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Research Article
Prevalence of Bacterial Urinary Tract Infections Amongst Diabetes Mellitus Patients Attending Ibn-sina General Hospital in Mukalla, Yemen

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Abstract

Background and Objective: Bacterial Urinary Tract Infection (BUTI) is more prevalent in uncontrolled diabetic patients. However, its significance is not entirely unknown. Further more BUTI treatments are usually empirical without the performance of urine culture and sensitivity. This study has aimed to determine the prevalence of BUTI and to identify their possible risk factors. Antibiotics commonly used to treat BUTI. **Materials and Methods:** A total of 106 Yemeni diabetic patients among males and females were recruited into the cross-sectional study. This study was conducted at the diabetic clinics of Ibn-Sina General Hospital in Al-Mukalla, Yemen, from 1st January-30th March, 2020. Socio-demographic and clinical data were taken from each participant using pre-tested questionnaires. Sterile midstream urine samples were collected and analyzed using microscopy and urine reagent pinstripe. Urine samples were inoculated on MacConkey agar, Cystine Lactose Electrolyte Deficient (CLED), blood agar, chocolate medium with a calibrated loop to determine Colony Forming Units (CFU). Identification of isolates has been done by gram stain and different biochemical tests. Data was analyzed by using SPSS statical analysis. **Results:** The prevalence of BUTI was significantly higher in females than males ($p = 0.002$). *Staphylococcus aureus* was the most common organism (57.9%), followed by *Escherichia coli* (31.6%). On the other hand diabetic patients with BUTI had significantly increased HbA1c ($p<0.051$). **Conclusion:** To sum up bacterial Urinary Tract Infection (BUTI) was more prevalent in people with diabetes mellitus and higher in females than males. Thus, the presence of BUTI can be considered as a risk factor for subsequent symptomatic UTI.

Key words: Culture media, diabetes mellitus, *Escherichia coli*, urinary tract infections, *Staphylococcus aureus*, sensitivity test, metabolic disorders

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Urinary Tract Infections (UTIs) are one of the most prevalent microbiological disorder realized in medical practice, affecting persons of all ages. The site of UTIs may be either in the kidneys (pyelonephritis) or in the urinary bladder (cystitis)[1]. Worldwide. The prevalence of UTIs is estimated to be around 150 million people per year[2].

Diabetes Mellitus (DM) is a group of metabolic disorders characterized by high blood sugar levels over a prolonged period. It is classified as type I or type II based on the pathology. Type I results due to the failure of the pancreas to produce insulin, whereas type II is the resistance of insulin by the cells of the body. Both types of DM have acute or chronic complications. Some of the acute complications are hyperglycemia, diabetic ketoacidosis, coma, or death, while the chronic ones are nephropathy, ophthalmopathy, foot ulcers and cardiovascular diseases[3,4]. Diabetes mellitus contributes to the pathogenesis of UTIs in diabetic patients[5]. Type II DM has been widely associated with an increased risk of UTIs[6]. Factors that enhance the risk for UTIs in people with diabetes include age, metabolic control and long-term complications, primarily diabetic nephropathy and cystopathy[7].

Diabetes Mellitus is a worldwide health problem, with an anticipated prevalence of 593 million people by 2035. Type II DM is the most common type[8,9]. Also, in other study in Sudan on 200 Sudanese patients, seven of them had T1DM and the remaining suffered from T2DM[10].

Urinary tract infections are the most common infections among patients with DM and responsible for morbidity and mortality as a result of cystitis, pyelonephritis, impaired leukocyte function, recurrent vaginitis, emphysematous complications and renal perinephric abscesses, This mainly when glycemic control is poor and if UTIs are unrecognized or untreated in these patients[9]. Diabetes mellitus alters the genitourinary system, where UTIs can cause severe complications ranging from dysuria organ damage and sometimes even death due to pyelonephritis[11]. When compared to people without DM, patients with DM have a higher prevalence of Asymptomatic Bacteriuria (ASB) and a higher incidence of urinary tract infections. They are also more likely to develop bacteremia with the urinary system being the most prevalent site of infection. If infection is not treated, it will cause inflammation of the kidney and its pelvis (pyelonephritis) and higher mortality outside the hospital than patients without DM[7].

The urinary tract is the leading site of infection in diabetic patients[12]. Diabetic people have five times the rate of urinary tract infections in non-diabetics vs diabetic patients are 1:5. Other researchers, on the other hand, have discovered that the possibility of UTIs in diabetic patients is 2 times higher than in non-diabetics and that diabetic UTIs are more severe and have worse outcomes than non-diabetic UTIs[12,13].

Obesity, female sex and prostate condition in men have all been recognized as risk factors for UTIs in individuals with and without DM[10,14]. In addition, DM-related glycosuria, poor immunity and bladder dysfunction are all considered risk factors for UTIs[10,15].

The main risk factors of UTIs in developing countries such as Yemen are poverty, inadequate personal hygiene, lower socioeconomic level of population, sexual activity, specific contraceptive methods and increment of antimicrobial resistance[16].

Another study has been conducted in Malaysia presented that a total of 348 DM patients were 140 had UTIs. Prevalence of UTI was higher among females than males. Out of 140 patient with UTIs 89.3% were found in DM patients with poorly uncontrolled glycaemia, while 10.7% of cases of UTI were found in controlled glycemic DM patients[17]. Another study in Saudi Arabia with 1000 diabetic patients found that 48.3 percent of diabetic people have UTI. Males and females account for 41.1% and 7.2% of diabetic patients with UTI respectively. The incidence of UTIs was 23.7% in type 1 and 25.6% in type 2[12,14].

Therefore, to the best of the researchers knowledge, no study has been published or conducted in Al-Mukalla city on an association between urinary tract infections and diabetes mellitus. This study aimed to determine the prevalence of urinary tract infections and identify possible risk factors and the etiological agents of UTIs and their susceptibility patterns to commonly used antibiotics among diabetes mellitus patients attending Ibn-Sina General Hospital (ISGH) in Al-Mukalla city, Yemen.

MATERIALS AND METHODS

Study design and subjects: A cross-sectional study was conducted at the diabetic clinic in Ibn-Sina General Hospital (ISGH), Hadhramout, Yemen. Patients were enrolled in the research regardless of UTI symptoms. Pre-tested questionnaires were used to collect socio-demographic and clinical data from each patient.

Specimen collection: This study was carried out on 106 urine samples collected from all patients (aged $\geq$20 years) with

diabetes from 1st January-30th March, 2020. Participants were asked to provide a midstream urine sample according to the clean-catch procedure. Samples were collected using a sterile container and transported to the laboratory to estimate UTI among diabetic patients within one hour of collection. The delayed samples were refrigerated at 4°C[10]. Patients with antibiotic therapy were excluded from the present study.

Urine analysis

Urine dipstick chemical analysis (chemistrip): Dipstick urinalysis was done using multistix 10 SG (SD). In brief, the reagent strip contains tests pads for protein, blood, leukocyte, nitrite, glucose, ketone, pH, specific gravity, bilirubin and urobilinogen. In this study, the parameters considered in dipstick analysis were nitrites, leukocyte esterase and pH. Reading time for nitrites and pH is one minute and 2 min for leukocyte esterase. Cutoff values for a positive result are trace or more of leukocyte esterase, alkaline pH and nitrite (+). (Note: Nitrite (–), the negative result does not mean that there are no bacteria in urine because some bacteria have no nitrate-reducing enzymes that reduce nitrate to nitrite).

Microscopic examination: The urine samples were thoroughly mixed and centrifuged at 500-1000 rpm for 5 min. The sediments were investigated by microscope using both 10× and 40× objectives. Urine with >10pus cells (pyuria) per high power field is considered significant. A drop of the urine sample was placed on a glass microscope slide and examined microscopically.

Urine culture: Aliquots of urine samples for culture were tested shortly after collection. The samples were plated parallelly with a calibrated loop (10 µL) on Blood Agar (BA), MacConkey's agar (MCA), chocolate agar, Cysteine Lactose Electrolyte Deficient (CLED), while Nutrient Broth (NB) might be used if necessary. Culture media incubated at 37°C for 24 hrs. After incubation, plates with a single organism growth were selected. A bacterial count of 2 log CFU mL^{-1} or more from a fresh clean-catch urine specimen indicates urinary tract infections. A count of 2 log CFU mL^{-1} could mean illness or contamination. A repeat specimen was displayed. A countless more than 2 log CFU mL^{-1} is nearly always due to contamination, unless the urine was cultured after starting antimicrobial treatment.

Identification of the bacterial isolates: Identification of isolated bacteria has been done using gram stain and biochemical tests. Biochemical tests including catalase test, coagulase test, oxidase test, indole test and citrate as elucidated by Cheesbrough (2010) were carried out on the colonies to ascertain organisms isolated.

Statistical analysis: The data was entered and analyzed using the Statistical Package for Social Science (SPSS version 24) Software Program. The information is presented in tables and graphs using a computer application (Microsoft Excel and Word).

Ethical consideration: An approval project was obtained from Hadhramout University College of Medicine (HUCOM) Medical Laboratories Sciences; informed consent had taken from the management Authority of the diabetic clinic in Ibn-Sina General Hospital. The objectives of the present study are clarified for participants. All the study participants gave verbal informed consent before the initiation of data collection. The data and results obtained in this study were kept confidential and used only for scientific purposes.

RESULTS

The Diabetic Clinic at Ibn-Sina Hospital in Mukalla, Yemen, saw 106 type 1 and 2 diabetic patients during the period from 1st January-30th March, 2020. The data in Table 1 summarized the prevalence of UTI associated with sociodemographic characteristics of diabetic patients. The patients' average age was 50 years. The findings revealed that 53.8% of the 106 samples were male and 46.2% were females. The majority of patients were between the ages of 46 and 55 (33.0%), while the fewest were above 65. (6.6%). The vast majority of them were married (85.8%), on the other hand, most of the patients were illiterate (40.6%), while the fewest were educated (8.4%). Diabetic patients with significant bacteriuria accounted for 21.1% of males and 78.9% of females, respectively. There was no statistically significant relationship between significant bacteriuria and the age, social status, or educational status of the respondents. In this study, 19 (17.9%) was the total number of diabetic patients who had UTI 15 (78.9%) were married.

Table 2 summarize the association between increased urinary bacterial growth and diabetes duration. Patients with diabetes from 1 to 5 years had higher bacterial growth (42.1%), followed 6-10 years (21.1%), 11-15 years (10.5%), >15 years (5.3%).

The frequency of urine bacteria in diabetes individuals are described in Table 3. *Staphylococcus aureus* was the most common (52.38%), followed by *Escherichia coli* (28.58%).

Table 1: Prevalence of UTI associated with sociodemographic characteristics of diabetic patients

	Demographical information		Significant bacteriuria		
Variables	Numbers	Percentage	Positive (%)	Negative (%)	p-value
Gender					
Male	57	53.8	4 (21.1)	53 (60.9)	0.002
Female	49	46.2	15 (78.9)	34 (39.1)	
Age					
<35	14	13.2	2 (10.5)	12 (13.8)	0.330
35-45	21	19.8	2 (10.5)	19 (21.8)	
46-55	35	33.0	7 (36.8)	28 (32.2)	
56-65	29	27.4	8 (42.2)	21 (24.1)	
>65	7	6.6	0 (0.0)	7 (8.0)	
Social status					
Single	9	8.5	4 (21.1)	5 (5.7)	0.125
Married	91	85.8	15 (78.9)	76 (87.4)	
Divorced	2	1.9	0 (0.0)	2 (2.3)	
Widowed	4	3.8	0 (0.0)	4 (4.9)	
Education status					
Illiterate	43	40.6	11 (57.9)	3 (36.8)	0.381
Primary	39	36.8	5 (26.3)	34 (39.1)	
Secondary	15	14.2	1 (5.3)	14 (16.1)	
University	8	8.4	2 (10.5)	6 (6.9)	

Table 2: Association between bacterial urinary tract infection and diabetes duration

Diabetes duration	Bacterial growth	Non-bacterial growth
<1 year	4 (21.1)	17 (19.5)
1-5 years	8 (42.1)	29 (33.3)
6-10 years	4 (21.1)	25 (28.7)
11-15 years	2 (10.5)	5 (5.7)
>15 years	1 (5.3)	11 (12.6)

Table 3: Frequency of urinary bacteria in diabetic patients

	Bacterial urinary tract infection		
Types of bacteria	Significant growth (%)	Non-significant growth (%)	p-value
Staphylococcus aureus	11 (52.38)	0 (0.0)	<0.001
Escherichia coli	6 (28.58)	0 (0.0)	
Streptococcus pyogenes	2 (9.52)	0 (0.0)	
Citrobacter freundii	1 (4.76)	0 (0.0)	
Providencia spp.	1 (4.76)	0 (0.0)	
No growth	0 (0.0)	87 (100.0)	

Table 4: Prevalence of UTI according to glycemic control

	Urinary tract Infection		
HbA1c	Positive (%)	Negative (%)	p-value
Controlled	0 (0.0)	15 (17.2)	0.051
Uncontrolled	19 (100.0)	72 (82.8)	

Table 4 shows the prevalence of UTI according to glycemic control; patients with less controlled glycemic (HbA1c>7) were 19 (100%) compared to well-controlled glycemic groups (HbA1c7) were 0 (0.0%), indicating that diabetes patients with poor glucose control had a higher frequency of UTI.

DISCUSSION

Table 1 shows that diabetes mellitus has long been implicated as a predisposing factor for UTI. In terms of gender, females are more prone to get UTI than males[18,19]. Women are vulnerable to UTIs due to their anatomy and reproductive physiology[20]. Because of the narrow urethra, its proximity to the perirectal area, where pathogen colonies are easier to establish, the lack of bacteriostatic prostatic secretions and sexual intercourse, bacteria may be forced into the female bladder. In the line with prior research, females were shown to have a higher prevalence of UTI than males, with 78.95 and 21.05% respectively[21,22]. UTI was shown to be prevalent in 62.5% of females and 37.5% of males, according to other studies[23,24]. Ijaz *et al.*[25], found similar to those seen in

this study. The prevalence of UTI was determined to be 48.63 and 51.37% for males and females, respectively.

The results indicate that age is an influence in the prevalence of UTI so, the most age groups affected were above 50 years (57.89%), followed by those between 36-50 years (26.32%) and the less affected were between 20-35 years (15.79%). In a study similarly to the current study, the prevalence of UTI in another study was higher (68.6%) in patients >55 years old than in those 41-55 years old (42.9%)[26]. On the other hand, Shah *et al.*[5], discovered a high prevalence of UTI (27.2%) among DM patients aged 41-60 years.

In the current study, the most frequently isolated bacteria were *Staphylococcus aureus* 52.38%, consistent with a previous study done in Ethiopia[26]. Other studies showed that the most frequent isolated bacteria were *Escherichia coli*.

Most of the UTI cases 16 (84.21%) in this study were found in patients with poor glycemic control. At the same time, only 3 (15.79%) cases of UTI were found in patients with reasonable glycemic control. Those patients with poor glycemic control had more risk of getting UTI than suitable glycemic control patients. Poor metabolic control may suppress the immune system. Furthermore, high urine glucose concentration shows significant bacterial growth than normal urine. A high sugar concentration in the urine may serve as an ideal environment for the growth of uropathogenic bacteria[27]. Similarly, other studies also stated the high prevalence of UTI in patients with uncontrolled DM[17,28].

This study was confirmed the association between UTI patients and the diagnostic helpful for diabetic patients. Several clinical parameters as well as socio-demographic variables, have been investigated as potential risk factors for Diabetes Mellitus (DM). When a diabetic's urine analysis is abnormal, it's a sign that something is wrong. a urine culture must be performed to determine the type of pathogen and the relevant drugs. On the other hand, it's also recommends that diabetic patients should be required to follow their diet and medications regularly. Further studies are needed to validate the predictive significance of other DM risk variables and to enhance the diagnosis process.

CONCLUSION

Urinary tract infections are more frequent and likely to be more complicated in patients with diabetes mellitus. Furthermore, the prevalence of UTIs was higher in females than males. *Staphylococcus aureus* was the most frequently isolated bacteria, followed by *Escherichia coli.*

SIGNIFICANCE STATEMENTS

This study discovers the prevalence of UTI among diabetic patients in Ibn-Sina General Hospital (ISGH) in Al-Mukalla city, Hadhramout-Yemen. The most common bacteria found in patients were *S. aureus* followed by *E. coli*. This study will aid researchers in conducting additional research at various hospitals and private clinics to spotlight the Diabetes Mellitus (DM) patients who are also suffering from Urinary Tract Infections (UTI). In addition, this is the first study describing BUTI in Diabetic patients in Hadhramout /Yemen

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