment itself (Savas et al., 2006). Until recently, infections acquired outside the hospitals have been treated with co-trimoxazole and aminoglycosides antibiotics (Abu-Hujier and Sharif, 2008). However, resistance to existing drugs is wide spread and of serious concern not only to clinicians, hospital administrators, the Pharmaceutical industries, but also to the academia (Hosein *et* al., 2002). In the last three decades, there has been a lot of reports in the scientific literature describing the changing patterns in the etiological agents of urinary tract pathogens and their sensitivities to commonly prescribed antibiotics (Tenover and McGowan, 1996; Hryniewicz et al., 2001; Kurutepe et al., 2005). Despite their toxicity, the quinolone class of antibiotics is widely used to treat urinary tract infections (Khaki et al., 2009) with encouraging results. Along side aminoglycosides (Gentamicin, neomycin, streptomycin), the quinolones and the fluoroquinolones groups of antibiotics(ofloxacin, ciprofloxacin) are routinely used by fertility specialists to treat such bacterial infections occurring prior to the *in-vitro* fertilization treatment or when high concentration of leukocytes are present in the semen of these patients irrespective of microbial evidence of infection (Khaki et al., 2008). However, several studies have demonstrated that the use of the quinolones had resulted in the impairment of testicular function and structure. The use of ofloxacin and cipro-floxacin specifically has been associated with apoptosis in testis (Khaki et al., 2009). The susceptibility of uropathogens to the quinolone groups of antibiotics has not been extensively studied in Nigeria. However, there have been some reports on the prevalence of pathogenic microorganisms and their susceptibility to other groups of antibiotics (Kolawole et al., 2009; Mbata, 2007; Ebie et al., 2001; Ekweozor and Onyemenen, 1966; Mordi and Erah, 2006; Nwanze et al., 2007).

Studies aimed at gaining knowledge about the type of pathogens responsible for UTIs and their susceptibility patterns may help the clinicians to choose the right empirical treatment. health care facility.

This study was conducted to determine the etiological agents of UTIs in the tertiary, the Federal Medical Centre, Yola, Nigeria and their antimicrobial susceptibility pattern to some quinolone class of antibiotics. It is hoped that the results will provide useful information which would be used in the formulation of policies for the rational and effective use of the quinolone group of antimicrobial agents in view of their reported effectiveness against a wide range of pathogens and propensity of bacteria to develop resistance to the drugs.

MATERIALS AND METHODS

Study population

The study population was patients who attended the Federal Medical Centre, Yola, Nigeria, either as inpatient or out patient with symptoms suggestive of UTI. All patients had clinical evidence of urinary tract infections, as determined by the treating doctors. Only a single positive culture per patient was included in the analysis. These patients did not include those who were on antibiotics a week before the samples were collected.

Specimen collection

Early morning midstream urine specimens were collected aseptically from 250 (125 males and females each) patients. The urine samples were collected into sterile, wide mouthed glass bottles with screw cap tops as described by Kolawale et al. (2009). On the labels were the name, age, sex, and time of collection. In each container, boric acid (0.2 mg) was added to prevent the growth of bacteria in the urine. All patients were instructed on how to collect the urine samples aseptically and taken to the laboratory immediately for culture. The study was carried out between January, 2009 - June, 2009.

Total aerobic plate count

The bacterial load of the urine samples was determined using the surface plating method (Inabo and Obanibi, 2006; Santo et al., 2007). Serial dilutions of the urine samples were carried out by pipetting 1 ml of the urine into 9 ml of peptone water in a sterile test tube. Then 1 ml of this dilution was pipetted into another test tube till a 5^{th} test tube was reached in order to obtain countable colonies. One millilitre of the final dilution was spread on sterile 90 mm Petri plates and these were then incubated at 35 - 37°C for 24 h, after which the count was obtained using a Quebec Darkfield colony counter (Leica Inc. Bufallo, New York). Only urine samples that yielded 10^5 CFU/ML was considered for further analysis. The mean of triplicate results were taken (El-Astal, 2005).

Bacteriology

In the hospital laboratory, each well mixed urine sample (5 µl) was inoculated on McConkey agar (Oxoid), Blood agar (Oxoid), and cysteine lactose electrolyte deficient agar (CLED, International Diagnostic Group). The inoculum on the plate was streaked out for discrete colonies with a sterile wire loop following standard procedures (Cheesborough, 2006, Inabo and Obnibi, 2006, Mordi and Erah, 2006). The culture plates were incubated at 35 - 37°C for 24 h and observed for growth through formation of colonies. All the bacteria were isolated and identified using morphological, microscopy and biochemical tests following standard procedures described by Cowan and Steel (1974) and Cheesborough (2006).

Table 1. Distribution of patients by age and gender.

Gender	Age group						
	<26	26 - 35	36 - 45	46 - 55	56 - 65	>66	Total
Male	18	22	28	17	20	20	125
Females	21	28	31	20	19	6	125
Total	39	50	59	37	39	26	250

Table 2. Prevalence of the isolates according to gender.

Bacteria	Proportion					
	Number		Male		Female	
	N	%	n	%	n	%
E. coli	37	25.9	13	24.5	24	26.7
S. aureus	25	17.5	7	13.2	18	20.0
E. faecalis	22	15.4	10	18	12	13.3
K. aerogens	21	14.7	8	15.1	13	14.4
P. vulgaris	16	11.2	7	13.2	9	10.0
K. pneumoniae	8	5.6	3	5.7	5	5.6
P. aeroginosa	7	4.9		5.7	4	4.4
S. saprophyticus	5	4.5	2	3.8	3	3.3
P. mirabilis	2	1.4	-	-	2	2.2
Total	143	100.0	52	100	90	100

Key: n = number; % = percentage

Antibiotic susceptibility testing

The disc diffusion technique was used for antibacterial susceptibility testing of the isolates (Bauer et al., 1966; CLSI, 2006; Nwanze et al., 2007) using commercial antibiotics containing discs. Zones of growth inhibition were then measured to the nearest millimetre and recorded. The mean of triplicate results was taken as the zone diameter. The commercial antibiotics discs and the concentration used was Nalidixic acid (30 µg, Abtek Biological Lab., England). Others were Sparfloxacin, (5 µg), Oflaxacin (5 µg), Ciprofloxacin (5 µg) manufactured by Dynamcro Labs., PVT., LTD. India. Interpretation of results was done using zone sizes. Zones of inhibition ≥ 18 mm was considered sensitive, 13 - 17 mm intermediate and < 13 mm resistant. Isolates were classified as either resistant or intermediate sensitive or sensitive based on the definition of the Clinical and Laboratory Standard Institute (CLSI, 2006). Resistant and intermediate isolates were grouped together for purposes of analysis in this study. An isolate was considered multi-drug resistant if it was resistant to at least three of the antibiotics tested (Santo et al., 2007).

Some laboratory strains of known sensitivity of *S. aureus; E. faecalis, E. coli* and *P. aeruginosa* were used as quality control strains for the antimicrobial discs.

Statistical analysis

All data were analysed with SPSS for Windows, version 16.0 (SPSS Inc. Chicago, III, USA). The trend x^2 test for statistical comparisons between the groups and a $P < 0.05$ was considered as statistically significant.

RESULTS

The 250 urine samples collected from patients attending the Federal Medical Centre, Yola (FMCY) during the six month period yielded 143 (57.2%) positive urine cultures of bacterial growth. Table 1 shows the distribution of patients by age and gender. Most of the clients belonged to the 36 - 45 age group (31 females and 28 male patients) followed by 26 - 35 (28 females and 22 males) and <25 (21 females and 18 males) respectively. Male patients were more predominant over the 56 year group. However, a paired sample t-test showed that there was no significant difference between the number of males and females at 5% ($P < 0.05$) although there was higher mean value for females than males. Irrespective of gender, most of the patient belongs to the 36 - 45 age group (59) patients.

Table 2 depicts the prevalence of the uropathogen isolated according to gender. Among the different uropathogens, 53 (37.1%) were obtained from male subjects, while the remaining 90 (62.5%) were from female subjects. Of the 143 bacterial isolates obtained, gram negative bacteria had the highest frequency of occurrence with 91 (63.6%) than gram positive bacteria with 52 (36.4%). The organisms isolated included *E. coli* 37 (25.9%), *S. aureus* (17.5%); *E. faecalis* (15.4%), *K. aerogenes* (14.7%), *K. pneumoniae* (5.6%), *P. vulgaris*

Table 3. Sensitivity of the isolates to the quinolone antibiotics.

Bacteria	Antibiotics										
		CIP		NAL		OFL		PEF		SPA	
	N	n	%	n	%	n	%	n	%	n	%
E. coli	37	25	67.6	17	45.9	18	48.6	23	62.2	30	81.1
S. aureus	25	1	64.0	2	8.0	14	56.0	13	52.0	13	52.0
E. faecalis	22	15	68.2	12	54.6	13	59.1	9	40.9	14	63.6
K. aerogenes	21	17	81.0	9	42.9	16	76.2	14	66.7	15	71.4
P. vulgaris	16	11	68.8	6	37.5	9	56.3	10	62.5	11	68.8
K.pneumoniae	8	8	100.0	4	50.0	4	50.0	8	100.0	5	62.5
P.aeroginosa	7	5	71.4	-	-	3	42.9	4	57.1	3	42.9
S. saprophyticus	5	3	60.0	1	20.0	4	80.0	5	100.0	5	100
P. mirabilis	2	2	100.0	-	-	1	50.0	1	50.0	1	50.0

Key: n = number; % = percentage, N = number; CIP = Ciprofloxacin; NAL = Naldixic acid; OFL = Ofloxacin; PEF = Perfloxacin; SPE = Sparfloxacin.

Table 4. Proportion of the isolates susceptible to a number of antibiotics.

Bacteria	Proportion susceptible to number of antibiotics												
	N	0		1		2		3		4		5	
		n	%	n	%	n	%	n	%	n	%	n	%
E. coli	37	-	-	2	5.4	9	24.3	15	40.5	12	32.4	3	8.1
S. aureus	25	-	-	3	12.0	6	24.0	13	52.0	15	60.0	1	4.0
E. faecalis	22	-	-	2	9.1	8	36.4	8	36.4	10	45.5	2	9.1
K. aerogenes	21	-	-	-	-	6	28.6	10	47.6	11	52.4	4	19.1
P. vulgaris	16	-	-	1	6.3	5	31.3	9	56.3	8	50.0	2	12.5
K.pneumoniae	8	-	-	-	-	2	25.0	6	75.0	3	37.5	3	37.5
P.aeroginosa	7	-	-	-	-	2	28.6	4	57.1	2	28.6	-	-
S. saprophyticus	5	-	-	-	-	1	20.0	3	60.0	4	80.0	2	40.0
P. mirabilis	2	-	-	-	-	-	-	1	50.0	1	50.0	-	-

Key: N = total number of bacterial isolates, n = number; % = percentage.

(11.4%) specie 8 (10%); *P. aeroginosa* 7 (4.9%), *S. saprophyticus* (4.5%) and *P. mirabilis* 2 (1.4%)
in order of ranking, and out of these, majority of the isolates were from female subjects.

Table 3 shows the susceptibility of the isolated uropathogenic bacteria to all the quinolone antibiotics used in this study. All the organisms showed variable susceptibility to the quinolones. Among the gram-negative bacteria, *P. aeroginosa* was less susceptible with a profile of (71.4%) to ciprofloxacin, ofloxacin Zones of growth inhibition were then measured to the nearest (42.9%), pefloxacin (57.1%), and sparfloxacin (42.9%), but no activity for nalidixic acid. *P. mirabilis* had a susceptibility profile for ciprofloxacin (100%), ofloxacin (50.0%), pefloxacin (50.0%), and sparfloxacin (50.0%), but no activity for nalidixic acid. *E.* coli had a susceptibility profile for ciprofloxacin (67.6%), ofloxacin (48.6%), pefloxacin (62.2%), and sparfloxacin (81.1%), and nalidixic acid (45.9%). The susceptibility pattern followed similar trend for the other gram-negative bacteria. Among the gram-positive bacteria, *E. faecalis* had a susceptibility profile for ciprofloxacin (68.2%), ofloxacin (59.1%), pefloxacin (40.9 %), and sparfloxacin (63.6%), and nalidixic acid (54.6%).*S. aureus* was least sensitive with a profile of 64.0% for ciprofloxacin, ofloxacin (56.0%), pefloxacin (52.0%), Sparfloxacin(52.0%) and nalidixic acid (8.0%), while *S. saprophyticus*. had a susceptibility profile for ciprofloxacin (60.0%), ofloxacin (80.0%), pefloxacin (100%), sparfloxacin (100.0%), and nalidixic acid (20.0%).

Table 4 depicts the sensitivity pattern of the various isolates to a number of the quinolone antibiotics. All the isolates displayed sensitivity profiles, though to variable degrees. Strains of *S. aureus* had the least value for sensitivity (4), followed by *E. coli* (3) and *P. aeroginosa* (1).

Table 5 depicts the non-sensitivity patterns of the quinolones to the clinical isolates. The gram-negative bacteria were more resistant to nalidixic acid (39.6%) and

Table 5. Resistance of the isolates to the quinolone antibiotics.

Drugs	G ram negative		Gram positive		Combined isolate	
	n	%	n	%	n	%
CIP	23	25.3	18	34.6	41	28.7
NAL	36	39.6	34	65.4	70	59.0
OFL	26	28.6	21	40.4	47	32.9
PEF	30	33.0	25	48.1	55	38.5
SPA	26	28.6	20	38.5	46	32.2

Key: n = number; % = percentage; CIP = Ciprofloxacin; NAL = Naldixic acid; OFL = Ofloxacin; PEF = Perfloxacin; SPE = Sparfloxacin.

least to ciprofloxacin (25.3%). The gram-positive bacteria were also more resistant to nalidixic acid (65.4 %) and least resistant to ciprofloxacin (34.6%). The combined resistance of the uropathogens was nalidixic acid (49.0%), pefloxacin (38.5%), ofloxacin (32.9%), sparfloxacin (32.2%) and ciprofloxacin (28.7%).

DISCUSSION

Since the discovery of nalidixic acid in 1962 (Lescher et al., 1962), (the usefulness of which was restricted to the treatment of gram-negative UTIs, the quinolones have evolved to a class of widely used oral (and in some cases intravenous) antibiotics with extensive indications for infections caused by many bacterial pathogens in most body tissues and fluids (Ball, 2000, Khaki et al., 2009). This evolutionary pattern has arisen through the development of new core and side chain structures, with associated improvements in activity, pharmacokinetics and tolerability, and through the selection of molecules that remain useful and well tolerated (Ball, 2000). However, concomitant excessive incidences of class adverse drug interactions and specific 'unexpected' reactions with individual agents have restricted the use of some of these drugs (Hooper, 1998).

The 250 urine samples collected from patients attending the Federal Medical Centre Yola (FMCY) yielded 143 (57.2%) positive urine cultures of bacterial growth. Table 1 shows the distribution of patients by age and gender. Most of the clients belonged to the 36 - 35 age group (31 females and 28 male patients) followed by 26 - 35 (28 females and 22 males) and <25 (21 females and 18 males) respectively. Members belonging to these group of people are sexually active than those in the 56 and over. Irrespective of gender, most of the patient belongs to the 36 - 45 age group (59) patients. The paired sample statistical t-test shows that reveals that there was no significant difference between ages and gender, the test also shows that there is no significant difference between males and females at 5% ($P < 0.05$).

When compared with other Nigerian cities, this is lower than the 60% reported for Lafia (Kolawole et al., 2009), 77.9 for Abuja (Mbata, 2007), but higher than the data of 35.5% obtained at Jos (Ebie et al., 2001) and 22% in Ibadan (Ekweozor and Onyemenen, 1966). The relatively high prevalence may be due to factors such as promiscuity and drug abuse which is very common among young men and women. Results in this study indicate that the proportion of bacteria isolated from females was 90 (62.9%) while that of males was 53 (37.1%), and this concur with results obtained from other studies elsewhere in Nigeria (Mordi and Erah, 2006; Nwanze et al., 2007) and in other countries (Kunin, 1994; Mincey and Parkulo, 2001). Many researchers have reported that urinary tract infections are far more frequent in females than males during youth and adulthood (Mordi and Erah, 2006; Nwanze et al., 2007; Mbata, 2007).

The anatomical relationship of the female's urethra and the vagina makes it liable to trauma during sexual intercourse as well as bacteria been massaged up the urethra into the bladder during pregnancy and child birth (Kolawole et al., 2009). It has been reported in several studies that women who are sexually active, and especially if they use contraceptives, foams, gels, diaphragm and spermicides which are known to promote greater colonization of the vagina are at higher risk of developing UTIs (Nwanze et al., 2007; Mbata, 2007). At ages higher than 56 years, males seemed to have more infections than females. Several reports have indicated that as people advance in age, males are more liable to have complicated UTIs and also multi-drug resistant pathogens than females (Alhambra et al., 2004; Nwanze et al., 2007; Mbata, 2007).

Table 2 shows the organisms isolated included *E. coli* 37(25.9 %), *S. aureus* (17.5 %); *E. faecalis* (15.4%), *K. aerogenes* (14.7%), *K. pneumoniae* (5.6%), *P. vulgaris* (11.4%) specie 8 (10%); *P. aeroginosa* 7 (4.9%), *S. saprophyticus* (4.5%) and *P. mirabilis* 2 (1.4%) in order of ranking. These isolates clearly represented clinically significant pathogens, and are similar to the data obtained by other scholars (Sweih et al., 2005; Mordi and Erah, 2006; Nwanze et al., 2007; Rai et al., 2008). The isolation frequency of the bacterial species reported in this study, falls within the range of frequencies reported in some Nigerian cities of Lafia (Kolawole et al., 2009), Abuja (Mbata, 2007), Jos (Ebie et al., 2001), Okada (Nwanze et al., 2007), Ibadan (Ekweozor and Onyemenen, 1966) other

countries such as Egypt (El- Kholy et al., 2003), China (Wang et al., 2001), Israel (Turner and Dagan, 2001), Belgium (Goosens, 2000), Palestine (El-Astal, 2004), Poland (Hryniewicz et al., 2001), India (Navaneeth et al., 2002), Italy (Bonadio et al., 2001), Norway (Grude et al., 2001) and the United Kingdom (Hosein et al., 2002, Farrell et al., 2003). Most of these pathogens were recovered from females. The present of these pathogenic bacteria in females is actually a cause for concern. Some of these bacteria have been reported when present in significant proportions to cause miscarriages, prevent future conceptions, cause several complications in labour as well as risk for the foetus (Kunin, 1997; Inabo and Obanibi, 2006). Quinolones, especially ofloxacin and ciprofloxacin antibiotics are frequently prescribed for a variety of diseases including male genital tract infections, which often leads to reduced fertility (Khaki et al., 2009). Khaki *et* al.(2009) had reported that frequent use of quinolones would result in the interference with the processes of spermatogenesis. Also, Weyers et al. (2002) had reported in increase in germ cell apoptosis and cell damage and ascribed it to an increase in peroxide radical generation in the testis following ofloxacin treatment. In addition, ofloxacin could inactivate caspases 3 and induce apoptotic pathways (Kahki et al., 2009). As in several reports, *E. coli* was the most common bacteria isolated though it accounted for only 25% of the total isolates and 40.7% of gram-negative bacteria. This may be because *E. coli* is the most predominant bacteria in the gastrointestinal tract of humans. *E. coli had* the highest prevalence closely followed by *S. aureus* and this is similar to the reports of Okesola and Oni (2009) and Akerele et al. (2000) but differs with that of Mordi and Erah (2006). Several other studies have established that *E. coli* and the other members of the enterbacteriaceae are the most predominant organisms in urinary tract infections (Olusi et al., 2004; Mbata, 2007). Winstanley et al. (1997) reported a higher incidence of *Proteus* sp., *Klebsiella* sp., *Enterobacter* sp., *Citrobacter* sp., *Acinetobacter* sp., *Serratia* sp. *Enterococci* and *Pseudomonads* in their isolates along sides with *E. coli.* Although *E. coli* was the most common uropathogen in this study, there is a difference in its prevalence rates when compared with other reports, which gave a higher prevalence rate of 60 - 90% for *E. coli*, than other isolates (Fluit et al., 2000). Results from several studies have shown that the proportion of *E. coli* as a principal causative agent of UTIs is slowly declining, being replaced by other members of the *Enterobacteriaceae* and *Enterococci* (Gruneberg, 1994). This changing spectrum of microorganisms causing UTIs and the emerging resistance to many of the older and cheaper antibacterial agents require continuous monitoring. S*. aureus* was the second most prevalent bacteria accounting for 17.5% of the total isolates and 48.1% of gram-positive bacteria in this study, and this agrees with the reports of Nwanze et al. (2007).

The *in vitro* activities of the qiunolones antibiotics against the uropathogens are illustrated in Table 3. With the exception of nalidixic acid, all the quinolones have substantially inhibited the growth of the pathogens, though to various degrees. Among the gram-negative bacteria, *P. aeruginosa* was less susceptible with a profile of (71.4%) to ciprofloxacin, ofloxacin (42.9%), pefloxacin (57.1%), and sparfloxacin (42.9%), but no activity for nalidixic acid. The data obtained in this study compared very well with data obtained elsewhere, though in some case, some isolates were slightly sensitive to nalidixic acid (Kapoor and Aggarwal, 1997; Hryniewicz et al., 2001; Sharifian et al., 2006; Nwanze et al., 2007), Rai et al., 2008). *P. aeruginosa* maintains antibiotic resistance plasmids and is able to transfer these genes by bacterial processes of transduction and conjugation (Chah et al., 2003).

This study also recorded an intermediate susceptibility rates for most of the uropathogens. *P. mirabilis* had a susceptibility profile for ciprofloxacin (100%), ofloxacin (50.0%), pefloxacin (50.0%), and sparfloxacin (50.0%), but no activity for nalidixic acid, similar to the reports of Rai et al. (2008). *E. coli* had a susceptibility profile for ciprofloxacin (67.6%), ofloxacin (48.6%), pefloxacin (62.2%), and sparfloxacin (81.1%), and nalidixic acid (45.9%). Rai et al (2008) also reported a sensitivity pattern to nalidixic acid (20.6%), ofloxacin (45.5.0%) and ciprorofloxacin (29.4%). Savas et al. (2006) also presented a data in which *E. coli* was 55.9% sensitive to norfloxacin and 54.4% sensitive to ciprofloxacin, while the sensitivity of *Klebsiella* was 91.3% to norfloxacin and 87.0% to ciprofloxacin.

The susceptibility pattern followed similar trend for the other gram-negative bacteria. Among the gram-positive bacteria, *E. faecalis* had a susceptibility profile for ciprofloxacin (68.2%), ofloxacin (59.1%), pefloxacin (40.9%), and sparfloxacin (63.6%), and nalidixic acid (54.6%). Rai et al. (2008) also reported a sensitivity pattern to nalidixic acid (33.3%), ofloxacin (100.0%) and ciprofloxacin (66.7%) while Das et al. (2006) reported that *Klebsiella* sp. was sensitive to ofloxacin. *S. aureus* was least sensitive with a profile of 64.0% for ciprofloxacin, ofloxacin (56.0%), pefloxacin (52.0%), Sparfloxacin (52.0%) and nalidixic acid (8.0%) and these results are similar to the to results obtained in other studies (Onanuga et al., 2005; Sharifian et al., 2006). *S. saprophyticus* had a susceptibility profile for ciprofloxacin (60.0%), ofloxacin (80.0%), pefloxacin (100%), sparfloxacin (100.0%), and nalidixic acid (20.0%) and this agrees with the findings of Sharifian et al. (2006).

This result of the antimicrobial susceptibility patterns shows that quinolones used in this study were useful antibiotics for the treatment of UTI because they inhibit most uropathogenic bacterial isolated, with ciprofloxacin having the highest activity among them all, followed by sparfloxacin, perfloxacin, Ofloxacin and lastly Naldixidic acid. Antibiotic sensitivity pattern of organisms changes

rapidly over a short period of time, more so in developing countries where these drugs are purchased over the counter without prescription. They are not easily available and are very costly to be afforded by the majority of the populace.

The proportion of the isolates susceptible to a number of the quinolones is shown in Table 4. Majority of the uropathogens isolated in this study are important nosocomial pathogens that frequently express extended –spectrum β-lactamase (ESBL) enzymes (Jones et al., 2005; Mordi and Erah, 2007). These extended –spectrum B-lactamases producing isolates are usually resistant to a number of antimicrobial agents. There is little if any published data on microorganisms that produce ESBL in Nigeria. However, Mordi and Erah reported that their isolates that were resistant to many antibiotics were susceptible to the quinolones (ofloxacin).

Though most of the uropathogens are susceptible to quinolones, the susceptibility to most of the isolates to Perfloxacin, Ofloxacin and Nalidixic acid was low compared to those by ciprofloxacin and Sparfloxacin but higher incidence of susceptibility to these drugs has been reported by some other scholars including Iyera et al. (2007) and Inabo and Obanibi, (2006). In a related study, Onanuga et at. (2005) reported the isolation of *S. aureus* resistant to ampicillin (100%), cephalexin (100%), clindamycin (92%), vancomycin (89%), pefloxacin (35%), ofloxacin (27%), sparloxacin (24%), ciprofloxacin (27%).The proportion of the isolates not susceptible to the antibiotics are given in Table 5. Gram-negative bacteria were averagely resistant to ciprofloxacin (25.3%), nalidixic acid (39.6%), ofloxacin (28.6%), pefloxacin (33.0%) and sparfloxacin (28.6%), while resistance for gram-positive bacteria were ciprofloxacin (34.6%), nalidixic acid (65.4%), ofloxacin (40.4%), pefloxacin (48.1%) and sparfloxacin (38.5%). When both the gram-negative and gram-positive organisms were combined, the resistance rates were ciprofloxacin (28.7%), nalidixic acid (49.0%), ofloxacin (32.9%), pefloxacin (38.5%) and sparfloxacin (32.2%). These results indicate that gram-negative were more sensitive to the quinolones than their gram-positive counterparts. Onanuga et al. (2005) also presented a data showing that 82.2% of their *S. aureus* isolates displaying multi-drug resistance to the antibiotics tested, and none was fully sensitive to all the antibiotics, similar to the data obtained in this study. Antibiotics have been of immense value in controlling many infections, but this depends on judicious use to minimize resistance. The emergence and spread of resistance to these antibiotics have created serious concern to clinicians and hospital administrators. Recent studies in Europe and North America have demonstrated an increasing resistance among uropathogens.

In Spain, for instance, there were reports that some 22 - 27% of *E. coli* strains were resistant to cipfloxacin (Daza et al., 2001; Goettsch et al., 2000). Brown et al. (2003) had observed that horizontal gene transfer is a factor in the emergence and spread of antimicrobial resistance in clinical isolates. Consequently, it has been suggested that the high prevalence of resistance to a particular antibiotic does not always reflect antibiotic consumption in a given environment (Ako-Nai et al., 2005).

Antimicrobial therapy especially for treatment of UTIs especially when using the quinolones should be based on local experience of sensitivity, tolerability and resistance patterns. In this study, the quinolones have proven to be drugs of choice in the treatment of UTIs. Even though susceptibility pattern shown by this study emphasizes the need for *in-vitro* sensitivity reports before initiation of antibiotic therapy, it must not be forgotten that *in-vitro* antimicrobial sensitivity reports serve only as guide and that conditions *in-vivo* may be quite different. Although the disc diffusion method was used to assess sensitivity and resistance and can be correlated clinically, further investigations employing the MICs method will be needed to obtain more reliable results. Also the safety profiles of the quinolone class of antibiotics should be thoroughly assessed in view of their reported interference with the processes of spermatogenesis.

Conclusion

In conclusion, the results show that there is a high prevalence of occurrence of urinary tract infection among patients attending Federal Medical Centre, Yola (FMCY). Most of the bacteria were susceptible to ciprofloxacin, perfoloxacin, sparfloxacin and ofloxacin while the susceptibility to nalidixic acid varies. Nalidixic acid should not be used blindly to treat urinary tract infections in this locality in order to prevent the emergence and spread of multi-drug resistant bacterial strains.

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