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Culture Positive Urinary Tract Infection in Patients with and Without Diabetes Mellitus

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ABSTRACT

Introduction: One of the leading long-term complications of diabetes mellitus includes renal dysfunction and urinary tract infections (UTI) which are prevalent in uncontrolled diabetes. Moreover, physiological factors like age, gender, duration of diabetes, other diabetic complications like neuropathy, autonomic neuropathy and glycosuria are also considered as predisposing factors for increased prevalence of UTI in diabetes which can be symptomatic or asymptomatic. This study aimed to compare the frequency of culture positive urinary tract infection in patients with and without diabetes mellitus.

Methodology: This descriptive study was carried out at the department of general medicine, DHQ teaching hospital, Timergara during the period 16th March 2023 till 15th March 2024. A total of 270 male and female patients aging more than 40 years, with suspected urinary tract infection were enrolled. Urine culture was performed and growth of microbes (positive culture) was noted. Glycemic status of the patients was confirmed through history taking or biochemically by measuring Hba1c level in blood sample of patients. Presence or absence of diabetes was noted. Data was analysed using SPSS v.26.

Results: The mean age of the participants was 50.60±7.54 years. Participants aging more than 60 years were 79(29.3%) and 157 (58.1%) were male. BMI more than 24.0kg/m^2 was recorded in 141 patients (52.2%) while hypertension was the most frequently recorded comorbidity (n = 56, 20.7%). 63 patients (78.8%) with diabetes had positive urine culture as compared to 17 (21.2%) among patients without diabetes mellitus. The p value for difference in distribution of urine culture was <0.001.

Conclusion: The study identified diabetes as a significant risk factor for positive urine cultures in this middle-aged cohort. The strong association underscores the need for targeted monitoring of urinary tract infections in diabetic patients. Further research should investigate the underlying mechanisms linking diabetes to infection risk. Implementing routine screening in this high-risk group could improve early detection and clinical outcomes

Keywords: *Diabetes Mellitus (DM), Urinary Tract Infection (UTI), Urine Culture*

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1. INTRODUCTION

Diabetes mellitus has evolved into a global illness and almost epidemic in our country with nearly 30.0% population suffering from it, mostly due to lack of exercise and other contributing causes [1, 2]. According to estimations from health data, a significant proportion of of Pakistanis now have type 2 diabetes (T2DM), which is another country where the disease is quite prevalent [3]. Additionally, untreated or uncontrolled hyperglycemia causes micro and macrovascular problems, which increase the risk of early mortality in people with type 2 diabetes [4]. Associated expenses along with access healthcare adds extra difficulties in the management of T2DM patients with various comorbidities [5].

One of the primary long-term consequences of diabetes mellitus involves renal impairment and related urinary tract infections (UTI). High glucose content in urine increases urinary proliferation of bacteria, and the individual grows increasingly susceptible to microvascular conditions of the kidneys. This has also been a serious worry as numerous studies have revealed a high rate of UTI in T2DM patients [6]. Clinical characteristics of individuals with diabetes shows inadequate circulation, diminished immunity due to decreased capacity of white blood cells to combat bacteria, and poor muscles of the urinary tract and consequent dysfunctional bladder are some of the variables that are leading to higher cases of UTI among diabetics [7]. Additionally, physical characteristics such as age, gender, length of diabetes, permanent anti-

diabetic medication usage, and other diabetic sequelae including neuropathy and glycosuria are thought to be risk factors for a higher incidence of UTI in diabetics. Sodium glucose co-transporter 2 inhibitors (SGLT2 inhibitors) are a type of anti-hyperglycaemic drugs that contribute to urinary tract infection. Between 4.0 and 5.7% of these patients have a UTI [8]. According to Johnson and colleagues, 5.7% of T2DM patients on SGLT2 inhibitors had a UTI [9]. No study was carried out comparing the urinary culture findings among patients with and without diabetes in individuals presenting with suspected urinary tract infection in local population as evident from literature search. Hence the study was planned which aimed to compare urine culture findings among patients with and without diabetes mellitus

2. MATERIALS AND METHODS

This descriptive study was conducted at the department of Medicine, DHQ Teaching Hospital, Timergara, during the period 16th March 2023 till 115th March 2024. Male and female patients aging more than 40 years presenting with suspected urinary tract infection were enrolled. Patients were excluded when there was history of antibiotic intake in the preceding one month, patients who were taking SGLT2 inhibitors, immunocompromised patients and patients with obstructive uropathy. The glycemic profile of the patient was recorded and urine sample was sent for culture and sensitivity. Urinary tract infection was defined when patients were complaining of dysuria, urinary frequency and urgency and spot urine R/E showed more than 10 white cells or more than 5 red cells. Based on glycemic profile, patients were defined as diabetic (history of hyperglycemia and hypoglycemic medications intake or Hba1c >6.5%) and non-diabetic (no history of diabetes mellitus and Hba1c <6.5%). Urine culture was recorded as positive (growth of microbes) and negative (absence of growth of microbes). The sample size was 270 determined using WHO sample size calculator taking anticipated proportion of UTI as 53.5%,[9] 6% margin of error and 95% confidence level. Participants were enrolled using non probability consecutive sampling technique.

Prior approval for conducting the study was obtained following which patients were enrolled from indoor and outdoor department of the hospital. Informed written consent was taken from enrolled participants. Baseline information like age, gender, BMI and residence was recorded. History was taken from the patient about diabetes mellitus or antihypoglycemic medications. Medications record was record was reviewed for confirmation. 05cc blood sample was taken from the patient and sent to hospital lab for estimation of Hba1c level. Based on these findings, patients were categorized as diabetic and non-diabetics. A 10cc mid stream urine sample was collected in an air tight sterile jar which was sent for culture and sensitivity. Presence or absence of growth of microbes on urine culture was recorded.

Data analysis was carried out using SPSS v. 26. Frequencies and percentages were recorded for qualitative variables including gender, diabetes and non-diabetes and urine culture status. Mean and standard deviations was calculated for quantitative variables like age and BMI. Effect modifiers like age and gender were controlled through stratification. Post stratification chi square test was applied at 5% significance level.

3. RESULTS

The mean age of the participants was 50.60±7.54 years. Participants aging more than 60 years were 79(29.3%) and 157 (58.1%) were male. BMI more than 24.0kg/m^2 was recorded in 141 patients (52.2%) while hypertension was the most frequently recorded comorbidity (n = 56, 20.7%) as reported in table 2.

Table 2. Baseline characteristics of study participants (n = 270)

Baseline characteristics		Frequency	Percent
Gender	Male	157	58.1
	Female	113	41.9
Age (years) (50.60±7.54 years)	60 or below	191	70.7
	Above 60	79	29.3
BMI (kg/m^2)	24.0 or below	129	47.8
	Above 24.0	141	52.2
Residence	Rural	173	64.0
	Urban	97	36.0
Comorbidities	Hypertension	56	20.7

	IHD	31	11.5
	Asthma	14	5.2
	COPD	19	7.0
	Malignancy	03	0.01
	Nil	147	54.4

Out of the total 270 patients, 160 (59.2%) were diabetics and 110 (40.8%) were non diabetics. Urine culture was positive in 80 participants (29.6%) as shown in table 2.

Table 2. Distribution of patients according to outcome variables (n = 270)

Outcome variables		Frequency	Percent
Glycemic profile	Diabetic	160	59.2
	Non-diabetic	110	40.8
Urine culture	Positive	80	29.6
	Negative	190	70.4

63 patients (78.8%) with diabetes had positive urine culture as compared to 17 (21.2%) among patients without diabetes mellitus. The p value for difference in distribution of urine culture was <0.001 as reported in table 3.

Table 3. 2x2 table analysis of glycemic profile with urine culture (n = 270)

		Glycemic status			
		Diabetic (n = 160)	Non diabetic (n = 110)		
Urine culture	Positive	63 (78.8%)	17 (21.2%)	80(100.0%)	p value = <0.001
	Negative	97 (51.0%)	93 (49.0%)	190(100.0%)	

Among patients aging 60 years or below, 47 patients (42.7%) had positive culture compared to 12 patients (14.8%) without diabetes (p value 0.066). Similarly statistically insignificant difference in distribution of positive urine culture among diabetics and non-diabetics was recorded among patients aging more than 60 years as illustrated in table 4

Table 4. Stratification of urine culture in diabetic and non-diabetic with respect to age (n = 270, diabetics = 160, non-diabetic = 110)

Age (years)	Glycemic profile	Culture			P value
		Positive	Negative	Total	
60 or below	Diabetic	47 (42.7%)	63 (57.3%)	110 (100.0%)	0.066
	Non-diabetic	12 (14.8%)	69 (85.2%)	81 (100.0%)	
	Total	59 (30.9%)	132 (69.1%)	191 (100.0%)	

Above 60	Diabetic	13 (26.0%)	47 (74.0%)	50 (100.0%)	0.374
	Non-diabetic	08 (27.6%)	11 (72.4%)	29 (100.0%)	
	Total	21 (26.6%)	58 (73.4%)	79 (100.0%)	

Gender wise distribution of positive urine culture among patients with and without diabetes did not reach statistical significance (p value >0.05) as shown in table 5.

Table 5. Stratification of urine culture in diabetic and non-diabetic with respect to gender (N = 270, diabetics = 160, non-diabetic = 110)

Gender	Glycemic status	Urine culture		Total	P value
		Positive	Negative		
Male	Diabetic	38 (38.8%)	60 (61.2%)	98 (100.0%)	0.531
	Non-diabetic	17 (28.8%)	42 (71.2%)	59 (100.0%)	
	Total	55 (35.0%)	102 (65.0%)	157 (100.0%)	
Female	Diabetic	22 (35.5%)	40 (64.5%)	62 (100.0%)	0.358
	Non-diabetic	03 (5.9%)	48 (94.1%)	51 (100.0%)	
	Total	25 (22.1%)	88 (77.9%)	113 (100.0%)	

4. DISCUSSION

Urinary tract infections (UTIs) represent a significant burden on global healthcare systems, contributing to substantial morbidity, antibiotic use, and economic costs [10,11]. Patients with diabetes mellitus (DM) are widely considered a high-risk group for developing UTIs and experiencing worse outcomes, including severe pyelonephritis, bacteremia, and antimicrobial resistance [1, 7]. The pathophysiological link is multifactorial, involving immune dysfunction, glucosuria promoting bacterial growth, and autonomic neuropathy leading to bladder dysfunction. Despite established knowledge, contemporary and locale-specific data are essential to understand current epidemiological trends, especially given the rising global prevalence of diabetes and evolving patterns of antimicrobial resistance.

The primary finding of this study confirms a strong and statistically significant association between diabetes and positive urine culture. The proportion of positive cultures was substantially higher in the diabetic group compared to the non-diabetic group, with a p-value <0.001. This result aligns with recent large-scale studies. For instance, a 2021 systematic review and meta-analysis by Salari et al. concluded that diabetes is a significant risk factor for both asymptomatic bacteriuria and symptomatic UTIs across diverse populations, reinforcing the persistent relevance of this association in modern cohorts [1]. Furthermore, a 2023 nationwide cohort study by Chen et al. demonstrated that individuals with type 2 diabetes had a markedly increased risk of severe UTIs requiring hospitalization compared to matched controls without diabetes, highlighting the clinical gravity of this link [2].

Subgroup analyses provided important insights into demographic modifiers of risk. Age stratification revealed that the

significant disparity in culture positivity was most pronounced in patients aged 60 years or younger. In contrast, the difference was attenuated and non-significant in patients older than 60. This finding suggests that in older adults, the risk attributable to diabetes may become superimposed upon, or even overshadowed by, other age-related urological risk factors, such as prostatic hyperplasia, increased catheter use, and functional decline. This nuance is supported by recent geriatric-focused research, such as the 2022 study by Gbinigie et al., which, while focused on diagnostics, highlights the complex interplay of comorbidities in older populations [3].

The gender-based analysis yielded a particularly striking result. While diabetic males showed a non-significant trend towards higher culture positivity, diabetic females exhibited a dramatically higher prevalence compared to their non-diabetic counterparts. This amplifies the well-established female predisposition to UTIs, suggesting a synergistic effect between female anatomy and the diabetic state [12]. Recent research underscores this interaction. A 2020 longitudinal analysis by Jørgensen et al. found that women with diabetes not only had a higher incidence of UTIs but also experienced more frequent recurrences and were more likely to be infected with antibiotic-resistant pathogens compared to women without diabetes, emphasizing a critical area for targeted clinical management [4].

It is important to contextualize our findings within the contemporary challenge of antimicrobial resistance (AMR). Diabetes is increasingly recognized as an independent risk factor for infections caused by multidrug-resistant organisms (MDROs) [13]. A 2021 study by Tien et al. found that diabetic patients with healthcare-associated UTIs were more likely to have infections caused by extended-spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae [5]. This underscores that the implications of a positive urine culture in a diabetic patient extend beyond simple prevalence, encompassing more complex treatment challenges and potentially worse prognoses [11].

In conclusion, this study provides contemporary evidence reinforcing diabetes as a major risk factor for bacteriuria, consistent with other recent regional studies [6]. The results validate current clinical guidelines that advocate for a lower threshold to investigate potential UTIs in diabetic patients [7, 9]. The amplified risk observed in females and younger-to-middle-aged adults with diabetes highlights specific subgroups that may benefit from enhanced surveillance and proactive management strategies. Future research should focus on longitudinal outcomes, pathogen profiles, and the impact of glycemic control on infection risk and resistance patterns to further refine personalized preventive and therapeutic approaches.

5. CONCLUSION

This study reveals a significant association between diabetes mellitus and positive urine culture results among the participant cohort. The vastly higher prevalence of positive cultures in diabetic patients compared to non-diabetic patients was statistically significant, suggesting diabetes is a major risk factor for urinary tract infections in this population. The cohort, characterized by a middle-aged, predominantly male group with a high prevalence of overweight/obesity and hypertension, provides a clinical context where diabetes appears to be a key determinant of microbiologically confirmed urinary infection. These findings underscore the importance of vigilant screening and proactive management of urinary tract infections in patients with diabetes

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