

Studying the clinical and microbiological characteristics of urinary tract infections in people with diabetes mellitus

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Abstract

Objective: According to reports, diabetes mellitus raises the risk of urinary tract infections (UTI) and increases the likelihood of drug-resistant microorganisms. Effective prevention and management require an understanding of the burden, microbiological profile, and antibiotic sensitivity trend. The aim was to evaluate the microbiological makeup and pattern of antibiotic sensitivity of urinary tract infections in people with type 2 diabetes.

Method: The research was prospective observational research conducted on 120 type 2 diabetic patients over the age of 17 who presented to a tertiary care hospital with symptoms of a urinary tract infection. A midstream urine sample was tested using conventional diagnostic procedures for antibiotic sensitivity, culture, and normal urine inspection. For quantitative variables, the mean and standard deviation were used in the descriptive analysis, while frequency and proportion were used for categorical variables.

Results: The study population was 56 years old on average. 62.39% of participants were female. The most typical presenting symptom was burning micturition (52.98%). 51.27% of UTIs tested positive for culture. Escherichia coli (20.50%) and Klebsiella (6.84%) dominated the culture reports for gram-negative bacilli. The predominant gram-positive isolates were Staphylococcus aureus (2.5%) and Enterococcus (4.26%) The most efficient antibiotic against Klebsiella (94%) and E. coli (87.4%) was meropenem. Vancomycin was 99% sensitive to S. aureus and Enterococci.

Conclusion: The majority of gram-negative organisms caused UTIs in more than half of diabetic patients who presented with symptoms. Studies comparing people with diabetes to controls are required to examine the key variations in the pattern of UTIs.

Keywords: Resistance to Antibiotics, A Healthy Culture Resisting Drugs, E. Coli, A Profile Of Microorganisms, And Urinary Tract Infection

Introduction

A metabolic illness called diabetes mellitus causes elevated blood glucose levels, which damage the body generally and particularly cause retinopathy, neuropathy, nephropathy, and cardiac problems. The prevalence of diabetes mellitus has dramatically increased during the last few decades. The IDF Diabetic Atlas estimates that there were 451 million persons worldwide with diabetes in 2017 who were 18 to 99 years old, and that number will rise to 693 million by the year 2045 [1]. According to data standardised for the age range of 20 to 79 years, the global prevalence of diabetes was estimated to be 8.8% in 2017 with a 95% confidence interval of 7.2-11.3% [2].

The total prevalence of diabetes was 73% (95% CI 70%-75%), according to an Indian study conducted by the ICMR [3]. From 4% in Bihar to roughly 10% in Punjab, the percentage fluctuated. In comparison to rural areas, it was higher in cities [3]. Serious ascending urinary tract infections are more likely to occur in diabetes patients [4,5]. These people's greater urine glucose excretion rates contribute to the development of bacteria.

Diabetes is characterised by disruption of the intracellular insulin signalling pathways as well as deficiencies in the innate immune system's defence mechanism against microorganisms [6]. The aetiology of UTI in the diabetic population is heavily influenced by altered bacterial adherence to uroepithelium and granulocyte dysfunction [Figure 1; 7]. In those with diabetes, there is a greater likelihood that antibiotic-resistant bacteria will cause UTI.

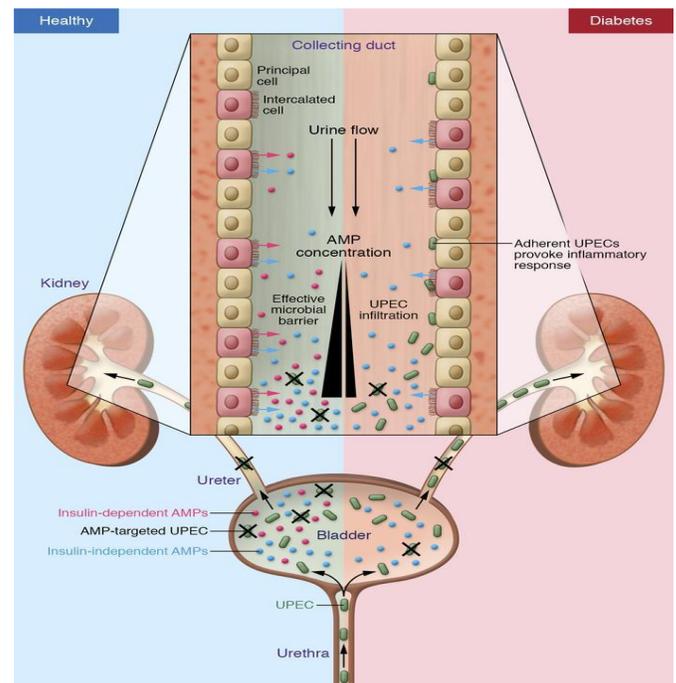


Figure 1: Association of Diabetes and UTI

Diabetes patients have a much higher prevalence of pyelonephritis than individuals without the disease. *E. coli* was the most often isolated organism [8]. Those with diabetes are more likely to develop UTIs due to elevated HbA1c levels (HgbA1c) [8]. When compared to persons without diabetes, diabetic subjects have more severe UTIs that are brought on by microorganisms that are more resistant to treatment [4].

Thus, it is crucial to test diabetic patients for UTI in order to correctly treat bacteriuria and avoid future problems. Nonetheless, there are disagreements regarding the frequency of UTIs with a positive culture in diabetics [9–12]. When antibiotics are used carelessly, urinary bacteria frequently develop greater resistance to the majority of regularly used antimicrobial drugs [13]. Thus, the current study was carried out to evaluate the prevalence of culture-positive urinary tract infections (UTI) among people with type 2 diabetes mellitus who present with UTI symptoms and to examine the

microbiological profile and antibiotic sensitivity pattern among the type 2 diabetic population.

Method

Study Design: The current investigation was an observational prospective study carried out in the Department of Community Medicine, Jannayak Karpoori Thakur Medical College. In the period from February 2021 to January 2022, the study was carried out.

Methodology: Participants in the study were assessed by a thorough clinical history and physical examination. The history of diabetes's duration and associated comorbidities was gathered. All study participants provided a mid-stream urine sample, which was then sent for regular screening, culture testing, and antibiotic sensitivity. Under aseptic conditions, 15 ml of venous blood were drawn and transported for analysis of the FBS, PPBS, HbA1c, blood urea, serum creatinine, haemoglobin, and total leucocyte counts.

Sample size: According to Simkhada R et al., [12] sample size was estimated using a 21% UTI prevalence assumption. 8% absolute precision and a 95% confidence level were the other factors taken into account when determining the sample size. For calculating sample sizes, the formula shown below was utilized. According to prior hospital records, 190 probable anterior uveitis cases were estimated to be present during the data collection period in the study setting. In light of this, a finite population correction was used for 190. According to the computation described above, a minimum of 110 subjects were needed. A minimum sample size of 120 was required to account for a 5% non-participation rate.

Inclusion Criteria: The study cohort consisted of persons over the age of 17, both sexes, with known type

2 diabetes mellitus cases for at least the previous two years with UTI-like symptoms.

Exclusion Criteria: Individuals with type 1 diabetes mellitus, those with a history of hospitalization in the past two months requiring a urinary catheter, and people with any surgical procedure involving the genito-urinary tract were excluded from the study.

Statistical Analysis: Descriptive analysis was carried out using mean and standard deviation for quantitative data, frequency and proportion for categorical variables. The median and Interquartile Range were used to summarise non-normally distributed quantitative values (IQR). Data was also displayed using relevant diagrams, such as box plots, pie charts, and bar charts. Statistics were judged significant at $p < 0.04$. The statistical evaluation was performed using IBM SPSS version 22.

Ethical Committee: The study was approved by Jannayak Karpoori Thakur Medical College and written consent was given by the patients, participating in the study.

Results

The final analysis involved 120 individuals in all. 57.12 ± 11 years old was the average age. 42 (37.60%) of the participants in the study were men, and the rest 78 (62.38%) were women. In the study population, there were 52.98% of cases of burning urination, 41.02% of fever cases, 38.45% of frequency cases, 22.21% of suprapubic pain, 19.65% of urgency cases, 16.23% of incontinence cases, 14.52% of hematuria cases, 8.54% of back pain cases, and 5.97% of flank cases. The average number of years with diabetes was 9.36±4.94. 27.34% of the participants in the study had diabetes that had just been present for a few years. 8.71% and 23.92% of people had diabetes that had been present for more than 11 years, respectively. In the study population,

34.18% of participants took insulin, 31.61% took OHA, and 22.21% took both insulin and OHA (Table 1).

Table 1: Baseline characteristics of Patients

Parameter	Percentage
Gender	
Male	37.60%
Female	62.38%
Age (Mean ± SD)	57.11±12.1
Symptoms	
Burning micturition	52.98%
Fever	41.02%
Frequency	38.45%
Suprapubic pain	22.21%
Urgency	19.65%
Incontinence	16.23%
Hematuria	14.52%
Back pain	8.54%
Flank pain	5.97%
Duration of Diabetes	
<4 years	27.34%
4-11 years	48.71%
>11 years	23.92%
Treatment	
Insulin	34.18
OHA	31.60
No treatment	11.96
Both Insulin and OHA	31.61

The average heartbeat measured 87.18±16.94 beats per minute. The average systolic blood pressure was 117.77±20.5 mm Hg. The average diastolic blood pressure was 76.84±15.02 mm Hg. GHB on average was 8.54±2.52%. FBS was 172.37±73.66 mg/dl on average. PPBS was 225.34±103.90 mg/dl on average. Urea levels averaged 49.37±32.26 mg/dl. Creatinine levels averaged 1.40±1.0 mg/dl. Hemoglobin levels averaged 10.2±2.38

g/dl. WBC on average was 14.7±7.15 T/cumm. Platelets had a mean density of 249.02±114.83 T/cumm. In the study population, 27.34% had good diabetes control (GHB 6.5), 7.08% had acceptable control (GHB 6.5 to 7), 22.21% had sub-optimal control (GHB 7) to 9, and 33.32% had poor control (GHB 9). 5.97% of the participants in the study had severe anaemia, compared to 30.76% who had moderate anaemia, 30.76% who had mild anaemia, and 32.47% who were normal. 18.81% of the participants in the research reported tachycardia.

All 120 participants in the study (100%) had urine with an acidic pH. 74 people (64.11%) in the study population had proteinuria. Of them, only two subjects had grade 4 proteinuria, only 44 (38.45%) had grade 1 proteinuria, 17 (15.37%) had grade 2, 8 (7.68%) had grade 3, and 3 (1.70%) had traces of protein in their urine. Among the participants in the study, 52 (45.2%) had glycosuria.

15.37% of them had grade 1 glycosuria, 13.67% had grade 2, 1.70% had grade 3, and 14.53% had urine with traces of glucose. 47.85% of the study participants had up to 6 WBC in their urine, while 52.13% had more than 7 WBC in their urine. 36.74 percent of the participants in the research had hematuria. Grade 1 hematuria affected 17.94% of them, grade 2 affected 10.25%, and grade 3 affected 8.54%.

Most of the participants in the study produced E. coli in their urine cultures, followed by Insignificant Bacteriuria (8.6%), Klebsiella (7.84%), and Enterococcus (4.26%). (Figure 2).

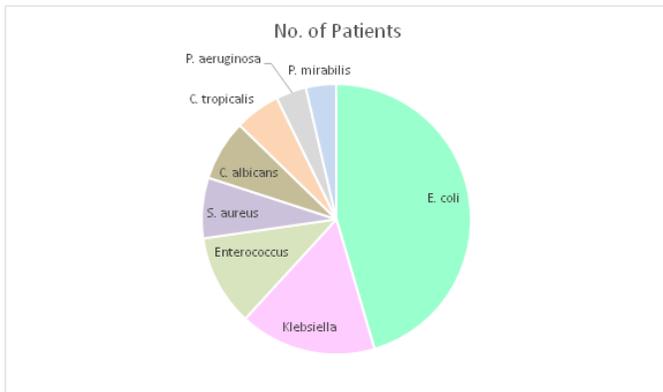


Figure 2: descriptive analysis of isolated organisms

Among the study's participants, 62 (51.27%) was gram-positive, whereas the remaining 58 (48.73%) were gram-negative (Figure 3).

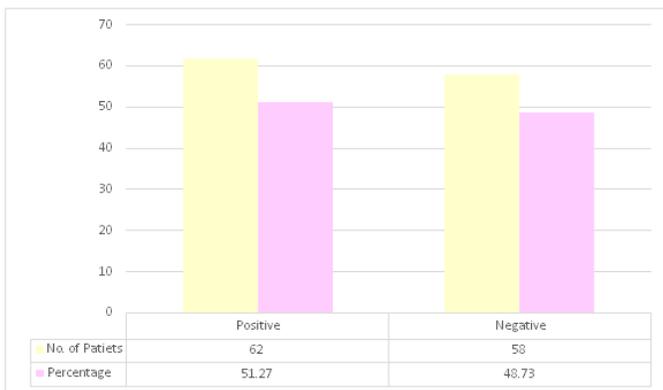


Figure 3: culture in the research population (N=120).

Discussion

Diabetes mellitus patients can develop a variety of UTIs, from asymptomatic bacteriuria to pyelonephritis, renal abscess, and severe urosepsis. Both community- and hospital-acquired urinary tract infections (UTIs) are at risk due to type 2 diabetes mellitus [4, 15–16]. The prevalence of UTIs with a positive culture was 51.28% in this study. In a research on diabetic people older than 60 years old in south India, Sharma S et al. reported a prevalence of 43% [16]. Only 21% of diabetic participants had a culture-positive urinary tract infection, according to a study by Simkhada R et al. in Nepal [12]. They studied 100 individuals, 53 of whom were female, for their study.

There were 120 participants in this study, with women making up the majority (62.38%). This discrepancy might result from the fact that their study was conducted in Nepal among a distinct demographic group that was 80 years of age and older. The population under investigation was 56 years old on average. The most frequent presenting symptom was burning urination (52.98%), which was followed by fever (41.02), frequent urination (38.45%), suprapubic discomfort (22.21%), urgency (19.65%), incontinence (16.24%), and hematuria (14.52%). Burning micturition (90%), increased frequency of micturition (80%), suprapubic pain (60%), urgency (70%), loin pain (30%), and fever (20%) were found to be the most prevalent symptoms in Simkhada R et al's study to be identical to this one [12]. The majority (48.71%) of participants in this study (with a mean diabetes duration of 9.6 years) had the disease for 4 to 11 years.

According to Simkhada R et al findings, 's UTI was more frequent in participants with long-standing diabetes ($p=0.039$) and in those taking insulin than in those on only oral medicines ($p=0.08$) [12]. In this study, 34.18% of the study participants were taking insulin, compared to 31.61% who were taking OHA. In their study, Aswani SM et al. found that the majority of those with diabetes and UTI (87.14%) had HbA1c levels above 6.5% with a p -value of <0.001 [8]. Leukocytosis was seen in 12.3% of patients with non-bacteriuric disease and 30.2% of patients with bacteriuric disease, according to Sharma S et al's study [16].

E. coli was found in the urine cultures of most participants in this study (20.50%). 7.6% of people reported negligible bacteriuria. E. coli (20.50%) and Klebsiella (6.84%) were the most prevalent gram-negative bacteria found in the culture reports.

Enterococcus (4.26%) and Staphylococcus aureus (2.5%) were the most common coliforms found in Gram-positive organisms. Candida albicans and Candida tropicalis were found in 2.5% and 2.7% of the individuals, respectively, among the fungus. E. coli was the most prevalent isolated organism in culture, according to other research that are similar to this one [11,12,16].

E. coli (69.8%) and Klebsiella (16.3%) were the two most frequent causal organisms in urine culture analysis in Sharma S et al study [16]. In their investigation, Sharma S. et al. found that the majority of isolated organisms were susceptible to antibiotics such nitrofurantoin and imipenem [16]. Escherichia coli were the most prevalent bacterium, followed by Klebsiella, proteus, and pseudomonas, according to Simkhada R et al. [12]. The majority of the urine isolates were found to be responsive to ciprofloxacin, cotrimoxazole, and ceftriaxone, but ampicillin resistance was high, according to Simkhada R et al. [12] E. coli and K. pneumoniae were the most common isolate organisms in diabetic people in Sudan, according to Hamdan HZ et al's study [11].

They also noted that gentamicin and cephalexin were completely effective against E. coli. According to the findings of this study, Meropenem is the antibiotic of choice for gram-negative bacteria, followed by Nitrofurantoin. Vancomycin was 99% sensitive to Enterococci and S. aureus in gram-positive organisms. Meropenem was found to be the most efficient antibiotic in this trial against both Klebsiella (94%), and E. coli (87.4%). With sensitivity rates of 79.1% against E. coli, 64% against Klebsiella, 61% against Enterococcus, and 99% against S. aureus, Nitrofurantoin came in second.

Tobramycin was 37.4% sensitive to Klebsiella and 41.6% sensitive to E. coli.

In order to treat urinary tract infections, Meropenem and Nitrofurantoin may be the best antibacterial options. Due to the rise of antimicrobial drug resistance in poor nations, it's critical to pinpoint the risk factors that put a patient at an elevated risk for developing a multidrug-resistant infection. This way, broad-spectrum antibiotics can be saved for use in these individuals. It may be possible to reduce the occurrence of antibiotic resistance by only prescribing broad-spectrum empiric antibiotics to individuals with established risk factors.

Conclusion

A culture-positive UTI was present in more than half (51.27%) of the diabetic patients with suspected UTIs. It's crucial to pinpoint the risk factors for multidrug-resistant infections in diabetic patients so that broad-spectrum antibiotics can be saved exclusively for them.

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