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Bacterial Causes of Urinary Tract Infection among Diabetic and Non-Diabetic Patients in Al-Kut City, Iraq

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Abstract

Introduction: Urinary tract infection is a very prevalent disease among humans and it is highly presented among patients with diabetes mellitus. The main aim of the current study was to find out the commonest bacterial organisms causing urinary tract infection among a sample of diabetic and non-diabetic patients in Al-Kut city, Iraq.

Methods: A cross-sectional study was conducted among 100 conveniently sampled patients suffering from urinary tract infections and attending Al-Karama Teaching hospital laboratory for urine culture between October and December 2019 were included in the study. The patients were consented to answer a special questionnaire containing data like patients' age, gender, and disease status (diabetic or non-diabetic).

Results: From the 100 participated patients there were 29 (29%) with diabetes and the remaining 71(71%) from the sample were non-diabetics. The females represent the majority of the sample (67%) while males represented only (33%). The most common identified bacteria from this sample were *Staphylococcus aureus* (48%), *Escherichia coli* (24%), *Klebsiella pneumoniae* (17%), *Enterococcus species* (5%), and *Pseudomonas aeruginosa* (2%). The study result shows a significant association of being diabetic or not with age and gender of the patients (p-value<0.001, 0.038) respectively. While this association was non-significant when considering the type of bacteria between the two groups (P-value=0.056).. While this association was non-significant when considering the type of bacteria between the two groups (P-value=0.056).

Conclusion: The urinary tract infection is frequently presented among young non-diabetic females and near half of the urine cultures showed the *Staphylococcus aureus* bacteria as the commonest cause of infection among them.

Keywords: Diabetes Mellitus, Causative bacteria, Urinary Tract Infection, Iraq.

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Introduction

The disease Diabetes mellitus (DM) is a syndrome of multiple symptoms occurs due to increased glucose level in the blood. This high level of blood glucose is called hyperglycemia which can lead to both acute and chronic complications. Metabolic decompensation can occur acutely with obvious symptoms that may end with hospital admission. While chronic complications of hyperglycemia can affect multisystem like kidneys, blood vessels, nerves, and eyes (Ralston, S. *et al.*, 2018).

Diabetes can cause numerous types of complications for the renal system which may later be developed into end-stage renal failure (USRDSCC, 2004 & ADA, 2012). The prevalence of kidney diseases related to diabetes was increasing during this period and about 45% of American diabetic patients suffer from renal diseases related to diabetes, which may be due to multiple attacks of renal injury either from infections, nephrotoxins, or even prescribed drugs and treatments (De Boer, I.H. *et al.*, 2011 & NKF, 2002). UTIs are five times more likely to occur in diabetics than non-diabetics.

In people with diabetes, UTIs are also more severe and have a poor prognosis. The increasing incidence and poor outcome of UTIs among diabetic patients can be due to low levels of interleukin-8 and interleukin-6 in diabetic patients' urine in addition to decrease the leukocyte cell count (Shah, M.A. *et al.*, 2020). Previous works of literature found that *E. coli* was the major causative bacteria for UTIs among diabetics followed by *Klebsiella pneumoniae*. In a study conducted in Jordan, it was found that *E. coli* was presented the higher percentages (44.8%) of UTI in both groups divided to (15.5%) in DM patients and (29.3%) in the non-DM patients (Shah, M.A. *et al.*, 2020, Al-Asoufi, A. *et al.*, 2017).

Diabetic patients are frequently suffering from acute kidney infections which may be contributed to immune system damage and weakness. In addition to incomplete bladder evacuation due to nerve injury and increasing glucose level in the urine that can play as a good environment for bacterial growth and colonization (Chin, H.P.V., 2006; Muller, L.M.A.J. *et al.*, 2005; Boyko, E.J. *et al.*, 2005 & Boyko, E.J. *et al.*, 1995).

So, Urinary Tract Infections (UTIs) are the most common bacterial infections among diabetic patients, and they must be suspected, identified, and treated by doctors (Ribera, M.C. *et al.*, 2006). If UTI persists and doesn't deal with correctly, it can lead to numerous harmful problems like renal papillary necrosis, renal abscess, and even bacteremia (Boyko, E.J. *et al.*, 2005; Boyko, E.J. *et al.*, 1995; Ribera, M.C. *et al.*, 2006; Geerlings, S.E. *et al.*,2000). Correct identification of antimicrobial susceptibility by urine culture and early management of UTI with proper antimicrobial drugs in patients with diabetes can help prevent further complications and avoid antimicrobial resistance to antibiotics (WHO & IDF, 2006 & Ajay, K.P., 2018.

Therefore, it is important to control frequent UTIs with accurate screening, treatment, and avoiding future linked problems. Though, it is of great significance to outline the specific types of microbes affecting patients with diabetes to keep in minded their features and sensitivity when facing it. This study was prepared and conducted to assess the type of microbiologically confirmed urinary infections among DM patients in comparison with non-diabetic patients visiting the AL-Krama Teaching Hospital in Wasit province/ AL-Kut city.

Materials and Methods

Study design and setting: The study is designed as a cross-sectional study. Duration of data collection was continuous for 2 months (October to December) 2019 at Al- Karama teaching hospital laboratories. AL-Karama teaching hospital is one of the largest hospitals in AL-Kut city/ Wasit province. Wasit province is located in the eastern part of Iraq with a total population of about 1,450,000.

Study sample: The study included 100 convenient patients with positive UTIs who visiting hospital laboratories from different areas of Wasit province during the determined period of the study.

Inclusion criteria: All patients suffering from UTI from different age groups with a positive laboratory test that confirming their UTI.

Exclusion criteria: Patients with severe pain preventing them from participation and those urgent to back home were excluded from the study.

Data collection: Relevant data were collected by a self-administered special questionnaire prepared by the researchers and consisted of demographic features like age, gender, and disease status (diabetic or non) in addition to data related to results of their urine cultures. Data were obtained from participants after their full consent and acceptance to participate in the study. The questionnaire was validated by two experts in community medicine and microbiology and it was pretested for 5 patients who were then excluded from the final analysis and results.

Urine collection and processing: The patients were provided with special sterile cups for collecting urine samples and were instructed to collect a midstream clean urine properly. After that, the samples were inoculated using a calibrated special inoculation needle. Only 10 µL of urine sample was used to be inoculated on three different types of media used in the laboratory (blood agar, Nutrient agar, and MacConkey agar plates) and incubated for 24–48 hours under 37°C temperature.

Recognition of the type of the isolated micro-organisms: First of all, all urine samples were counted for the available colonies. If it appears to be more than 104 CFU/mL, so it is judged as UTI positive, and consequent biochemical tests were completed using the automated system Micro scan. Different types of panels were used for both Gram-negative (NC34 and NC53) and Gram-positive bacteria (PC21) and advanced tests were done for species isolates (API E20, API strep, and API staph) in addition to quality control (QC strains) for (*Escherichia coli* ATCC 25922, *Klebsiella pneumoniae* ATCC 13883).

Statistical analysis*:* All collected data were entered into a computer and analysis was performed by SPSS program version 26. Categorical variables were presented in frequencies and percentages while the continuous variable (age) was presented by mean and standard deviation. For association chi-square test and fisher's exact test were used as appropriate. For contentious variables, an independent sample t-test was used considering P-value equal to or less than 0.05 as significant.

Ethical approval: Official approvals were obtained from the College of Medicine/ Wasit University and Wasit Health Directorate / AL-Karama Teaching Hospital manager office.

Results

The results of this study were depending on the analysis of 100 UTI confirmed patients to determine the different types of microorganisms causing UTI among DM compared to non-DM patients. The result showed the frequency distribution of socio-demographic features of the patients. The minimum age among participant patients was 3 years and the maximum was 80 years old with a mean age of 32.12±19.05, the females represented more than two-thirds (67%) of the patients. The majority of patients with UTI (71%) were non-diabetics and the most frequent bacteria causing the infection was *Staphylococcus aureus* (48%) followed by *Escherichia coli* (*E. coli*) (24%) as appeared in **Table 1**. Table 2 shows significant differences between DM and non-DM patients concerning age and gender (*p*-value <0.001 and 0.038) respectively. No significant association between the two groups regarding the causative bacteria for UTI (*p*-value= 0.056).

Table 1: Frequency distribution of participant characteristics according to age, gender, disease status, and causative bacteria for urinary tract infection

Age (years)		**Mean**	**Standard deviation**
		32.12	19.05
Variables		**Frequency**	**Percentage**
Gender	Female	67	67%
	Male	33	33%
Disease status	Diabetic	29	29%
	Non-diabetic	71	71%
Causative Bacteria	*E. coli*	24	24%
	Klebsiella pneumonaie	17	17%
	Pseudomonas aeruginosa	2	2%
	Staphylococcus aureus	48	48%
	Enterococcus spp.	5	5%
	Streptococcus spp.	4	4%

Table 2: Association between disease status with age categories, gender, and causative microorganisms

Variables		**Disease status**		**P-value**
		Diabetic	**Non- diabetic**	
Age (years)	Mean±Standard deviation	56.28±10.35	22.25±11.39	<0.001 (Independent t-test)
Gender	Male	14(48.3%)	19(26.8%)	0.038 (Chi-square test)
	Female	15(51.7%)	52(73.2%)	
Causative Bacteria	*Staphylococcus aureus*	11(37.9%)	37(52.1%)	0.056 (Fisher s exact test)
	E. coli	6(20.7%)	18(25.4%)	
	Klebsiella pneumonaie	10(34.5%)	7(9.9%)	
	Enterococcus spp.	1(3.4%)	4(5.6%)	
	Streptococcus spp.	0(0%)	4(5.6%)	
	Pseudomonas aeruginosa	1(3.4%)	1(1.4%)	

Discussion

The identification of the most common causative microorganisms causing UTIs among confirmed patients was of great interest for the physicians to manage properly especially among DM patients who complain from recurrent infections that may be developed to severe and significant health problems. The result obtained from the participant patients in the current study showing a significant association of being diabetic or not with the age and gender of the patient, while disease status was non-significantly associated with the causative UTI pathogens.

Regardless of the disease status, the most predominant bacteria isolated from UTI patients in this study were in the following order: *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Enterococcus species*, and lastly *Pseudomonas aeruginosa*. The *Staphylococcus aureus* is a high resistance bacterium so it presents commonly among patients with UTIs. The study in Zakho/ Iraq in 2018, showed a different observation where *E. coli* was the most commonly isolated bacterium (Jameel A.Y. *et al.*, 2019) just like what was found by Bonadio M et al. (2006) (Bonadio, M. *et al.*, 2006). *Staphylococcus aureus* is considered the second commonest bacterial cause of UTI, especially among females worldwide. Even though urinary tract infections can affect both males and females, females show higher percentages of infection than males which may be attributed to the difference in their and reproductive physiology (Kenny, L. *et al.*, 2017). The urethra in general is shorter in women than in men, so bacteria need very little time to reach the bladder and causing infection in addition to their location near the rectum (Tan, C.W. *et al.*, 2016). The same results were obtained from previous studies conducted in different places in the world [(Jameel A.Y. *et al.*, 2019; Bonadio, M. *et al.*, 2006 & Tan, C.W. *et al.*, 2016). This study found that the younger age group females who represented mostly women of reproductive age were the most vulnerable age group to be diagnosed with UTI which mainly due to sexual contact and pregnancy.

Previous studies had shown that elevated glucose levels in the blood were associated with the risk of UTI occurrence so leading to an increase in the prevalence of infection among DM patients compared with other non-diabetes. Even, in this study diabetic patients have represented the lower percentages among the study sample. This may be due to the diabetic patients may visit other specialist diabetic centers and private clinics or maybe the patient with DM may have asymptomatic bacteriuria and so the percentage rate of their incidence was less than non-diabetics. Diabetic patients suffer commonly from fungal UTI rather than bacterial especially among those who are hospitalized for a long period, catheterized, and frequently using the parenteral antibiotic (Joshi, N. *et al.*, 1999). This result was in contrast to other studies that found a higher risk of UTI among DM patients (Jameel A.Y. *et al.*, 2019, Aswani, S.M. *et al.*, 2014). The elevated plasma glucose level develops glucosuria that empowers the bacterial proliferation by the increase in cell number; suggesting neutrophil dysfunction (Goswami, R. *et al.*, 2001, Gul, N. *et al.*, 2004). Another mechanism might be related to the lower rate of kidney cytokine (IL-8 and IL-6) secretion that is responsible for the development of immunity against infection in the urinary tract (Chen, C.Y. *et al.*, 2012). This increasing prevalence of UTIs among DM patients can also be explained by increased adherence to bacteria due to decrease anti-adherence action of the urine and higher adherence ability of uroepithelial tissue (Funfstuck, R. *et al.*, 2012). Increase bacterial adherence to urinary cells in patients with DM caused by a decrease in the level of production of Tamm-Horsfall Protein (THP) by the kidney which is responsible for the prevention of bacterial connection to urinary cell tissues (Saber, M.H. *et al.*, 2010).

Limitations

It is difficult to generalize the finding due to the small sample size, convenient sampling method, and also the high possibility that the patients are all symptomatic (asymptomatic UTI patients are likely not included in the study). The small sample size collected from one center was the major limitation of this study which was because of security and health conditions in that period of the study.

Conclusion

The Staphylococcus Aureus was the commonest bacterial isolate among patients with UTI in both diabetic and non-diabetic patients. Age and gender were significantly associated with disease status among UTI patients, while there was no significant association between disease status and causative bacteria causing the infection. This study recommends further studies including a larger multicentral sample from different places.

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