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Incidence and Antibiotic Susceptibility Pattern of Urinary Tract Infection in Aminu Kano Teaching Hospital (AKTH) Kano, Nigeria

Maimuna Sidi Muhammed[1], Halidu Yakub Bello,[2] Shehu A. A[3] and Sanjoy Kumar Pal[4]

[1]Department of Microbiology, Kano University of Science & Technology, Wudil, Nigeria
[2]Department of Microbiology, Aminu Kano Teaching Hospital, Kano, Nigeria
[3]Department of Microbiology, Kano University of Science & Technology, Wudil, Nigeria
[4]Department of Biological Sciences, Skyline University, Kano, Nigeria

ABSTRACT

Urinary Tract Infection (UTI) is a serious health problem that affects people of all ages and genders globally. A study was carried out to determine the incidence of urinary tract infection (UTI) in patients present at AKTH with UTI from January 2019 to January 2020. The study aimed to determine the incidence and identify the infective uropathogens and their antibiotic sensitivity pattern. Urine samples were collected from 128 (Male 63) patients ranging from 0 to 84 years. Culture plates with bacteria count greater than or equal to 1x105 cfu-ml-1 were taken as positive for UTI. The bacteria isolates were identified based on colony morphology characteristics, gram stain reaction and biochemical tests. The identified bacteria were then tested in vitro with standard antibiotics disc to determine their antibiotic sensitivity patterns. The result showed that 35 (27.3%) out of 128 patients investigated had UTIs. The urine culture of 65 female patients resulted in 24(36.9%) positive samples, while 11 (17.5%) of the 63 males had significant bacteriuria. Escherichia coli constituted the predominant organism and was responsible for 24(68.7%) of the cases of UTI. The other encountered uropathogens were *Klebsiella* sp. 5(14.3 %), and Staphylococcus saprophyticus 2(5.5%). One sample (2.9%) each was found to have *Morganella morganii, Pseudomonas aeroginosa, Enterococcus fecalis* and *Salmonella* sp., respectively. All gram-negative bacteria were highly-sensitive to Meropenem and Gentamicin and were mostly-resistant to Piperacillin. Gram-positive organisms were sensitive to Gentamicin, Chloramphenicol, and Cefoxitin and resistant to Erythromycin. The highest incidence (39.1%) of UTI was found in the age range (10 – 19 years), with a significant gender difference.

KEY WORDS: URINARY TRACT INFECTION (UTI), UROPATHOGENS, ANTIBIOTIC SENSITIVITY, KANO.

INTRODUCTION

Urinary tract infections (UTIs) are a serious health problem that affects millions of people throughout the world every year. The presence and proliferation of microorganisms in the urinary tract cause this infection. It incurs one of the highest total healthcare expenditures among urological cases. One of the most prevalent bacterial illnesses in the community and hospitals is urinary tract infection (UTI) (Oluwafemi et al. 2018). It can cause anything from asymptomatic bacteriuria to serious kidney injury and sepsis, depending on the clinical manifestation (Nguyen 2008; Geerlings 2016). A UTI can be diagnosed based on a combination of symptoms as well as a positive urine assay or culture (Geerlings 2016). Except in early infancy, UTIs are prevalent in children, and females are at a much higher risk than boys. Urinary tract infections are linked to poor hygiene, malnutrition, and low socioeconomic position, all of which are prevalent in rural areas (Oladeinde et al. 2011; Mattoo et al 2021).

Several studies have been reported on Urinary tract infections from various parts of Nigeria (Oladeinde et al 2011; Iregbu and Nwajiobi-Princewill 2013; Oluwafemi et al. 2018; Okechukwu et al. 2019). *Enterobacteriaceae* such as *Klebsiella* spp., and *E. coli* as well as gram-positive organisms such as *Enterococci, Staphylococci*, and *Candida albicans* in patients with underlying physiological debilitation, are the most common causative agents of UTI. Similar etiological agents have been detected for UTIs in other places viz. Enugu, Zaria, Yola, Maiduguri, and Ife in

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Nigeria (Iregbu and Nwajiobi-Princewill 2013; Isa et al. 2013). Other organisms that have been identified include *Staphylococcus aureus* and *Staphylococcus epidermidis, Morganella morganii*, and Group B *Streptococcus*. Most UTIs in infants and children is caused by *E. coli*, which is the most commonly isolated pathogen. (Dixon-Umo et al. 2020). Earlier investigations conducted at the AKTH had concluded that the UTI incidence range from 1.3% to 50% in various patient groups (Yakasai et al 2012; Sule et al 2018; Ibrahim et al. 2019). The purpose of the present study was to look into the prevalence and antibiotic susceptibility pattern of urinary tract pathogens among patients coming for treatment at Aminu Kano Teaching Hospital, Kano, Nigeria.

MATERIAL AND METHODS

A prospective study was conducted in the Department of Microbiology, Aminu Kano Teaching Hospital (AKTH), in northern Nigeria. AKTH is a 700-bed capacity referral hospital, serving a catchment population of 17 million from Kano and neighbouring states (Ado-Kurawa 2006). Prior ethical approval to conduct this research work was obtained from the Research Ethics committee of Aminu Kano Teaching Hospital, Kano, Nigeria (Reference no. AKTH/MAC/SUB/12A/P-3/VI/2858). The selected period of study was from January 2019 to January 2020.

The subjects were patients who presented with urinary tract complaints at the general outpatient department of AKTH. These patients are then referred to the Microbiology department. After getting verbal and written informed consent urine samples were collected from 128 people of different gender and age group. Following enrollment, each subject underwent clinical and physical examinations by the attending physician. The subjects were then given a plastic universal sterile transparent container with a screw cap for urine collection. Clear oral and written instructions on how to collect urine were given to each subject or their parents/guardians. Early morning midstream urine samples were collected. Female subjects were instructed to clean their genitalia before sample collection, while infants were instructed to be held on their laps with their genitals exposed before sample collection. Urine samples were delivered to the laboratory within 1-2 hours of collection.

All urine samples were observed macroscopically to check for turbidity, and colour and using a strip of Combii -10 to check for pH, specific gravity, presence of blood, protein, and other parameters (Wu 2010). The antibiotic susceptibility of the bacterial isolate was tested on Mueller-Hilton Agar using the traditional Kirby-Bauer disc diffusion method, and bacterial isolates were identified based on their culture, gram-stain, and biochemical properties (CLSI 2020). The disk diffusion method was used to evaluate the antibiotic susceptibility of each isolate and control strain (Okechukwu, & Thairu 2019). The following antibiotics were used for the present study Ciprofloxacin, Nitrofurantoin, Chloramphenicol, Gentamicin, Augmentin, Ceftazidime, Ceftriaxone, Meropenem, Piperacillin, and Tigecycline). SPSS version 20.0 was used to analyze the data. The student t-test was used to examine the relationship between variables. Significant was defined as a p-value of less than 0.05.

RESULTS AND DISCUSSION

A total of 128 patients with urinary tract complaints were enrolled in this study, the details of the demographic characteristic are given in Table 1. Out of the 128 samples tested 93(72.7%) had no bacterial growth after 24 hours of incubation, while 35(27.3%) were positive for bacterial presence. Among the 35 positive samples, 24(39.6%) were females and 11(17.5%) were males. The female gender was found to be a significant risk factor for acquiring UTIs. The frequency of occurrence of bacteria isolated was as follows: *Escherichia coli* 24(68.75%), followed by *Klebsiella* with 5(14.3%), and Staphylococcus saprophyticus with 2(5.5%).

One sample each was found to have *Morganella morganii, Pseudomonas aeruginosa, Enterococcus faecalis* and *Salmonella* spp., details is presented in Table 2. Among the 35 positive samples, 24(39.6%) were females and 11(17.5%) were males. A significant difference in UTIs was observed between the genders. It was observed that the most number of cases i.e., 39.1 % was from the age group 10-19 years, followed by the age group 0 – 9 years. The detailed breakup is presented in Table 3. In the age group, 0-9 years all the positive samples were from female patients. All the Gram-negative organisms were highly sensitive to Meropenem. Mixed results were seen in the case of Gentamicin, Tigecycline, Ceftriaxone, Ceftazidime, Augmentin, and Ciprofloxacin, respectively. The highest frequency of resistance was observed with Piperacillin, the details are given in Table 4. While five antibiotics were used to determine the susceptibility pattern of the gram-positive isolates. Except for Erythromycin all other antibiotics viz. Gentamicin, Chloramphenicol, Cefoxitin, and Clindamycin, showed positive results (Table 5).

Table 1. Distribution of the demographical characters

Demographical	Characters Frequency	Percentage (%)
Age (Years)		
0 - 9	25	19.5
10 – 19	23	18.0
20 – 29	22	17.2
30 – 39	20	15.6
40 – 49	10	7.8
50 – 59	6	4.7
60 – 69	4	3.1
70 – 79	15	11.7
80 – 89	3	2.3
Total	128	100.0
Gender		
Male	63	49.2
Female	65	50.8
Total	128	100.0

Table 2. Incidence of urinary tract infection

Suspected Organism	No. of Positive Samples	Incidence (%)
Escherichia coli	24	68.75
Klebsiella pneumonia	5	14.3
Staphylococcus aureus	2	5.5
Morganella morganii	1	2.9
Pseudomonas aeruginosa	1	2.9
Enterococcus faecalis	1	2.9
Salmonella spp	1	2.9
Total	35	100.0

The present investigation revealed the incidence of UTI of 27.3% with a significant gender difference ($p < 0.1$). This result is similar to the earlier investigations conducted by Muhammad et al. (2017) and Muhammad (2015), who reported UTI incidences of 26% and 25%, respectively. However, a low prevalence of UTIs (16%) was reported in malnourished children (Ibrahim et al. 2019). Even lower incidences of UTIs 12-13% have been reported (Aiyegoro et al. 2007; Iregbu et al. 2013). A high incidence of UTI (38%) was reported by Sule et al. (2018); a study done in Onitsha by Nwachukwu et al. (2018) report a prevalence of 46.1%. Even higher prevalence of 56% and 61% UTI was reported by Nwachukwu et al. (2018) and Simon et al. (2019), respectively.

Table 3. Comparison between Demographical Characters and Isolated Organisms

Demographical Characters	Isolated Organisms				X^2	Df	*P-value*
	No. Examined	Positive (%)					
Age (Years)			M	F			
00 – 09	25	7 (28.0)	-	7	2.883	8	0.942
10 – 19	23	9 (39.1)	3	6			
20 – 29	22	6 (27.3)	3	3			
30 – 39	20	6 (30.0)	3	3			
40 – 49	10	2 (20.0)	-	2			
50 – 59	6	2 (33.3)	-	2			
60 – 69	4	1 (25.0)	-	1			
70 – 79	15	2 (13.3)	2	-			
80 – 89	3	0 (0.0)					
Total	128	35 (27.3)					
Gender							
Male	63	11 (17.5)			2.828	1	0.093
Female	65	24 (36.9)					
Total	128	35 (27.3)					

χ^2 = Chi square value, significance level p-value = $p < 0.1$. M = Male; F = Female

Table 4. Antibiotic susceptibility pattern of Gram negative bacterial organisms

Antibiotics	MEM		CRO		AMC		CTX		PRL		GN		TGC		CIP	
	R	S	R	S	R	S	R	S	R	S	R	S	R	S	R	S
A = (24)	0	23	10	14	13	11	13	11	21	3	0	24	6	18	19	5
B = (5)	0	5	4	1	5	0	4	1	4	1	3	2	0	5	2	3
C = (1)	0	1	0	1	0	1	0	1	1	0	0	1	0	1	1	0
D = (1)	0	1	0	1	0	1	0	1	1	0	0	1	0	1	0	1
E = (1)	0	1	0	1	1	0	1	0	0	1	0	1	1	0	1	0

A = *Escherichia coli*; B = *Klebsiella pneumonia*; C= *Morganella morganii*; D= *Pseudomonas aeruginosa*; E= *Salmonella* spp. MEM = *Meropenem*; CRO = *Ceftriaxone*; AMC = *Augmentin*; CTX = *Ceftazidine*; PRL = *Piperacillin*; GN = *Gentamicin*; TGC = *Tigecycline*; CIP = *Ciprofloxacin*

The variations in prevalence of UTI in different places of Nigeria might be due to differences in study populations and the criteria used by various centres in sample selecting, mode of screening, and compounding risk factors, like gravidity, type of toilet used, age, drainage system, socioeconomic condition, etc. (Simon-Oke et al 2019; Ibrahim et al. 2019; Dixon-Umo et al. 2020). The incidence of UTIs varies based on age, sex, and gender. In the present study, the age group with the highest frequency of UTIs was 10-19 years (39.1%). In an earlier study, Aiyegoro et al. (2007) reported 12% of UTIs in the age group of 5-18 years. In resource-rich countries, the prevalence of UTIs is

very less compared to developing countries. Overall, UTIs of children in the United States annually are estimated to be between 1-3% (Moreno 2016). This is to be expected, as infection rates are low due to improved sanitation and easy access to standardized health care (Dixon-Umo et al. 2020). Most of the bacteria isolates in the present investigation are normal flora of faecal materials. *Escherichia coli* was the most common pathogen encountered in the present study. Much earlier investigation reports also indicated *E. coli* to be the most prominent organism of UTI (Oladeinde et al. 2011; Isa et al. 2013; Simon-Oke et al 2019; Dixon-Umo et al. 2020).

Table 5. Antibiotic susceptibility of Gram-positive bacterial organisms

	ERY		GN		C		FOX		DA	
	R	S	R	S	R	S	R	S	R	S
F = (1)	1	0	0	1	0	1	0	1	0	1
G = (2)	2	0	0	2	0	2	1	1	0	2

Key: ERY= *Erythromycin*, GN = *Gentamicin*, C = *Chloramphenicol*, FOX = *Cefoxitin*, DA = *Clindamycin*, F= *E. faecalis*, G= *Staphylococcus saprophyticus*

The present study indicated that UTIs are less prevalent in males than females. Different studies have reported female predominance (Aiyegoro et al. 2007; Oladeinde et al., 2011). There is a significant association between sex and positive cases. The higher prevalence rate recorded in females could be due to the proximity of the urethral to the anus, shorter urethra, contraception, pregnancy, and sexual intercourse which introduces bacteria into the female urinary tract (Omoregie 2008) Furthermore, the spread of normal flora in faeces from the anus to the vagina from where it may ascend to the bladder could result from poor anal hygiene. In a contrasting report by (Otajevwo, 2013), a prevalence rate of 30.1% was recorded among males. Even though they stated that the reason for this was not clear, they, however, enumerated the probable causes like lack of circumcision, and receptive anal intercourse (Dixon-Umo et al. 2020).

Among the isolates observed in the present study, gram-negative microorganisms' presence was 96.2%, while Gram-positive organisms accounted for 3.8%. This observation was consistent with an earlier report (Otajevwo 2013). Our investigation also had a marked resemblance with the earlier investigation done by Aiyegoro et al. (2007). *E.coli* was the most predominant isolate causing UTI in this study while *Klebsiella* spp ranked second in prevalence. This is consistent with other studies (Uwaezuoke et al. 2006; El-Mahmood 2009; Otajevwo 2013; Otajevwo and Eriagbor 2014) and emphasizes the fact that the majority of organisms causing UTIs are found in the lower gastrointestinal tract, it is noteworthy that *E. faecalis* was isolated only in the female population which may be an indication of poor anal hygiene, especially among teenagers. Among the age groups, UTIs occurred highest in the 10–19 years age group with a prevalence of 39.1%. This could be because patients in this age group are sexually active. Infections were observed to be higher in males under 0-9 years of age than in females. Some reports have stated that at advanced ages, males have more complicated UTIs and also more drug-resistant pathogens than females (Alhambra 2004; Dixon-Umo et al. 2020).

The uropathogens isolated in this study showed high sensitivity to Meropenem, gentamicin, and Tigecycline. The sensitivity to Meropenem is in tandem with other reports of 97.6% and above 50% sensitivity (Haruna et al. 2014; Alabi et al. 2014). In a study conducted at Redeemers University, Nigeria Augmentin and Piperacillin were also found to be resistant (Ayoade et al. 2013). This might be due to the abuse of these drugs leading to mutations that may be transferred through bacteriophages or plasmids thereby promoting resistance. The availability of drugs over the counter without the need for a prescription encourages the abuse of drugs. In addition, the use of fake and substandard drugs in Nigeria may also be a contributory factor to the emergence of resistant strains (Mordy et al. 2006). Inappropriate antimicrobial use as a result of a lack of drug knowledge can result in ineffective therapy and contribute to the spread of drug resistance. (Kariuki et al. 2007; Getachew et al. 2012). The strength of this prospective study was that it tested a good number of urine samples for pathogenic bacteria and underlined the presence of susceptible and resistant bacterial strains. This may provide clear-cut scientific information for appropriate UTI treatment, prevention, and control (Dixon-Umo et al. 2020).

CONCLUSION

The findings of the present study indicated the incidence of UTI to be 27.3%, and most of the infection was noted in children and teenagers. Females showed significantly higher infection rates. As many patients come from rural backgrounds poor hygiene practices and poor sanitation by these patients may be one of the major factors for UTIs. Though all the Gram-negative bacteria were found to be sensitive to Meropenem. Many other antibiotics that were studied indicated mixed results and some like Piperacillin and Erythromycin were found to be resistant to gram-negative and gram-positive bacteria, respectively. However, the sample studied was very small. Antibiotic resistance is a universal problem and can result in a delay in the recovery process and escalation of the treatment cost. It is always

better to have information about the microbe before starting the antibiotic treatment. However, in many situations, if the UTI needs immediate treatment, then it should be started with Meropenem even though it is an expensive drug.

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