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Original Research Article

Determination of Bacteriological Profile of Antimicrobial Susceptibility Testing among Diabetic Patients with Urinary Tract Infections in Shendi, Sudan

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Abstract: ***Background***: Urinary tract infection is a widespread microbial disease and 2nd most disease in women due to the anatomy of women type 2 diabetes is a high risk of infection of the urinary tract. ***Objective:*** To identify the agent that causes urinary tract infections in diabetic patients, select the best antibiotic, and assess the types of diabetes that are connected with urinary tract infections. ***Materials and Methods:*** From May to August 2018, a hospital-based cross-sectional study was carried out. According to the established methodology, urine samples were obtained for culture and identification. All isolates underwent an antimicrobial susceptibility test (AST) using the Kirby-Bauer disk diffusion method. The Statistical Package for the Social Science (SPSS) version 20 was used to import the data from Epi-data version 3.2.1. ***Results:*** The study's findings indicated that *E. coli* is the most prevalent bacterium, with a prevalence of approximately (30.2%). It is followed by *K. pneumoniae* (26.3%), and then by *Staphylococcus aureus* and *Saprophiticus* in percentage (15%). Gentamicin has a high rate of antibiotic sensitivity (approximately 36%), while Ceftazidime has a high rate of antibiotic resistance (about 35%). Around (52%) of people are resistant to Ceftriaxone and Cloxacillin. ***Conclusions:*** There was a high rate of UTI in diabetes patients. Female diabetics were more likely to experience UTIs than male diabetics.*E. coli* and *K. pneumoniae* species making up the majority of isolates. The isolated pathogens were highly susceptible to Gentamicin, Cloxacillin, and Ceftriaxone. These findings demonstrate the importance of glycemic management in diabetics for reducing UTIs, regardless of age or sex. By treating UTIs with the appropriate antimicrobial medications and monitoring the antimicrobial susceptibility patterns of isolated microorganisms, antibiotic-resistant urinary organisms can be managed.

Keywords: Bacteriological Profile, Gentamicin, *E. coli*, Urinary tract infection**.**

INTRODUCTION

Diabetes Mellitus (DM) has become a substantial socioeconomic burden for developing countries and is a major public health concern globally [1]. There were 451 million diabetics globally in 2017, and it is predicted that number would increase to 693 million by 2045 [2]. Microorganisms such as bacteria, fungi, and viruses colonize and develop within the urinary tract (UT), which leads to urinary tract infection [3, 4]. The most prevalent uropathogens are group B *streptococcus, Escherichia coli, Staphylococcus saprophyticus, Klebsiella pneumoniae, Proteus mirabilis, Enterococcus species, and Klebsiellasaprophyticus* [3-6]. In both men and women with and without DM, The most common cause of UTI is *E. coli*. According to some reports, this bacterium causes fewer UTIs in diabetic people compared to age-matched non-diabetic persons [7]. UTIs are more frequent in women than in males due to their anatomical and physiological characteristics [3, 8]. At least once in their lifetime, this virus has infected nearly half of all women [9]. Other significant risk factors for

UTIs include age, delayed urination, antibiotic misuse, and other immune-suppressing illnesses [10]. They also include diabetes mellitus (DM), hypertension, allergies, catheterization, and use of diaphragms, birth control pills, and spermicidal agents. One of the main factors contributing to morbidity and mortality globally is now recognized as being chronic diseases. One of these prevalent chronic, non-communicable, and endocrine disorders is diabetes mellitus (DM) [11, 12]. A significant burden on medical costs may result from the elevated risk of UTI among diabetes patients and the rise in DM incidence shown globally in recent years [13]. Additionally, the high rates of broad-spectrum antibiotic prescriptions for UTI in this patient population may further encourage the development of antibiotic-resistant urinary bacteria [14]. Additionally, improper use of antibiotics frequently causes microorganisms that cause UT to become more resistant to the most widely used antimicrobial medications [15]. Appropriate antibiotic treatment in patients with a complex UTI appears to shorten hospital stays, which improves patient outcomes and lowers medical expenses [16]. Strict glycemic control in diabetes mellitus (DM) may aid in lowering UTI incidence, and further, routine screening, identification of the causal agent, and appropriate medication by susceptibility pattern may lower fatal outcomes [17, 18]. With a higher risk of urinary system consequences, such as dysuria (pain or a burning feeling during urine), organ damage, and occasionally even death, the colonized urinary tract can also hasten the extended discharge of germs [19, 20]. The correct identification of the causing microorganisms and the choice of potent antimicrobial medicines against them are essential for the successful treatment of UTIs in diabetic patients [21]. Due to uncontrolled antibiotic usage, a high incidence of fake and spurious medications of doubtful quality in use, and a lack of infection prevention, the issue is particularly exacerbated in low-income countries [22]. Epidemiologists, scientists, health planners, and clinicians must ascertain the prevalence of UTI among diabetic patients and investigate the sensitivity of bacterial isolates to antimicrobial agents because DM prevalence is rising globally and the emergence of multi-drug- resistant (MDR) strains is intensifying. As far as we are aware, Shendi has no published information on the prevalence of UTI among diabetic patients. To offer epidemiological information about UTI among diabetes patients in Shendi, Sudan, this study was carried out there.

MATERIALS AND METHODS

Study Design: This is Hospital based Descriptive cross-section study.

Study Area

The area is Shendi locality which is located 172.01 Kilometers north of the capital, Khartoum southern part of the river Nile and covers an area of about 30 Km². There are several general centers for different services and purposes, also there is Shendi University with various faculties such as faculty of medical laboratory sciences, Education, Economics, Law, Community, and science and technology. Shendi has 3 hospitals the biggest is Elmek Nimer university hospital which has different departments and provides good health for this town's population.

Study Population: Diabetic patients in Shendi Hospital.

Inclusion Criteria

The study involved DM patients of different ages with urinary tract infections during the study period.

Exclusion Criteria

The study excluded patients with diabetes mellitus (DM) who were pregnant, taking antibacterial medications within the previous two weeks, and patients with DM who had undergone catheterization in the past.

Sample Collection

A hundred sample (100) of Midstream urine (MSU) is collected as follows: Patient was given a sterile, dry, wide-necked, leak-proof container and requested a 10–20 ml specimen. The container was labeled with the date, the name and number of the patient, and the time of collection. When immediate delivery to the laboratory is not possible, refrigerate the urine at 4°C.

Interpretation of Culture Growth

We checked the plates for any significant bacterial growth. The isolated bacteria were then identified by colonial morphology, Gram stain, and biochemical test to isolate the bacteria that cause UTI in diabetic patients made by the following steps are culture the samples gram stain and Biochemical test. Antimicrobial susceptibility test.

Characterization and Identification of Isolated Microorganisms

Clean voided midstream urine samples were collected in the sterile container after giving proper instruction and samples were processed in the laboratory within 2 hours of collection. Urine cultures were performed using a semi- quantitative technique where urine samples were inoculated on cysteine-Lactose electrolyte deficient (CLED) medium plates with a calibrated loop (0.001ml) and incubated at 37° C for 18-24 hours. Urine culture reports that exhibited colony. After 24 hours of incubation, the culture plates were examined and the appearance, size, color, and morphology were observed. Agram stain reaction, Catalase, Coagulase, Indole, Oxidase, and Citrate utilization tests were carried out as gram stain test detects the type of microorganism isolated based on its staining reaction.

Data Analysis

Data were analyzed using SPSS 25.0, descriptive statistics in terms of frequency, percentages, means and standard deviations, and Chi-square test was calculated. A *p. value*≤0.05is considered statistically significant.

Ethical Considerations

Ethical approval for the study was obtained from the Board of the Faculty of medical laboratories sciences, at Shendi University. The written informed consent form was obtained from each guardian of the participant as well as from the subject himself before recruitment into the study. All protocols in this study were done according to the Declaration of Helsinki (1964).

RESULTS

During the study period, 100 diabetes patients were examined. These were made up of 78% women and 22% men. It was discovered that a substantial portion of the participants 60% belonged to the over-44 age group. 70% of the study participants were from rural areas, 30% were from urban areas, and 54% had type II diabetes mellitus (Table 1). *E. coli* isolates were the most common bacteria, followed by *Klebsiella* (26.3%), *S. aureus* (15%), and *S. saprophyticus* (15%) (Table 2). Gentamycin (95.6%), Ceftrioxone (95.6%), and Cloxacillin (91.3%) exhibited better sensitivity in *E. coli*, whereas Ceftazidime (100%), and Cloxacillin (8.6%), showed stronger resistance. Though more resistant to Ceftazidime (85%), *Klebsiella spp*. exhibited increased sensitivity to Cloxacillin (95%), Ceftrioxone (85%), and Gentamycin (85%). Higher sensitivity to Gentamycin and Ceftriaxone was seen in *Proteus species* (100%). Ceftrioxone resistance was highest in *P. aeruginosa* isolates, showing 100% resistance. The isolates of *S. Saprophiticus* were 100% resistant to Ceftrioxone, Gentamycin, and Cloxacillin, but only 81% resistant to Ceftazidime. Gentamycin (83.3%) and Ceftrioxone (75%) were more effective against *S. aureus* isolates, while Ceftazidime (83.3%) and Cloxacillin (66.6%) were less effective. Compared to other isolates of *E. feacilus*, it was more sensitive to Cloxacillin (100%), Ceftrioxone (75%), and Ceftazidime (100%) (Table 3).

Table 1: Socio-Demographic Characteristics of Diabetes Mellitus Patients Investigated for Urinary Tract Infection

Types	Variables	Frequency	Percentage %
Gender	Male	22	22
	Female	78	78
Age	Lessthan24	8	8
	25 – 34	13	13
	35 – 44	19	19
	More than 44	60	60
Residence	Rural	70	70
	Urban	30	30
Typeofdiabetes	Type(1)	22	22
	Type (2)	54	54

Table 2: The percentage of micro-organism isolated from urine among study population

Bacteria name	***No***	***Percentage %***
S. aureus	12	15
S. saprophyticus	12	15
E. fecalis	4	5.2
E. coli	23	30.2
Klebsiella	20	26.3
Pseudomonas	3	4.0
ProteusVulgaris	2	2.6
Total	**76**	**100**

Table 3: Antimicrobial Susceptibility Patterns of Bacteria Isolated from Diabetes Mellitus Patients Investigated for UTI

Antimicrobials	***E. coli* N=23**	***E. feacilus* N=4**	***S. saprophit* N=12**	***S. aureus* N=12**	***Pseudo Monas,* N=3**	***Proteus* N=2**	***Klebsiella N=20***
Gentamicin	S(22) R(01)	S(02) R(02)	S(09) R(03)	S(10) R(02)	S(2) R(01)	S(02) R(00)	S(17) R(03)
Ceftazidime	S(00) R(23)	S(00) R(04)	S(03) R(09)	S(02) R(10)	S(01) R(02)	S(01) R(01)	S(03) R(17)
Ceftrioxone	S(22) R(01)	S(03) R(01)	S(10) R(02)	S(09) R(03)	S(03) R(00)	S(02) R(00)	S(17) R(3)
Cloxacillin	S(21) R(02)	S(04) R(00)	S(08) R(04)	S(04) R(08)	S(02) R(01)	S(01) R(01)	S(19) R(01)

DISCUSSION

Poor glycemic control in Sudanese diabetic patients may contribute to the high frequency of UTI in this population [23]. A 24% greater chance of UTI results from poor DM management [24]. Diabetes patients typically experience more UTIs and asymptomatic bacteriuria than non-diabetic patients [25, 26]. Patients who have diabetes frequently experience urinary tract infections, which might manifest themselves as asymptomatic bacteriuria. An inflammatory reaction was brought on by the urinary tract infection. Compared to type 1, type 2 has a higher incidence of UTI (approximately 54%). Due to the anatomy of women and the prevalence of urinary tract infections in women compared to males, type 2 diabetics are at an increased risk of developing a urinary tract infection compared to non-diabetics. About 78% of the DM patients in this study who had UTIs were female, compared to 22% of the male patients. According to some reports, women are more likely than men to develop UTI [17]. In past searches, where there were no significant differences in the frequency of bacteriuria for males and females, different outcomes have been recorded [17, 27]. In contrast, Geerlings *et al.,* found that women with uncontrolled diabetes were more likely to experience bacteriuria than non-diabetic women [28]. There is conflicting information regarding UTI in diabetic patients because the majority of early investigations of UTI in diabetics were conducted in females [29]. Compared to earlier studies [17, 30, 31], our study's patients were somewhat older and had higher rates of UTI exposure (approximately 60% against 40% for young person's). Most of the UTI patients in Zubair *et al.,* study were between the ages of 51 and 60, while Kumar *et al.,* study found that most were between the ages of 31 and 40 [31]. This difference may be the result of late diabetes diagnosis, ethnic variation, and the general population's views about seeking medical assistance. On the other hand, it is now widely acknowledged that aging is a factor in T2D [17, 32]. According to the study, *E. coli* is the bacteria that most frequently causes urinary tract infections in people with diabetes (30.2%), followed by *Klebsiella* (26.3%), *S. aureus,* and *S. saprophyticus* (15%), *E. facials* (5.2%), *Pseudomonas* (4%) and *Proteus vulgaris* (2.6%).Ceftazidime has a high percentage of resistance (approximately 35%), Gentamicin has a high percentage of sensitivity (about 63%) against isolated bacteria, while Ceftriaxone and Cloxacillin have low sensitivity and high resistance, respectively. *The most common uropathogenic isolate was E. coli. Since E. coli is the most prevalent flora in the gastrointestinal tract and bowel, where it originates and ascends to the urinary tract, and uses its well-characterized virulence factors to colonize the urinary tract, this dominance of E. coli among UTI patients may not be surprising.* The major uropathogenic in the current investigation and the second most common bacterial isolate was *Klebsiella. E. coli*, which was susceptible to the antibiotics Gentamicin, Cloxacillin, and Ceftriaxone. Ceftazidime, on the other hand, was met with a very high level of resistance (100%). It was also previously reported from Sudan that *E. coli* had such great susceptibility to the first two antibiotics [33], In Ethiopia, it was shown to be 100% sensitive to Nitrofurantoin in Addis Ababa [15] and Hawassa [34], where it was 100% and 86.3% susceptible to Gentamicin and Nitrofurantoin, respectively. However, it has been discovered that this virus possesses a very high level of Ampicillin resistance (100%) which is also corroborated by findings from Hawassa (100%) and Bahir Dar [35], Iran (86.6%) [36]. On the other hand, the 92.2%, 100%, and 100% resistance of *E. coli* to Amoxicillin-clavulanate, Ampicillin, and Doxycycline, respectively, in our investigation conflict with the findings from Sudan [33], as do the sensitivity rates for Amoxicillin-Clavulanate (90.9%), Ampicillin (72.7%), and in Tehran, respectively [37], Doxycycline was advertised as a medication with a 100% sensitivity rate. Given that this uropathogenic is the primary cause of UTI infection in DM patients and that these antimicrobials are among the most widely used medications in Ethiopia, It is alarming that Ampicillin and Amoxicillin-Clavulanate are losing their ability to effectively combat *E. coli* from urinary tract infections.

CONCLUSION

There was a high rate of UTI in diabetes patients. Female diabetics were more likely to experience UTIs than male diabetics were, with *E. coli* and *K.pneumoniae* species making up the majority of isolates. The isolated pathogens were highly susceptible to Gentamicin, Cloxacillin, and Ceftriaxone. These results highlight the value of glycemic control in diabetics in minimizing UTIs, independent of age or sex. Antibiotic-resistant urinary organisms can be controlled by treating UTIs with the right antimicrobial medicines and keeping track of isolated microorganisms' antimicrobial susceptibility patterns.

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CONFLICT OF INTEREST

The author has affirmed that there are no conflicting interests.

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