Original Article

Antibiotic Susceptibility of Bacteria Isolated from Patients with Diabetes Mellitus and Recurrent Urinary Tract Infections in Babylon Province, Iraq

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Abstract

Background: The emergence of the antibiotic resistance in the treatment of UTIs is a serious health problem, especially in the developing countries where there is high level of ignorance, poverty, and bad hygienic practices, **Objective:** The aim of this study was to detect the types of bacteria and their antibiotic sensitivity in patients with diabetes mellitus with recurrent urinary tract infections and compare between types of bacteria in patients with the previous admission to hospital from those who are not. **Materials and Methods:** This cross-sectional study was conducted on eighty patients with diabetes mellitus and recurrent urinary tract infection, those patients who visited the Outpatient Unit in Diabetic and Endocrine Center in Merjan Medical City in Babylon Province. This study was carried out from March 1, 2016 to September 30, 2016. General urine examination was done to the patient with urinary tract infection. Urine samples were sent for culture and sensitivity against different types of antibiotics. **Results:** Results found that the mean age of the patients was (58.23 ± 14.38) and majority of them (63.7%) were female and (52.5%) of them came from rural area. The main bacteria causing urinary tract infection was *Escherichia coli* in more than 55% of cases, while the amikacin antibiotic regard as the best antibiotic in the treatment of urinary tract infection in this study with lowest resistance percentage (3.8%). Based on the history of previous admission to the hospital, there was 57.5% with a history of previous admission, and there was statistically significant difference in the types of bacteria between the two groups. **Conclusion:** There was significant difference in bacterial type between patients who previously had hospital admission and those who had not. E. coli was the main bacteria causing UTI in this study. Amikacin showed the best sensitive drug for bacteria that cause urinary tract infection.

Keywords: Antibiotic sensitivity, culture and sensitivity, diabetes mellitus, recurrent urinary tract infections, uropathogens

Introduction

The urinary tract infection (UTI) now regard as one of the most common health problems for medical practice which can affect the people of different age groups from the neonate till geriatric age group.[1] Worldwide, there was about 150 million patients are diagnosed that they have UTI each year.[2] Most infections are caused by transmission of the bacteria from the fecal flora through the urethra and then to the bladder and kidney, particularly in the female gender who have a short and wide urethra and so more liable for transferring microorganisms.[3] The structure and position of the female's urethra make it liable for trauma during intercourse and during pregnancy and childbirth in the labor.[4,5]

Urinary tract infections are one of the most common infections caused by bacteria in both community and hospital;[6-8] in most cases, there is a need to start treatment before the microbiological results of culture are available. Area-specific studies aimed to obtain knowledge about the type of bacteria responsible for UTIs and their antibiotics resistance patterns may help the clinician to choose the right empirical antibiotic treatment.[9]

The pattern of etiologic agents that causing UTIs and their antibiotics resistance pattern have been continuously changing over the time, both in the community and hospitals.[10]

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Access this article online

Quick Response Code:

Website:
www.medjbabylon.org

DOI:
10.4103/MJBL.MJBL_16_18

In the community and hospital patient, the etiology of UTI and the antibiotics susceptibility of urinary bacteria had been changing over the time and from one place to the others.[11-13]

In spite of the fact that antibiotics treatment has revolutionized the management of a lot of infectious clinical syndromes, their increasing usage in many ways such as noncareful discriminate prescribing, improper dosing and duration of the treatment, and over-the-counter availability of antibiotics to the populations has contributed to increasing of antibiotic resistance for various common pathogens.[14]

The emergence of the antibiotic resistance in the treatment of UTIs is a serious health problem, especially in the developing countries where there is high level of ignorance, poverty, and bad hygienic practices, and there is a high prevalence of fake and illegal drugs of poor quality in circulation.[15] Hence, the variations in the spectrum of microorganisms found in the urinary tract infections and emergence of antimicrobial resistance across geographical areas have made important of conducting an antibiotic susceptibility study of UTI bacteria in different regions from time to time. This study determines the prevalence of frequently isolated urinary tract bacteria and their antibiotic susceptibility in hospital- and community-acquired UTI in a Babylon Province in Iraq.

MATERIALS AND METHODS

A cross-sectional study was conducted on eighty patients with diabetes mellitus and recurrent urinary tract infection; those patients visit the Outpatient Unit in Diabetic and Endocrine Center in Merjan Medical City in Babylon Province. This study was carried out from March 1, 2016 to the September 30, 2016.

Those patients visit Diabetic and Endocrine Center in Merjan Medical City where history was taken about the name, age, sex, address, are there is symptom suggest urinary tract infection? time of firstly diagnosis diabetes, are there is recurrent urinary tract infection based on symptoms and investigation? are patient had receive previous antibiotic? and are the patients admitted previously to the hospital? With causes and duration of admission, the examination was done for patient information of general and abdominal examination.

Diabetes diagnosed as patient had a history of diabetes or fasting blood sugar above 126 mg/dl (7 mmol/L) or in a patient with classic symptoms of hyperglycemia and random blood sugar above 200 mg/dl (11.1 mmol/L).[16]

Urine collection
Midstream urine sample collected in a sterile container, general urine examination was done for each patient and accordingly, for the patient with UTI, urine culture and sensitivity test were performed. Plates of blood agar and MacConkey medium were inoculated under aseptic condition with a few drops of the urine precipitate and then incubated for 48–72 h. The detection of the types of bacteria was identified according to Cowan and Steel standard methods.[17] The disc diffusion method was carried out to determine the

antibiotic sensitivity testing, and the results were interpreted according to the CLSI guidelines.[18] The medium that used for this method was Muller-Hinton agar. The following antibiotic disks were obtained (from Oxoid, UK) as reference disks with known potency for laboratory use: Cefotaxime (30 μg), ceftriaxone (30 μg), amikacin (30 μg), ciprofloxacin (5 μg), and trimethoprim-sulfamethoxazole (1.25/23.75 μg), cephalexin (30 mg), cefixime (5 mg), norfloxacin (10 μg), gentamicin (10 mg), augmentin (20/10 mg), trimethoprim (5 μg), and nitrofurantoin (300 μg).

Data analysis
Statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS) software version 17, (IBM company). Categorical variables were presented as frequencies and percentages. Continuous variables were presented as (mean ± standard deviation). ANOVA test was used to compare means between three groups or more. Pearson's Chi-square and Fisher-exact test were used to find the association between categorical variables. $P \leq 0.05$ was considered statistically significant.

RESULTS

Table 1 shows distribution of patients according to

Table 1: Distribution of patients according to sociodemographic characteristics

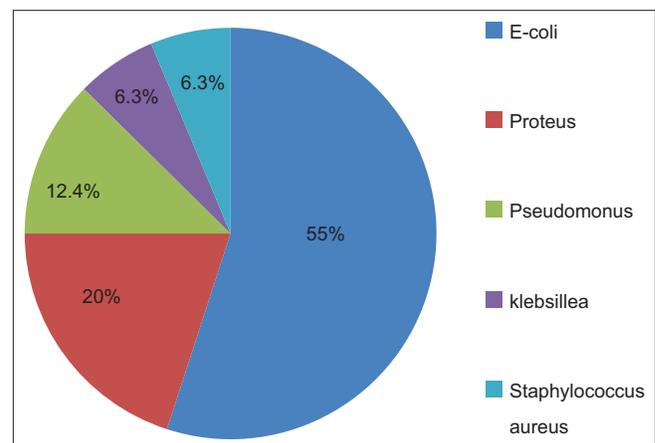| Sociodemographic variables	
Variable	No. (%)
Age (years)	58.23±14.38 (23-89)
Gender (%)	
Male	29 (36.3)
Female	51 (63.7)
Total	80 (100.0)
Residence (%)	
Urban	38 (47.5)
Rural	42 (52.5)
Total	80 (100.0)

Figure 1: Distribution of patients with recurrent urinary tract infection according to causative agent

sociodemographic characteristics including (age and gender, residence). The mean age was 58.23 ± 14.38 and majority of patients (63.7%) were female and 52.5% of them came from rural area.

Figure 1 shows the distribution of patients with recurrent UTI according to the causative agent. Among studied patients, culture showed that *Escherichia coli* caused more than a half (55%) of cases of recurrent UTI.

Table 2 shows distribution of patients according to antibiotic sensitivity. Amikacin appears to be more effective antibiotic with very low bacterial resistance (3.8%).

Regarding distribution of patients with recurrent UTI according to the history of previous admission, Majority of patients (57.5%) presented with a history of previous hospital admission.

Table 3 shows mean differences of age of patients by species of bacteria. There were no significant differences between means of age of patients by species.

Table 4 shows the association between bacterial species causing UTI and study variables including (gender, residence, and previous hospital admission). There was significant association between species of bacterial and history of previous admission.

Table 5 illustrates the association between bacterial species and antibiotic sensitivity.

Discussion

UTI is a common condition worldwide and the epidemiology and the pattern of antimicrobial resistance vary from area to area and may be different; depending on whether it occurs in the community or within the hospital. It has been advocated that there should be surveillance of the bacterial types and resistance pattern for antibiotic of uropathogens.[19]

The *E. coli* was the main isolated bacteria in this study, it was 55% of isolation, while it was 73% in Hryniewicz *et al*.[9] and 31.1% in Al-Jebouri and Mdish,[20] this difference may be explained due to geographic variation and sample under study. The resistance to antibiotic by microorganism in this study was as follows:

For ceftriaxone, the resistance was 67.5% while it was 70.6% in Dhukaa' study,[21] and it was 58.4% in in Otajevwo study.[22] For ciprofloxacin antibiotic, the percentage of resistance was 37.5% in this study, while it was 33.3% in Oluremi *et al*.,[23] 19.3% in Al-Jebouri and Mdish study,[20] 64.7% in Dhukaa' study,[21] and 58.4% in Otajevwo study,[22] this difference can be explained due to the practice of use the antibiotic in area understudy and geographical variation.

For gentamycin, the rate of resistance to this antibiotic was 55%, while it was 53.3% in Oluremi *et al*.,[23] 46.5% in Al-Jebouri and Mdish study,[20] 67.6% in Dhukaa' study,[21] and 79.6% in Otajevwo study.[22]

Table 2: Distribution of patients with recurrent urinary tract infection according to antibiotic sensitivity

Antibiotic	*n* (%)
Cefotaxime	
Resistant	54 (67.5)
Low sensitive	20 (25.0)
Moderate sensitive	6 (7.5)
Ceftriaxone	
Resistant	54 (67.5)
Low sensitive	20 (25.0)
Moderate sensitive	5 (6.3)
High sensitive	1 (1.3)
Cephalexin	
Resistant	70 (87.5)
Low sensitive	10 (12.5)
Cefixime	
Resistant	63 (78.8)
Low sensitive	17 (21.2)
Ciprofloxacin	
Resistant	30 (37.5)
Low sensitive	26 (32.5)
Moderate sensitive	14 (17.5)
High sensitive	10 (12.5)
Norfloxacin	
Resistant	34 (42.5)
Low sensitive	26 (32.5)
Moderate sensitive	16 (20.0)
High sensitive	4 (5.0)
Gentamycin	
Resistant	44 (55.0)
Low sensitive	23 (28.8)
Moderate sensitive	13 (16.2)
Amikacin	
Resistant	3 (3.8)
Low sensitive	13 (16.2)
Moderate sensitive	26 (32.5)
High sensitive	38 (47.5)
Augmentin	
Resistant	76 (95.0)
Low sensitive	4 (5.0)
Trimethoprim	
Resistant	69 (86.2)
Low sensitive	11 (13.8)
Nitrofurantoin	
Resistant	33 (41.3)
Low sensitive	36 (45.0)
Moderate sensitive	11 (13.7)

Table 3: Mean differences of age of patients according to species of bacteria

Variable	Bacterial species	*n*	Mean±SD	*F*-test	*P*
Age (years)	*Escherichia coli*	44	59.22±14.25	2.19	0.096
	Proteus spp.	16	60.68±18.04		
	Pseudomonas spp.	10	60.5±7.74		
	Klebsiella spp.	10	47.7±9.88		

P≤0.05 was significant. SD: Standard deviation

Table 4: Association between bacterial species and study variables

Study variables	Bacterial species				P
	Escherichia coli	*Proteus* spp.	*Pseudomonas* spp.	*Klebsiella* spp.	
Gender					
Male	14 (31.8)	7 (43.8)	2 (20.0)	6 (60.0)	0.241
Female	30 (68.2)	9 (56.3)	8 (80.0)	4 (40.0)	
Total	44 (100.0)	16 (100.0)	10 (100.0)	10 (100.0)	
Residence					
Urban	19 (43.2)	10 (62.5)	4 (40.0)	5 (50.0)	0.555
Rural	25 (56.8)	6 (37.5)	6 (60.0)	5 (50.0)	
Total	44 (100.0)	16 (100.0)	10 (100.0)	10 (100.0)	
History of previous admission					
Present	24 (54.5)	11 (68.8)	9 (90.0)	2 (20.0)	0.011*
Absent	20 (45.5)	5 (31.3)	1 (10.0)	8 (80.0)	
Total	44 (100.0)	16 (100.0)	10 (100.0)	10 (100.0)	

*$P \leq 0.05$ was significant. Fisher-exact test

Table 5: Association between bacterial species and antibiotic sensitivity

Antibiotic sensitivity	Bacterial species				P
	Escherichia coli	*Proteus* spp.	*Pseudomonas* spp.	*Klebsiella* spp.	
Cefotaxime					
Resistant	29 (65.9)	15 (93.8)	ND	0	<0.001*
Low, moderate, or high sensitive	15 (34.1)	1 (6.3)		10 (100.0)	
Total	44 (100.0)	16 (100.0)		10 (100.0)	
Ceftriaxone					
Resistant	29 (65.9)	15 (93.8)	ND	0	<0.001*
Low, moderate, or high sensitive	15 (34.1)	1 (6.3)		10 (100.0)	
Total	44 (100.0)	16 (100.0)		10 (100.0)	
Cefixime					
Resistant	33 (75.0)	15 (93.8)	ND	5 (50.0)	0.018*
Low, moderate, or high sensitive	11 (25.0)	1 (6.3)		5 (50.0)	
Total	44 (100.0)	16 (100.0)		10 (100.0)	
Cephalexin					
Resistant	44 (100.0)	16 (100.0)	ND	0	<0.001*
Low, moderate, or high sensitive	0	0		10 (100.0)	
Total	44 (100.0)	16 (100.0)		10 (100.0)	
Ciprofloxacin					
Resistant	11 (25.0)	11 (68.8)	3 (30.0)	5 (50.0)	0.014*
Low, moderate, or high sensitive	33 (75.0)	5 (31.3)	7 (70.0)	5 (50.0)	
Total	44 (100.0)	16 (100.0)	10 (100.0)	10 (100.0)	
Norfloxacin					
Resistant	15 (31.8)	11 (68.8)	3 (30.0)	5 (50.0)	0.087
Low, moderate, or high sensitive	29 (68.2)	5 (31.3)	7 (70.0)	5 (50.0)	
Total	44 (100.0)	16 (100.0)	10 (100.0)	10 (100.0)	
Amikacin					
Resistant	0	1 (6.3)	2 (20.0)	0	0.038*
Low, moderate, or high sensitive	44 (100.0)	15 (93.8)	8 (80.0)	10 (100.0)	
Total	44 (100.0)	16 (100.0)	10 (100.0)	10 (100.0)	
Gentamycin					
Resistant	27 (61.4)	12 (75.0)	5 (50.0)	0	0.001*
Low, moderate, or high sensitive	17 (38.6)	4 (25.0)	5 (50.0)	10 (100.0)	
Total	44 (100.0)	16 (100.0)	10 (100.0)	10 (100.0)	
Trimethoprim					

Table 5: Contd...

Antibiotic sensitivity	Bacterial species				P
	Escherichia coli	*Proteus* spp.	*Pseudomonas* spp.	*Klebsiella* spp.	
Resistant	44 (100.0)	9 (56.3)	ND	6 (60.0)	<0.001*
Low, moderate, or high sensitive	0	7 (43.8)		4 (40.0)	
Total	44 (100.0)	16 (100.0)		10 (100.0)	
Augmentin					
Resistant	44 (100.0)	16 (100.0)	ND	6 (60.0)	<0.001*
Low, moderate, or high sensitive	0	0		4 (40.0)	
Total	44 (100.0)	16 (100.0)		10 (100.0)	
Nitrofurantoin					
Resistant	25 (56.8)	1 (6.3)	ND	0	<0.001*
Low, moderate, or high sensitive	19 (43.2)	15 (93.8)		10 (100.0)	
Total	44 (100.0)	16 (100.0)		10 (100.0)	

*$P \leq 0.05$ was significant. Fisher-exact test. ND: Not determined

For amikacin antibiotic which regards as best antibiotic for the treatment of UTI, the resistance rate was 3.8% in this study, and this can be explained due to the fact that this drug is not widely used in Iraq,[24] while it was 4.3% in study of Al-Jebouri and Mdish[20] and 0.6% in study of Hryniewicz *et al*.[9]

For augmentin antibiotic, the resistance was very high (95%) in this study, while it was 77.3% in Otajevwo study[22] and 69% in Orrett and Davis study,[25] while it shows high resistance (100%) in Oluremi *et al*.[23]

Regarding nitrofurantoin, resistance was 41.3% in this study, while it was 45% in Al-Jebouri and Mdish study,[20] 51.7% in Oluremi *et al*.,[23] and 53% for Dhukaa' study.[21] Regarding the association between bacterial species and study variables, for gender, the association was nonsignificant as the *P* value was 0.214 in this study; this was compatible with Wijekoon *et al*. study, in which the association was not significant (0.061).[26] For the history of previous admission, the association was significant with *P* value was 0.011, and it was significant in Wijekoon *et al*. study in which the association was also significant with *P* value was 0.001.[26]

Conclusion

There are large numbers of resistance of antibiotic among bacteria causing UTI. There was significant difference in bacterial type between patients who previously had hospital admission and those who had not, but there was a significant difference in the type of bacterial infection between patients who live in urban area from those who live in rural area. *E. coli* was the main bacteria causing UTI in this study. Amikacin showed the best sensitive drug for bacteria that cause urinary tract infection. There are some antibiotics that previously used in the treatment of urinary tract infection showed very high degree of bacterial resistance such as Augmentin.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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