URINARY TRACT INFECTIONS IN TYPE 2 DIABETES: AN ANALYSIS OF PREVALENCE AND CONTRIBUTING FACTORS

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ABSTRACT

Background: *Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder with rising global prevalence, frequently associated with complications such as urinary tract infections (UTIs). Diabetic patients are more susceptible to UTIs due to impaired immune responses, glycosuria, and bladder dysfunction, resulting in more frequent, severe, and recurrent infections.*

Objective: *This study aimed to assess the prevalence, risk factors, and microbial etiology of UTIs among patients with T2DM presenting with clinical features suggestive of infection.*

Methods: *A prospective observational study was conducted at the Teerthanker Mahaveer University College of Paramedical Sciences and the Department of Microbiology, Teerthanker Mahaveer Hospital & Research Centre, Moradabad. A total of 158 T2DM patients aged above 18 years with symptomatic features of UTI were enrolled. Midstream urine samples were collected aseptically and analyzed using standard microbiological techniques including culture on CLED agar, wet mount microscopy, and Gram staining. Significant bacteriuria was defined as colony growth ≥10⁵ CFU/ml based on Kass criteria.*

Results: *Of the 158 urine samples, 40 (25.31%) showed significant bacteriuria. The prevalence was highest among patients aged >35 years. Gram-negative bacteria accounted for 65% of isolates, with Escherichia coli being the most common pathogen (52.5%), followed by Staphylococcus aureus (12.5%) and Pseudomonas aeruginosa (10%). Gram-positive organisms comprised 35% of isolates.*

Conclusion: *The study reveals a notable prevalence of UTIs among T2DM patients, particularly in older adults. E. coli remains the predominant uropathogen. Early microbiological evaluation and culture-guided antimicrobial therapy are crucial for managing UTIs in diabetics. Routine screening and timely diagnosis can significantly reduce complications and improve clinical outcomes in this high-risk population.*

Keywords*: Urinary Tract Infection, Diabetes Mellitus, Asymptomatic Bacteriuria, Bacterial Uropathogens, Glycemic Control*

INTRODUCTION

The term Diabetes Mellitus originates from two languages: the Greek word diabetes, meaning "to siphon" (referring to excessive urination), and the Latin word mellitus, meaning "sweetened" (indicating the presence of glucose in urine). It is currently one of the most common endocrine disorders, with its prevalence increasing significantly due to sedentary lifestyles and dietary shifts, especially in industrialized nations. Type 2 diabetes mellitus (T2DM), the most common form of the disease, is a progressive metabolic disorder characterized by insulin resistance, impaired insulin secretion, and excessive hepatic glucose production. In 2015, approximately 415 million individuals were living with type 2 diabetes worldwide—a figure projected to rise to 642 million by 2040. T2DM is associated with multiple complications, including cardiovascular disease, nephropathy, retinopathy, neuropathy, and an increased susceptibility to infections, particularly urinary tract infections (UTIs).

UTIs are the most frequently reported infections among individuals with T2DM. An estimated 150 million people worldwide are affected by UTIs annually. These infections can range from asymptomatic bacteriuria to symptomatic lower UTIs (cystitis), pyelonephritis, and severe urosepsis. Diabetic individuals are particularly vulnerable due to factors such as impaired immune response, glycosuria, autonomic neuropathy leading to bladder dysfunction, and poor glycemic control. Women are more prone to UTIs than men due to anatomical differences, including a shorter urethra and its proximity to the anus. In diabetics, UTIs are not only more common but also tend to be more severe and recurrent. Complications such as renal abscesses, emphysematous cystitis, and renal papillary necrosis are more prevalent in diabetic patients than in the general population.

T2DM is also a recognized risk factor for catheter-associated UTIs, healthcare-associated UTIs, and recurrent post-transplant UTIs. Furthermore, the incidence of fungal UTIs, particularly due to Candida species, is higher in diabetic individuals. Proper diagnosis and management of UTIs in diabetic patients are essential to prevent complications and reduce morbidity. Common symptoms include dysuria, urgency, frequency, and suprapubic discomfort, though neuropathic patients may exhibit atypical presentations. Hence, timely urine analysis and microbiological evaluation are crucial, especially in symptomatic or high-risk individuals.

MATERIAL & METHOD

This prospective and observational study was meticulously carried out over a defined period in the Teerthanker Mahaveer University College of Paramedical Sciences at Teerthanker Mahaveer University & Bacteriology section of the Department of Microbiology at Teerthanker Mahaveer Hospital & Research Centre, Moradabad. The primary aim of the research was to evaluate the prevalence, risk factors, and microbial etiology of urinary tract infections (UTIs) among patients diagnosed with Type 2 Diabetes Mellitus. A total of 158 patients were enrolled in the study, all of whom were aged above 18 years and exhibited either symptomatic or clinically suggestive features of UTI, including dysuria, increased urinary frequency, urgency, suprapubic discomfort, and occasionally fever. Inclusion in the study was based on well-defined criteria focusing exclusively on patients with Type 2 Diabetes Mellitus, while strict exclusion was applied to individuals with Type 1 diabetes, non-diabetic participants, and patients under 18 years of age to maintain consistency in data collection and eliminate confounding variables.

Each patient was instructed to provide a midstream urine sample, collected under aseptic conditions into sterile, leak-proof containers to prevent contamination. In cases where immediate sample processing (within 1–2 hours) was not possible, the samples were either stored at 4°C to prevent overgrowth of bacteria or chemically preserved using boric acid, as per standard clinical laboratory practices. Following collection, urine samples underwent a series of standard microbiological investigations. For culture and isolation, each sample was carefully inoculated onto CLED (Cysteine Lactose Electrolyte Deficient) agar using a calibrated nichrome loop delivering 0.001 mL of urine, ensuring accurate quantification of bacterial load. Plates were then incubated aerobically at 37°C for 24 hours. Based on the Kass Criteria (1956), the presence of bacterial colonies exceeding 10^5 colony-forming units (CFU/ml) was interpreted as significant bacteriuria, indicative of infection rather than contamination. In addition, wet mount microscopy of centrifuged urine sediments was conducted to identify the presence of red blood cells (RBCs), white blood cells (WBCs), epithelial cells, and casts, which could support the diagnosis of infection or inflammation. For preliminary bacterial identification, Gram staining was employed to categorize isolates based on their cell wall structure: Gram-positive organisms retained the primary crystal violet stain and appeared purple, whereas Gram-negative bacteria took up the safranin counterstain, appearing pink under the microscope.

RESULT

A total of 158 Type 2 diabetic patients were enrolled in this study to assess the prevalence and causative agents of urinary tract infections (UTIs). The findings are summarized below.

Bacteriuria Status	Number of Patients	Percentage (%)
Significant Bacteriuria	40	25.31%
Without Bacteriuria	118	74.68%
Total	**158**	**100%**

Table 1: Number of Patients with Bacteriuria (n = 158)

In this study, 25.31% of patients exhibited significant bacteriuria, while 74.68% showed no bacteriuria.

Age Group (Years)	Total Cases (%)	Significant Bacteriuria (%)
21–25	12 (7.5%)	1 (0.63%)
26–30	30 (18.98%)	3 (1.89%)
31–35	50 (14.87%)	14 (8.86%)
>35	66 (41.77%)	22 (13.92%)
Total	**158 (100%)**	**40 (100%)**

Table 2: Age-wise Distribution of Significant Bacteriuria

The majority of patients with significant bacteriuria belonged to the age group above 35 years (13.92%), followed by the 31–35 years group (8.86%).

Organism Type	Number	Percentage (%)
Gram-negative	26	65%
Gram-positive	14	35%
Total	**40**	**100%**

Table 3: Distribution of Gram-negative and Gram-positive Isolates

Gram-negative organisms accounted for the majority (65%) of isolates, while Gram-positive organisms represented 35%.

Organism	Number	Percentage (%)
Gram-Negative Bacteria (GNB)		
Escherichia coli	21	52.5%
Klebsiella pneumoniae	3	7.5%
Pseudomonas aeruginosa	4	10%
Acinetobacter spp.	2	5%
Gram-Positive Bacteria (GPB)		
Staphylococcus aureus	5	12.5%
Staphylococcus saprophyticus	3	7.5%
Enterococcus spp.	2	5%
Total	**40**	**100%**

Table 4: Bacterial Organisms Isolated in Significant Bacteriuria Cases (n = 40)

Among all isolated organisms, E. coli **was the most predominant pathogen**, responsible for 52.5% of infections, followed by S. aureus (12.5%), P. aeruginosa (10%), and others in smaller proportions.

DISCUSSION

The present study was conducted over a six-month period, from January to June 2022, at Teerthanker Mahaveer Hospital & Research Centre, Moradabad. A total of 158 urine samples were collected from patients diagnosed with Type 2 Diabetes Mellitus (T2DM) presenting with symptoms of urinary tract infection (UTI). Among these, 40 samples (25.31%) demonstrated significant bacteriuria. This prevalence aligns closely with similar findings reported in previous studies. For instance, OM Rahiman F et al. reported a 27.34% prevalence of symptomatic UTIs among T2DM patients, while Kant S et al. found a slightly lower rate at 23.3%. Thakur S et al. observed a higher prevalence of 30.23%, and Rizvi M et al. reported 24.2% of symptomatic bacteriuria in diabetic individuals. These findings suggest a consistent burden of UTI among the T2DM population across different settings.

In the current investigation, the majority of patients with significant bacteriuria were above 40 years of age, accounting for 13.92% of the total cases. This was followed by the 31–35 age group (8.86%), 26–30 years (1.89%), and 21–25 years (0.63%). Our findings are supported by Ranjan A et al., who noted the highest incidence of UTI in patients older than 40 years (14.32%), and similar age-related trends were also reported by Sujatha R et al., where the maximum prevalence (20.92%) was seen in the above-45 age group, followed by 31–40 years (16.93%).

n terms of microbial etiology, Escherichia coli was the most commonly isolated uropathogen, accounting for 52.5% of the total isolates. This was followed by Staphylococcus aureus (12.5%), Pseudomonas aeruginosa (10%), Klebsiella pneumoniae (7.5%), Staphylococcus saprophyticus (7.5%), Enterococcus spp. (5%), and Acinetobacter spp. (5%). These results are consistent with studies by Eshwarappa M. et al., who reported E. coli as the predominant isolate (57.3%), and MP Srinath et al., who reported a similar trend with E. coli at 55.3%. Likewise, Samage PM et al. found E. coli in 50.3% of UTI cases among diabetics.

Regarding Gram classification, our study revealed that Gram-negative organisms accounted for 65% of the isolates, while Gram-positive organisms represented 35%. These proportions are in agreement with Thattil SJ et al., who reported 66% Gram-negative and 33% Gram-positive organisms, and OM Rahiman R et al., who found 63% Gram-negative and 32% Gram-positive isolates.

These results collectively highlight the significant prevalence of UTIs in T2DM patients, particularly in older age groups, and reinforce the dominance of Gram-negative organisms—especially E. coli—as the primary causative agents. The findings emphasize the importance of early diagnosis, regular screening, and appropriate antimicrobial stewardship in managing UTIs among diabetic populations.

CONCLUSION

The present study highlights a significant association between Type 2 Diabetes Mellitus and urinary tract infections, with a prevalence of 25.31% significant bacteriuria among the study population. The incidence of UTI was highest among patients aged above 40 years, indicating age as a major contributing risk factor. Gram-negative bacteria, particularly Escherichia coli, were identified as the most common uropathogens, followed by Staphylococcus aureus and Pseudomonas aeruginosa. These findings are consistent with previous research and underscore the importance of early detection and proper microbiological evaluation in diabetic patients to prevent complications arising from undiagnosed or improperly treated UTIs. Regular screening, especially in asymptomatic individuals with diabetes, along with appropriate antimicrobial therapy based on culture and sensitivity, is essential for effective management and improved patient outcomes.

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