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The effect of diabetes mellitus on incidence of urinary tract infection

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A R T I C L E I N F O

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A B S T R A C T

Urinary tract infections (UTI) are common in diabetic patients. The propensity of the infection may vary in different individuals especially when there is underreporting from the patients having a risk of acquiring infections. This study was based on the effect of diabetes mellitus on incidence of urinary tract infection. This study targeted 120 cases of urinary tract infection patients in Rizgari hospital in Erbil city during the period from October - 2014 to March 2015, of which 75 were diagnosed with Diabetes Mellitus. All urine samples were processed in the laboratory following standard laboratory protocol. The infection was diagnosed by microscopic examination of urine samples and urine culture. Blood glucose level used for confirmation and follow-up of diabetes mellitus. The data about the patients such as gender, residence area, age and occupation were also collected by using a specially designed questionnaire prepared for this purpose. Results showed that diabetes has a high effect on the frequency of UTI. Other risk factors including gender, age and socioeconomic status may affect the incidence of UTI independent of Diabetes Mellitus. *Escherichia coli* is the predominant microorganism that causes UTI in patients independent to diabetes mellitus followed by *Klebsiella spp.* The antibiogram indicated that the Gram positive bacteria was towards Gentamicin, and the highest resistance was to Nitrofurantoin. While the highest sensitivity of Gram negative bacteria was toward Imipenem, and the highest resistance was to Ceftriaxone. Therefore, the antibiotic therapy should only be advocated after culturing and sensitivity test.

1. INTRODUCTION

Diabetes Mellitus (DM) patients are more prone to be affected by Urinary Tract Infections (UTI) than normal individuals because of the abnormalities in host defence system caused by DM and make them at higher risk of infections (Stapleton, 2002). Diabetes mellitus patients are also predisposed to develop more severe upper UTI (Forland *et al*., 1977). Patients with established urinary tract infections also are more likely to have complications from UTI if they are diabetic (Wheat, 1980).

Urinary Tract is consisted by organs for collection, storage and disposal of urine outside the body i.e. kidney, ureter, urinary bladder and urethra. Growth and multiplication of microorganisms within the urinary tract is called Urinary Tract Infection which affects millions of people around the world annually

from different age and sex groups (Connolly and Thorp, 1999). UTI can occur as asymptomatic bacteriuria with a prevalence of 2-13%. This is when up to 100 000 CFU of pathogenic bacteria are cultured from the urine without any urinary symptoms. When left untreated, 20-30% develop into pyelonephritis (Kallmeter, 2003).

UTI also occurs in the symptomatic form as pyelonephritis involving the kidneys, as cystitis involving the bladder with clinical symptoms of dysuria, frequency supra-pubic and loin pains alongside fevers and nausea and vomiting. Predisposing factors to UTI include the female sex, pregnancy, poor general and perineal hygiene, young age, multiparty, diabetes mellitus, sickle cell disease, and previous treatment for UTI (Mohamed, 2012).

Most infections are caused by *Escherichia coli*, although in the first year of life *Klebsiella pneumoniae, Enterobacter spp, Enterococcus spp, and Pseudomonas* are more frequent than later in life, and there is a higher risk of urosepsis compared with adulthood (Kanellopoulos *et al*., 2006, Shaikh *et al*., 2008).

In recent years, widespread use of antibiotics has been resulted in increasing incidence of antibiotic resistance among the urinary tract pathogens all over the world (Kahlmeter, 2003). Frequent use of wide-spectrum antibiotics may change the intestinal flora, and as a consequence, induce bacterial resistance (Al-Mardeni *et al*, 2009). Early recognition and prompt treatment can significantly decrease late serious complications of UTI. Appropriate treatment of UTI requires the knowledge about antibiotic resistance pattern of common uropathogens in specific geographical location (Sharifian *et al*., 2006).

2. MATERIALS AND METHODS

The Urine samples from120 cases of urinary tract infection patients were collected in sterile cups in Rizgari hospital in Erbil city during the period from October - 2014 to March 2015. The samples were tested within few hours of sampling, of which 75 were diagnosed with Diabetes Mellitus (Vandepitte *et al.*, 2003). Also a questionnaire was used to assess the participants' health. It included questions about; gender, family history, residence area, age and occupation.

Urine analysis for sediment was done. According to Burnett *et al.* (1994) two-five or more pus-cells/HPF were considered as a positive test indicative of infection.

The urine sample was taken and streaked by sterile loop on the nutrient agar, blood agar and MacConkey agar, respectively and incubated at 37 ^{0}C for 24 hours, the growth was processed, if there is growth.

The gram stain was used to differentiate between gram positive (purple/blue color) and gram negative bacteria (pink/red color).

The diagnostic emphatic tests for the bacteria were done by using API (Analytical Profile Index) in Rizgari hospital according to the regulatory diagnostic system which are based on (Vandepitte *et al*., 2003, Benson, 2001, Prescott *et al*., 2002).

Disc diffusion method (Kirby- Bauer-method) was carried out according to the Clinical and Laboratory Standard institute guidelines (CLSI) was used for examine susceptibility of isolated bacteria to the following antibiotics: Gentamicin, Vancomycin, Tetracycline, Rifampicin, Nitrofurantoin. Amikacin, Ceftriaxone, Imipenem and Aztreonam (Bauer *et al*., 1966).

Fasting Glucose is directly proportional to the severity of the diabetes mellitus. During this test, blood was drawn from a vein in the patient's arm after the patient has not eaten for at least eight hours, in the morning before breakfast. A plasma level of 126 mg/dL or

greater strongly indicated diabetes (Lawrence and Amadeo, 1996).

3. RESULTS AND DISCUSSION

Laboratory test for urinary tract infection depends on the microscopic examination which in turn shows the presence of pus cells. Hoberman & Wald (1997) have shown a great link between the presence of pus cells in the specimen and the infection of individual with urinary tract infection with a very high percentage of 85%. It also depends on the bacterial culture of the urine specimens (Klein, 1994, Ieanos *et al*., 1996). On these bases our urinary tract infection patients have been classified into diabetic group and non-diabetic group. The results in table (1) showed that UTIs are more frequent and are likely to have a more complicated course in patients with diabetes mellitus, the mechanisms which potentially contribute to the greater incidence of UTI in these patients, are malfunctioning in the local urinary cytokine secretions and an increased adherence of bacteria to the cells of the uro epithelial cells. The current results agree with many researches that patients with diabetes have a higher risk for UTI because of changes in the immune system. UTIs are more severe and serious in diabetic patients and can cause renal and perirenal damage (Baron *et al*., 1994, Saleem, and Daniel, 2011). The lower tract infections are common in diabetic patients, probably due to deficiency of local immune mechanisms and increasing adherence of bacteria to the linings of the urinary system (Meiland *et al*., 2002, Geerlings *et al*., 2002).

Table 1. The effect of diabetes mellitus on the frequency of urinary tract infection (UTI).

UTI patients	Diabetic group	Non diabetic group	Total
Number	75	45	120
%	62.50 %	37.50 %	100 %

After the interpretation of the data we found that the female was more vulnerable to have the UTI in high percentage table (2) compared to the male and this could be due to the very close anatomic site of the female urethra to the anus which act as a root of ascending of the bacteria to the urethra more than that can occur in male (Hallett *et al*., 1976). Our results agree with that reported by many authors who showed that, the incidence of UTI caused by culturable bacteria (particularly Enterobacteriaceae) is higher in females (Storm *et al*., 1987, Miller *et al*., 1996, Aldabagh, 1998). Also we found that the females are more likely to have diabetes than males and this is not due to the anatomical or functional aspects, but linked to the environmental factors and psychological factors like stress as she has a responsibility to take care of all the family members (Jackson *et al*., 2005, Brown *et al*., 2006).

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Table 2. The percentage of urinary tract infection in patients with and without diabetes mellitus according to the gender

UTI patients	Diabetic group		Non Diabetic group	
	Number	**%**	**Number**	**%**
Male	19	15.83 %	8	6.66 %
Female	56	46.66 %	37	30.83 %
Total	75	62.50 %	45	37.50 %

Finally, regarding the effect of the area of residency table (3) on the chance of being infected with UTI, we found that the infected (Non diabetic group) in the village were higher than the city and these results agree with what Aldabagh (1998) has found, and this can be attributed to the inappropriate water supply and sanitary condition in the village areas.

We found that the affected cases (diabetic group) which that have UTI and diabetes mellitus in the city were higher than the village and this is due to that individuals who live in the city may be under higher stress therefore they are most likely to have diabetes mellitus.

Table 3. The percentage of urinary tract infection in patients with and without diabetes mellitus according to the residence area.

UTI patients	Diabetic group		Non diabetic group	
	Number	**%**	**Number**	**%**
City	41	34.16 %	18	15.00 %
Village	34	28.33 %	27	22.50 %
Total	75	62.50 %	45	37.50 %

Our results about the effect of the age difference in the probability of having the disease have showed that there were differences in the percentage of the disease in age groups table (4) and these results coincide with the results of Miller who found that the age is very related to the chance of having UTI (Miller *et al*., 1996). Our results have showed that the infection rate with diabetes mellitus increases with age, which are acceptable to the point where the people after the age of forty develop diabetes as the secretion of the insulin

hormone will start to change with age, This agree with other researchers (Jin-Won *et al*., 2008) who obtained a results comparable to our study.

Table 4. The percentage of urinary tract infection in patients with and without diabetes mellitus according to the age.

UTI patients	Diabetic group		Non diabetic group	
age	**Number**	**%**	**Number**	**%**
1-10	1	0.83 %	1	0.83 %
10-30	15	12.50 %	18	15.00 %
31-50	29	24.16 %	16	13.33 %
51-70	30	25.00 %	10	8.33 %
Total	75	62.50 %	45	37.50 %

Table (5) showed that the house wife and the officer are more likely to have diabetes mellitus because of being under stress. That is due to their higher responsibility towards the others and this is in agreement with other published results (Barrett, 2001).

Table 5. The percentage of urinary tract infection in patients with and without diabetes mellitus according to the occupation.

UTI patients	Diabetic group		Non diabetic group	
	Number	**%**	**Number**	**%**
Student	3	2.50 %	9	7.50 %
Retired	4	3.33 %	1	0.83 %
Officer	33	27.50 %	17	14.16 %
House wife	35	29.16 %	18	15.00 %
Total	75	62.50 %	45	37.50 %

The results in table (6) showed that, in diabetic group the prevalence of *Escherichia coli* was 41 (54.66%), *Klebsella spp.* 11 (14.66 %), *Proteus spp.* 3 (4.00%), *Pseudomonas spp.* 6 (8.00%), *Staphylococcus spp.* 8 (10.66%), *Streptococcus spp.* 1 (1.33%), *Enterobacter spp.* 2 (2.66%), *Enterococcus faecalis* 1 (1.33%), *Providencia sturatii* 1 (1.33%) and *Shigella sp.*1 (1.33%) respectively. While in non-diabetic group the prevalence of

Escherichia coli was 29 (64.44%), *Klebsella spp.* 5 (11.11 %), *Proteus spp.* 2 (4.44%), *Pseudomonas spp.* 1 (2.22%), *Staphylococcus spp.* 5 (11.11%), *Streptococcus spp.* 2 (4.44%) and *Enterobacter spp.* 1 (2.22%). Our work agrees with other researches that refer to that the diabetic patients with poor glycemic control have a higher tendency of *E.coli* adherence (Stapleton, 2002, Andriole, 2002). This is also stated by Saleem and Daniel (2011) and other researchers (Zhanel *et al*., 2000, Zhanel *et al*., 2005) as they found that *E. coli* is the most dominant among the pathogenic bacteria in the UTI patients with and with diabetic mellitus.

From our point of view, the predominance of *E. coli* observed in those patients could be attributed to direct fecal contamination of urinary tract from the anus especially when common hygiene practices are not followed.

As indicated in Table (7) the highest sensitivity of Gram positive bacteria was toward Gentamicin where 14 (82.35%) of the isolates were sensitive to this drug. While the highest resistance was to Nitrofurantoin 17 (100%). While Table (8) shows the highest sensitivity of Gram negative bacteria was toward Imipenem where 101 (98.05%) of the isolates were sensitive to this drug. While the highest resistance was to Ceftriaxone 72 (69.9%). These results suggested that the antibiotic therapy should only be advocated after culturing and sensitivity test. This will help in the proper treatment and discourage the indiscriminate use of the antibiotics preventing further development of drug resistance (Ijaz *et al*., 2014).

Table 6. The percentage of the pathogenic bacterial species that cause urinary tract infection in patients with and without diabetes mellitus.

UTI patients	**Diabetic group**		**Non diabetic group**		**Total**	
Bacterial species	**Number**	**%**	**Number**	**%**	**Number**	**%**
Escherichia coli	41	54.66 %	29	64.44 %	70	58.33 %
Klebsilla spp.	11	14.66 %	5	11.11 %	16	13.33 %
Proteus spp.	3	4.00 %	2	4.44 %	5	4.16 %
Pseudomonas spp.	6	8.00 %	1	2.22 %	7	5.83 %
Staphylococcus spp.	8	10.66 %	5	11.11 %	13	10.83 %
Streptococcus spp.	1	1.33 %	2	4.44 %	3	2.50 %
Enterobacter spp.	2	2.66 %	1	2.22 %	3	2.50 %
Enterococcus faecalis	1	1.33 %	Non	0%	1	0.83 %
Providencia sturatii	1	1.33 %	Non	0%	1	0.83 %
Shigella sp.	1	1.33 %	Non	0%	1	0.83 %

Table 7. Antibiotic susceptibility pattern of Gram positive bacteria.

Antibiotics	Sensitive		Resistant		Total
	Number	%	Number	%	
Gentamicin	14	82.35 %	3	17.64 %	17
Vancomycin	2	11.76 %	15	88.23 %	17
Tetracycline	9	52.94 %	8	47.05 %	17
Rifampicin	3	17.64 %	14	82.35 %	17
Nitrofurantoin	Non	0%	17	100.00 %	17

Table 8. Antibiotic susceptibility pattern of Gram negative bacteria.

Antibiotics	Sensitive		Resistant		Total
	Number	%	Number	%	
Amikacin	75	72.81 %	28	27.18 %	103
Ceftriaxone	31	30.09 %	72	69.90 %	`103
Gentamicin	65	63.10 %	38	36.89 %	103
Imipenem	101	98.05 %	2	1.94 %	103
Aztreonam	41	39.80 %	62	60.19 %	103

4. CONCLUSIONS

The diabetes mellitus had a high effect on the frequency of urinary tract infection. It was found that females with diabetes mellitus are more prone to UTI than males, also the infected (Non diabetic group) in the village were higher than the city. While the infected (diabetic group) which have UTI and diabetes mellitus in the city were higher than the village. The age was highly related to the chance of having UTI, Therefor the infection rate with the diabetes mellitus increases with age.

In this study ten different genera of bacteria were isolated and identified from (120) cases of urinary tract infection patients with and without diabetes mellitus, these were: *Escherichia coli*, *Klebsella spp.*, *Proteus spp.*, *Pseudomonas spp.*, *Staphylococcus spp.*, *Streptococcus spp.*, *Enterobacter spp.*, *Enterococcus faecalis*, *Providencia sturatii* and *Shigella sp.* The bacterial isolates showed a wide range of resistance to a variation of antibiotics.

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