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Etiology and Antimicrobial Resistance Pattern of Bacterial Agents of Urinary Tract Infections in Students of Tertiary Institutions in Yola Metropolis

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Abstract: This study was carried out to determine the bacteriologic agents of UTIs among students of tertiary institutions in Yola. 150 urine samples were collected from students of three tertiary institutions in the metropolis. The urine samples were cultured on MacConkey and Blood agar. Identification of organism was done using appropriate microbiological tests. Antibiotics susceptibility test was carried out on Mueller Hinton agar using the modified Kirby - Bauer method. Statistical analysis was carried out on the results obtained using the chi square method. Of the 63 isolates obtained, 39 (61.9%) were from females while 24 (38.1%) were from males. The bacteriologic agents of UTI isolated from students of the three tertiary institutions were *Escherichia coli* (28.57%), *Staphylococcus saprophyticus* (23.81%), *Klebsiella aerogenes* (23.81%), *Staphylococcus aureus* (9.52%), *Pseudomonas aeruginosa* (6.35%), *Streptococcus faecalis* (6.35%) and *Proteus mirabilis* (1.59%). Gentamicin and ofloxacin were the most active antibiotics; the isolates showed high resistance to cotrimoxazole and amoxcicillin.

Key words: Urinary tract infection · Bacteriologic agents of UTI · Antibiotics

INTRODUCTION

Urinary tract infections are among the most common bacterial infections that lead patients to seek medical attention [1] and it has large socio-economic impacts. It is also one of the most common infectious diseases diagnosed in outpatients as well as in hospitalized patients and can lead to significant mortality.

UTIs account for a large proportion of antibacterial drug consumption. Since the majority of the treatments begins or is done completely empirically, the knowledge of the organisms, their epidemiological characteristics and their antibacterial susceptibility is mandatory. These data are essential to optimize the treatment and avoid the emergence of bacterial resistance, which is responsible for the increasing number of therapeutic failure. Temporal and local variables can modify these data so they need to be constantly re-evaluated. This investigation was therefore designed to isolate bacteriologic agents of UTI from students of tertiary institutions in Yola; determining the distribution or infection pattern of UTI in the sample population; studying the antibacterial susceptibility pattern of the isolates to antibiotics.

MATERIALS AND METHODS

Sample Collection: A total of 150 urine samples were collected from students of 3 tertiary institutions in Yola metropolis namely: Federal University of Technology, Yola (FUTY), Adamawa State Polytechnic, Yola (SPY) and School of Nursing, Yola (SNY). 50 samples were collected at each of the 3 locations listed above. Freshly voided mid-stream urine was collected into sterile universal bottles. The samples were conveyed to FUTY Microbiology laboratory for culture. All the samples collected were analyzed within 6 hours of collection to ensure that the pathogenic organisms present in the urine were isolated and also to avoid overpopulation of the pathogenic organisms.

Culture: Prior to inoculation, the samples were properly shaken in order to have an even distribution of the microorganisms. The urine samples were inoculated in duplicate onto Blood and MacConkey agar media and the sample plates were incubated at 37°C for 18-24 hours. The cultural characteristics of overnight culture plates with growth and the morphology of the isolated colonies after gram stain were used in differentiating the isolates.

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Appropriate biochemical tests were used to further differentiate and identify the isolates.

Antibiotic Sensitivity Test: The antibiotic susceptibility patterns of all the isolates to 8 antibiotics were determined by the modified Kirby - Bauer diffusion technique [2]. The concentration of the standard antibiotics discs used were gentamicin 10 µg; amoxicillin - clavulanic acid 30 µg; tetracycline 30 µg; ofloxacin 30 µg; amoxicillin 25 µg; and cotrimoxazole 25 µg. Standardized culture of each isolate was prepared by picking 2 distinct colonies using a sterile wire - loop and emulsifying them in 3 ml of physiological saline in a bijou bottle. This suspension was then incubated at 37°C overnight. The standardized overnight culture of each isolate was used to flood the surface of Mueller-Hinton agar plates, the excess was drained off and the plate allowed to dry. The standard antibiotic discs were then aseptically placed at reasonable equidistance on the inoculated Muller-Hinton agar plate and the plate allowed to stand on the bench for 1 hour. The plates were then incubated at 37°C for 18 hrs. The diameter of the zone of inhibition produced by each antibiotic disc was measured, recorded and the isolates were classified as "resistant", "intermediate sensitive" or "sensitive" based on the standard interpretation chart [2].

RESULTS

Distribution Pattern of Isolates Between the Sexes: Out of the 63 isolates obtained, 39 were from females while 24 were from males. The differences noted in the distribution pattern of isolates between the sexes was subjected to chi- square statistical test and it shows that there is significant difference between the isolates and sexes. This distribution is shown in Table 1.

Bacterial Agents of Urinary Tract Infection: A total of 63 isolates were obtained from the 150 people sampled.

Table 1: Distribution pattern of isolates between the sexes

Sex	Growth	No Growth	Total
Males	24 (32%)	51 (68%)	75
Females	39 (52%)	36 (48%)	75
Total	63	87	150

Table 2: Distribution of isolates in the urine of the sample population

Isolates	FUTY	SPY	SNY	Total	%
E. coli	4	5	9	18	28.57
K. aerogenes	3	4	8	15	23.81
S. saprophyticus	5	4	6	15	23.81
S. aureus	3	3	0	6	9.52
P. aeruginosa	3	0	1	4	6.35
S. faecalis	1	2	1	4	6.35
P. mirabilis	1	0	0	1	1.59
Total	20	18	25	63	100.00

The organisms isolated were *Escherichia coli*, *Staphylococcus saprophyticus*, *Klebsiella aerogenes*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Streptococcus faecalis* and *Proteus mirabilis*. *E. coli* was the commonest organism isolated (28.57%) followed by *Kleb. aerogenes* and *S. saprophyticus* with 23.81% respectively. *P. mirabilis* showed the least infectivity pattern, accounting for only 1.59% of the organisms isolated. The pattern of bacterial agents isolated is as shown in Table 2.

Antibacterial Susceptibility Test: The susceptibility pattern of the isolates to some prescribed antibiotics is shown in Table 3. While *E. coli* showed high susceptibility to the aminoglycosides - gentamicin (94%) and ofloxacin (100%) it showed low susceptibility to amoxicillin-clavulanic acid (11%) and amoxicillin (11%). *K. aerogenes* also showed a high susceptibility to gentamicin (100%) and ofloxacin (100%). The highest susceptibility to aminoglycosides tested was also obvious with *S. saprophyticus, S. aureus, P. aeruginosa, S. faecalis* and *P. mirabilis* isolates. All the isolates

Table 3: Distribution of bacteria susceptibility to antibiotics

Drugs	*E. coli* (n=18) %	*K. aerogenes* (n=15) %	*S. saprophyticus* (n=15) %	*S. aureus* (n=6) %	*P. aeruginosa* (n=4) %	*S. faecalis* (n=4) %	*P. mirabilis* (n=1) %	General (%)
Gen	94.0 (17)	100.0 (15)	67.0 (10)	100.0 (6)	75.0 (3)	100.0 (4)	100.0 (1)	89.0
Tet	22.0 (4)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	0.0 (0)	6.0
Ofl	100.0 (18)	100.0 (15)	0.0 (0)	0.0 (0)	100.0 (4)	0.0 (0)	100.0 (1)	60.0
Amc	11.0 (2)	7.0 (1)	40.0 (6)	33.0 (2)	0.0 (0)	0.0 (0)	0.0 (0)	18.0
Amx	11.0 (2)	7.0 (1)	0.0 (0)	17.0 (1)	0.0 (0)	0.0 (0)	0.0 (0)	6.0
Cot	17.0 (3)	0.0 (0)	33.0 (5)	33.0 (2)	0.0 (0)	0.0 (0)	0.0 (0)	6.0

Key: Gen - Gentamicin Cot - Cotrimoxazole; Tet - Tetracycline; Amx - Amoxicillin; Ofl - Ofloxacin; Amc - Amoxcillin-clavulanic acid

however showed low susceptibility to tetracycline, amoxicillin, amoxicillin - clavulanic acid and cotrimoxazole. Of all bacteria isolated from the urine samples, 89% were sensitive to gentamicin and 60% were sensitive to ofloxacin. The lowest levels of susceptibility were to amoxicillin - clavulanic acid (18%), tetracycline (6%), amoxicillin (6%) and cotrimoxazole (6%).

DISCUSSION

Urinary tract infection occurs in every age and in both genders. It is however more frequent in women. Most UTIs are thought to develop in the community at large. It is however unclear how primary community-acquired infections occur or how they are spread. In the community, it is important to guide general practitioners who generally treat UTIs. They need to be aware of the locally prevalent strains and their sensitivity pattern. Geographic variations in pathogen occurrence and susceptibility profiles thus require frequent monitoring to provide information to guide the therapeutic options.

Urinary tract infections occur more often in women than men, at least partially because of the short urethra and its closeness to the anus. Also, sexual activity appears to increase the chances of bacterial contamination of the female urethra. This was the pattern observed in this study as most of the isolates were from women. Of the 63 isolates, 39 (61.90%) were from the female sex while 24 (38.10%) were from males. The results corresponds to results obtained in similar studies conducted in India [3] with 60% of the infected population being female.

In this study, *E. coli* was the most common bacterial agent isolated in the sample population. The predominance of *E. coli* as the commonest aetiological agent of UTI has also been reported in studies conducted in Kuwait [4] and Brescia, Italy [5]. In most cases, *E. coli* which originates as a harmless microorganism in the intestine spreads to the vaginal passage where it invades and colonizes the UTI. The second most common bacterial agents obtained in this survey of UTI were *K. aerogenes* and *S. saprophyticus* each accounting for 24%. According to Cheesbrough [6], *K. aerogenes* is associated with hospital- acquired infections of the urinary tract often following catheterization or gynaecological survey. Thus, its isolation is very rare and hence, its presence in urine must be cautiously treated. The highest percentage of *K. aerogenes* obtained in this study gives cause for concern. 8 (53%) representing more than half of the total *K. aerogenes* isolated were from students of School of Nursing, Yola indicating the possibility that the infection had been acquired from the hospital environment. More males (10) were also infected with *K. aerogenes* with only 5 females infected with the organism. *S. saprophyticus* is usually found in infections among sexually active young women [6]. Of the 15 *S. saprophyticus* isolated obtained in this study, 11(73%) were from females and 4 (27%) were from males. The females infected with *S. saprophyticus* had an age range of between 19 and 26. It has often been postulated that women in this age range are sexually active and this may have predisposed them to UTI. *S. aureus,* which has often been touted as a leading cause of UTIs and STDs in Nigeria accounted for only 9.59% of the 63 isolates. Its presence as well as the presence of *P. aeruginosa* (6%) in the urine sample should however not be overlooked as both are usually implicated in nosocomial infections. The other organisms isolated were *S. faecalis* and *P. mirabilis* accounting for 6 and 2% of the isolates, respectively. Both have been reported as agents of UTIs and their presence in the sample population was not unusual.

The results of the antibiotic susceptibility tests showed that the isolates were generally highly susceptible to gentamicin (89%) and ofloxacin (60%). Gentamicin is the most commonly used aminoglycoside for serious UTIs but it could have serious side effects such as damage to hearing, sense of balance and kidneys. The highest efficacy of Gentamicin in the treatment of UTIs has also been reported by Al Sweih *et al.* [4]. Ofloxacin is a member of the quinolones which are effective against a wide range of organisms [6]. At the present time, the cost of obtaining this antibiotic it is quite high and because of this, fewer numbers of people have access to it, thus diminishing the chances of its misuse ad of organisms developing resistance to it.

The isolates however showed high resistance to amoxicillin - clavulanic acid (18%), Tetracycline (6%), Cotimoxazole (6%) and Amoxicillin (6%). Amoxicillin - clavulanic acid is usually administered for drug- resistant infections. It may be useful for UTIs caused by Gram-positive organisms, such as *Enterococcus sp.* and *S. saprophyticus.* In this study, it was observed that amoxicillin - clavulanic acid was only active against *Staphylococcus sp.* and inactive against *Streptococcus faecalis* which could possibly be as a result of extensive use or misuse of the drug by the correspondents since the drug is commercially available. This resistance pattern of amoxicillin - clavulanic acid is similar to results obtained by Al Sweih *et al,* [4]. Tetracycline is an antibiotic that inhibits bacterial growth. They are bacteristatic and

widely used as a broad- spectrum antibiotic with activity against Gram- positive and Gram- negative bacteria. Resistance to tetracycline is common and this is further confirmed from the results obtained in this study. Resistance to tetracycline has developed because it is readily available in the country and has been widely misused. Amoxicillin is broad- spectrum penicillin, which is active against Gram- positive bacteria such as *Streptococcus sp.* but inactive against *E. coli* in up to 25% of cases [7]. It is very clear from the results obtained in this study as well as in similar studies in Kuwait [4] that uropathogens have acquired resistance to this antibacterial agent. Susceptibility to cotrimoxazole by the isolates obtained was poor (6%). This is a clear indication that the isolated organisms have developed resistance to the antibiotic. Resistance to cotrimoxazole has also been reported in Italy [5] and in India [3].

CONCLUSION

The bacteriologic agents of UTI among students of tertiary institutions in Yola metropolis are *E. coli*, *S. saprophyticus*, *K. aerogenes*, *S. aureus*, *P. aeruginosa*, *S. faecalis* and *P. mirabilis.* The commonest agent was still *E. coli* but it accounted for lower percentage than usually observed. *K. aerogenes* and *S. saprophyticus* showed increased significance as agents of UTI in the sample population.

More females than males were infected with UTI, although this pattern varied at one of the locations (School of Nursing, Yola). There was however no significant difference at the three locations.

Gentamicin and ofloxacin were the most active antibiotics against the isolates and will thus be more effective in the treatment of UTI among students of tertiary institutions in Yola, than other antibiotics such as amoxicillin, tetracycline, augmentin and cotrimoxazole.

According to De Francesco *et al*. [5] region specific studies provide additional information about the type of pathogens causing UTIs and their susceptibility pattern. Therefore these data can serve as a basis to develop national country specific guidelines for the empirical treatment of UTIs.

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