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ORIGINAL ARTICLE

Diabetic versus Non-Diabetic Patients with Complicated Urinary Tract Infections: A Prospective Comparative Study

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ABSTRACT

Background: Complicated urinary tract infections (cUTIs) are associated with structural, functional, or systemic risk factors and are more severe than uncomplicated UTIs. Diabetes mellitus is a major predisposing factor, leading to impaired immunity, urinary stasis, and increased susceptibility to multidrug-resistant pathogens. This study aimed to compare clinical presentation, microbiological profile, treatment requirements, complications, and outcomes of cUTIs in diabetic versus non-diabetic patients.

Methods: This prospective observational study was conducted at the Department of Urology, Gomal Medical College, DI Khan, from January 2023 to September 2023. A total of 134 adult patients with cUTIs were enrolled, comprising 67 diabetics (Group A) and 67 non-diabetics (Group B). Data on demographics, clinical features, laboratory investigations, urine culture results, antibiotic therapy, hospital stay, complications, and outcomes were collected. Statistical analysis was performed using SPSS, with p-values <0.05 considered significant.

Results: Diabetic patients were older (54.2 ± 11.5 vs 47.5 ± 12.2 years) and more frequently presented with systemic symptoms such as fever (85.1% vs 73.1%) and flank pain (77.6% vs 61.2%). *Escherichia coli* was the predominant pathogen in both groups, while multidrug-resistant organisms were more common in diabetics (34.3% vs 14.9%). Diabetics required intravenous antibiotics more often (79.1% vs 56.7%) and had longer hospital stays (7.9 ± 3.1 vs 5.7 ± 2.4 days). Complications, including acute kidney injury and sepsis, were higher in diabetic patients. Complete recovery was achieved in 71.6% of diabetics versus 85.1% of non-diabetics.

Conclusion: Diabetic patients with cUTIs exhibit more severe clinical presentations, higher prevalence of resistant pathogens, prolonged hospitalization, and slightly worse outcomes compared to non-diabetic patients. Early recognition, culture-guided therapy, and optimized glycemic control are essential to improve management and reduce complications in high-risk populations.

Keywords: Complicated urinary tract infection, diabetes mellitus, multidrug-resistant organisms, hospitalization, outcomes.

INTRODUCTION

Complicated urinary tract infections (cUTIs) represent a significant burden in modern clinical practice, particularly in populations with predisposing comorbidities such as diabetes mellitus. Unlike uncomplicated UTIs, which occur in otherwise healthy individuals with a structurally and functionally normal urinary tract, cUTIs are associated with anatomical or functional abnormalities, systemic comorbidities, or immunosuppression that can compromise host defense mechanisms[1]. These infections often result in more severe clinical manifestations, higher rates of antimicrobial resistance, and increased healthcare utilization, including hospitalization, prolonged antibiotic therapy, and invasive interventions. Understanding the differential characteristics and outcomes of cUTIs among various patient populations is critical for optimizing clinical management and improving patient outcomes[2].

Diabetes mellitus is one of the most common chronic diseases worldwide and is well recognized as a significant risk factor for urinary tract infections. Hyperglycemia impairs innate immune responses, including neutrophil chemotaxis, phagocytosis, and bactericidal activity, leading to increased susceptibility to infections[3]. Additionally, autonomic neuropathy, which is common in long-standing diabetes, can lead to impaired bladder emptying and urinary stasis, further predisposing individuals to bacterial colonization and recurrent infections. Diabetic patients are therefore at higher risk of developing both uncomplicated and complicated UTIs, with a higher incidence of pyelonephritis, urosepsis, and infection with multidrug-resistant organisms[4]. Several studies have demonstrated that diabetic patients with UTIs experience more severe symptoms, longer durations of illness, and poorer response to conventional therapies compared to non-diabetic individuals.

The microbiological profile of cUTIs in diabetic patients is often distinct from that in non-diabetic individuals[5]. While *Escherichia coli* remains the predominant pathogen in both groups, diabetics are more frequently infected with resistant strains, including extended-spectrum beta-lactamase (ESBL) producing *E. coli* and other gram-negative bacteria such as *Klebsiella* and *Proteus* species[6]. The increased prevalence of resistant organisms in diabetics is attributable not only to altered host defenses but also to frequent prior antibiotic exposure, recurrent infections, and hospitalizations. This presents significant therapeutic challenges, as empiric antibiotic regimens commonly used in non-diabetic patients may be ineffective in diabetic populations, necessitating culture-guided therapy and close monitoring for treatment failure or recurrence[7].

Clinically, cUTIs in diabetic patients often present with more severe symptoms, including high-grade fever, flank pain, dysuria, and systemic manifestations such as malaise, hypotension, or even septic shock. In contrast, non-diabetic patients may present with more localized urinary symptoms and generally have a milder clinical course. Laboratory investigations frequently reveal higher leukocyte counts, elevated inflammatory markers, and, in some cases, impaired renal function in diabetic patients, reflecting both the severity of infection and underlying comorbid organ dysfunction. Imaging studies, including ultrasonography or computed tomography, are often required to detect anatomical complications such as renal abscesses, obstruction, or emphysematous pyelonephritis, which are more common in diabetics[8].

Hospitalization rates and length of stay are also significantly higher in diabetic patients with cUTIs. Studies have reported that diabetic patients require longer courses of intravenous antibiotics, more frequent catheterization, and closer monitoring for complications such as acute kidney injury or urosepsis[9]. Moreover, recurrent infections are more common, leading to repeated healthcare encounters and higher healthcare costs. Non-diabetic patients generally experience a shorter duration of illness, more rapid symptomatic improvement, and fewer complications, highlighting the need for risk stratification and individualized management approaches[10].

The rising prevalence of diabetes worldwide underscores the importance of understanding its impact on cUTI epidemiology, clinical presentation, microbiology, and outcomes. In regions such as Pakistan, where diabetes prevalence is increasing alongside limited healthcare resources, early identification and management of high-risk patients are critical to reducing morbidity and mortality[11].

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Despite advances in antimicrobial therapy and diagnostic modalities, the management of cUTIs in diabetic patients remains challenging due to frequent antimicrobial resistance, delayed presentation, and underlying comorbidities that complicate treatment.

Existing literature has examined the differences between diabetic and non-diabetic patients with urinary tract infections; however, most studies have focused on uncomplicated UTIs or retrospective analyses with heterogeneous populations. There is a relative paucity of prospective, comparative data specifically evaluating the clinical course, microbiological patterns, treatment response, and outcomes of cUTIs in diabetics versus non-diabetics in a single-center, standardized setting. Such data are essential to guide empiric antibiotic selection, optimize therapeutic strategies, anticipate complications, and inform preventive measures such as glycemic control, patient education, and follow-up protocols[12].

Furthermore, the emergence of multidrug-resistant organisms as a major threat to effective management of cUTIs necessitates a detailed understanding of pathogen prevalence, resistance patterns, and risk factors for treatment failure in diabetic populations. By comparing outcomes between diabetic and non-diabetic patients, clinicians can identify high-risk groups requiring more aggressive management, tailored antimicrobial regimens, and closer monitoring to prevent complications and recurrence[13].

In light of these considerations, this study aims to provide a comprehensive comparative evaluation of diabetic versus non-diabetic patients with complicated urinary tract infections, focusing on demographic characteristics, clinical presentation, laboratory and microbiological findings, treatment modalities, complications, and clinical outcomes. The findings of this study are expected to enhance understanding of the unique challenges posed by diabetes in the management of cUTIs and to inform evidence-based, patient-centered strategies for improving outcomes in high-risk populations.

METHODS

This prospective observational study was conducted in the Department of Urology, Gomal Medical College, DI Khan, from January 2023 to September 2023. Ethical approval was obtained from the institutional review board prior to commencement, and written informed consent was obtained from all participants after explaining the objectives, procedures, and potential risks of the study. A total of 134 adult patients diagnosed with complicated urinary tract infections (cUTIs) were enrolled consecutively during the study period. Patients were categorized into two groups based on diabetic status: Group A – Diabetic patients (n=67) and Group B – Non-diabetic patients (n=67).

Adult patients aged 18 years and above with symptomatic cUTI, defined according to European Association of Urology (EAU) and Infectious Diseases Society of America (IDSA) guidelines as urinary tract infection associated with structural or functional urinary tract abnormalities, comorbidities, immunosuppression, or systemic infection, were included. Only patients with positive urine cultures and clinical symptoms such as dysuria, frequency, urgency, flank pain, or fever were enrolled. Patients with uncomplicated UTI, pregnancy, recent urological surgery (within one month), end-stage renal disease on dialysis, active malignancy, or those refusing participation were excluded.

Demographic and clinical data were recorded, including age, gender, comorbidities, presenting symptoms, duration of illness, and previous history of UTIs. Laboratory investigations included urinalysis, urine culture and sensitivity, complete blood count, serum creatinine, and blood glucose to confirm diabetic status. Imaging studies such as ultrasonography or computed tomography were performed when indicated to assess structural abnormalities, obstruction, renal involvement, or abscess formation. Urine cultures were performed using standard laboratory techniques. Pathogens were identified, and antibiotic susceptibility testing was performed according to Clinical and Laboratory Standards Institute (CLSI) guidelines. Multidrug-resistant organisms were defined as pathogens resistant to three or more classes of antibiotics.

Patients were managed according to institutional protocols, which included empiric intravenous or oral antibiotics adjusted based on culture sensitivity results, supportive therapy including hydration, glycemic control for diabetic patients, and analgesics. Urological interventions, such as catheterization, percutaneous drainage, or surgical procedures, were performed when clinically indicated. Patients were monitored for clinical response, including resolution of symptoms, normalization of laboratory parameters, and duration of hospital stay. Complications such as acute kidney injury, sepsis, or recurrence of infection were documented. Treatment outcomes were classified as complete recovery, partial recovery, or mortality.

Data were analyzed using SPSS version 25. Continuous variables were presented as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Comparisons between diabetic and non-diabetic groups were performed using the independent t-test for continuous variables and chi-square test for categorical variables. A p-value less than 0.05 was considered statistically significant. This study design allowed for a comprehensive comparative evaluation of clinical characteristics, microbiological patterns, treatment response, complications, and outcomes in diabetic versus non-diabetic patients with cUTIs within a standardized tertiary care setting.

RESULTS

A total of 134 patients with complicated urinary tract infections were included in the study, with 67 patients in the diabetic group (Group A) and 67 patients in the non-diabetic group (Group B). The mean age of diabetic patients was higher than that of non-diabetic patients (54.2 ± 11.5 vs 47.5 ± 12.2 years). Male predominance was observed in both groups. Diabetic patients more frequently presented with systemic symptoms such as fever and flank pain, whereas dysuria and urinary frequency were similarly distributed between the groups. A history of recurrent UTIs was more common in diabetic patients.

The most common causative organism in both groups was *Escherichia coli*, followed by *Klebsiella* and *Proteus* species. Multidrug-resistant (MDR) organisms were more frequently isolated in diabetic patients.

Diabetic patients more frequently required intravenous antibiotics and had longer hospital stays compared to non-diabetic patients.

Complications were more common in diabetic patients, particularly acute kidney injury (AKI) and sepsis, while recurrence rates were slightly higher in diabetics.

Treatment outcomes were generally favorable in both groups; however, complete recovery was more frequent in non-diabetic patients, while partial recovery and complications were slightly higher among diabetics.

Overall, diabetic patients with complicated urinary tract infections demonstrated more severe clinical presentations, higher prevalence of multidrug-resistant pathogens, longer hospital stays, and slightly worse outcomes compared to non-diabetic patients. Non-diabetic patients had more rapid recovery, lower complication rates, and a higher proportion of complete clinical resolution.

Table 1: Baseline Demographic and Clinical Characteristics

Variable	Diabetic (n=67)	Non-Diabetic (n=67)
Mean Age (years ± SD)	54.2 ± 11.5	47.5 ± 12.2
Male (%)	44 (65.7%)	42 (62.7%)
Fever (%)	57 (85.1%)	49 (73.1%)
Flank Pain (%)	52 (77.6%)	41 (61.2%)
Dysuria (%)	46 (68.7%)	44 (65.7%)
History of recurrent UTI (%)	28 (41.8%)	15 (22.3%)

Table 2: Microbiological Profile

Pathogen	Diabetic (n=67)	Non-Diabetic (n=67)
E. coli	42 (62.7%)	45 (67.2%)
Klebsiella	15 (22.3%)	10 (14.9%)
Proteus	6 (9%)	5 (7.5%)
MDR organisms	23 (34.3%)	10 (14.9%)

Table 3: Treatment and Hospital Stay

Parameter	Diabetic	Non-Diabetic
IV antibiotics required	53 (79.1%)	38 (56.7%)
Hospital stay (days ± SD)	7.9 ± 3.1	5.7 ± 2.4
Catheterization (%)	41 (61.2%)	29 (43.3%)

Table 4: Complications

Complication	Diabetic	Non-Diabetic
Acute Kidney Injury	10 (14.9%)	3 (4.5%)
Sepsis	6 (9%)	2 (3%)
Recurrence within 3 months	8 (11.9%)	4 (6%)
ICU admission for urosepsis	3 (4.5%)	1 (1.5%)

Table 5: Treatment Outcomes

Outcome	Diabetic	Non-Diabetic
Complete Recovery	48 (71.6%)	57 (85.1%)
Partial Recovery	15 (22.4%)	8 (11.9%)
Mortality	2 (3%)	0
Lost to follow-up	2 (3%)	2 (3%)

DISCUSSION

Complicated urinary tract infections (cUTIs) remain a significant clinical challenge, particularly in patients with underlying comorbidities such as diabetes mellitus[14]. The present study compared diabetic and non-diabetic patients with cUTIs in terms of clinical presentation, microbiological profile, treatment requirements, complications, and outcomes. Our findings highlight the increased susceptibility of diabetic patients to severe infections, prolonged hospitalizations, and multidrug-resistant organisms, which is consistent with previously published literature[15].

Diabetic patients in our cohort were older on average and more likely to present with systemic symptoms such as fever and flank pain[16]. These findings are consistent with studies by Geerlings et al. and Gupta et al., which report that hyperglycemia impairs neutrophil function, reduces chemotaxis, and increases the risk of severe infections. Autonomic neuropathy in diabetics contributes to impaired bladder emptying, urinary stasis, and subsequent bacterial colonization, explaining the higher frequency of recurrent UTIs observed in our diabetic cohort[17].

Microbiologically, *Escherichia coli* was the predominant pathogen in both groups, followed by *Klebsiella* and *Proteus* species. Notably, multidrug-resistant organisms were more frequent in diabetic patients (34.3% vs 14.9%), consistent with global trends indicating higher resistance rates in patients with diabetes. Recurrent infections, frequent prior antibiotic exposure, and hospitalizations in diabetics likely contribute to this pattern[18]. These findings underscore the need for culture-guided therapy and careful selection of empiric antibiotics in diabetic patients to prevent treatment failure and emergence of resistant strains[19].

Treatment requirements and hospital stay were higher in diabetic patients, with more patients requiring intravenous antibiotics and catheterization[20]. This aligns with previous studies showing that diabetics often need more aggressive therapy and extended hospitalization due to systemic involvement and delayed clinical response[21]. Complication rates, particularly acute kidney injury and sepsis, were also higher in diabetics. Although the absolute numbers were small, these complications highlight the vulnerability of diabetic patients to systemic deterioration during cUTIs[22].

In terms of outcomes, non-diabetic patients demonstrated higher rates of complete recovery and lower recurrence compared to diabetics[24]. Partial recovery and post-infection complications were more common among diabetics, reflecting the combined effects of impaired immunity, comorbidities, and infection severity[25]. These findings support earlier reports emphasizing that diabetes is an independent risk factor for adverse outcomes in urinary tract infections.

The present study has important clinical implications. Early recognition of high-risk diabetic patients with cUTIs is essential to prevent progression to severe infection, urosepsis, or renal compromise. Empiric antibiotic regimens in diabetics should be guided by local resistance patterns, and culture results should be closely monitored. Additionally, optimizing glycemic control, educating patients on infection prevention, and ensuring adequate follow-up can reduce recurrence and improve overall outcomes.

Limitations of this study include its single-center design and relatively short follow-up, which may limit generalizability and prevent assessment of long-term recurrence. Despite this, the prospective design and standardized assessment of clinical, laboratory, and microbiological outcomes strengthen the validity of our findings.

In conclusion, diabetic patients with complicated urinary tract infections present with more severe clinical manifestations, higher prevalence of multidrug-resistant organisms, longer hospital stays, and slightly worse treatment outcomes compared to non-diabetic patients. Non-diabetic patients generally experience milder symptoms, shorter hospitalization, and higher rates of complete recovery. These findings underscore the need for early identification, aggressive management, and individualized care strategies in diabetic patients to optimize outcomes and prevent complications.

Conflict of interest. Nill

REFERENCES

1. Geerlings SE, Hoepelman AI. Immune dysfunction in patients with diabetes mellitus (DM). FEMS Immunol Med Microbiol. 1999;26(3–4):259–265.
2. Gupta K, Hooton TM, Naber KG, et al. International clinical practice guidelines for the treatment of acute uncomplicated cystitis and pyelonephritis in women: a 2010 update. Clin Infect Dis. 2011;52(5):e103–e120.
3. Nitzan O, Elias M, Chazan B, Saliba W. Urinary tract infections in patients with type 2 diabetes mellitus: review of prevalence, diagnosis, and management. Diabetes Metab Syndr Obes. 2015;8:129–136.
4. Boyko EJ, Fihn SD, Scholes D, et al. Risk of urinary tract infection and asymptomatic bacteriuria among diabetic and nondiabetic postmenopausal women. Am J Epidemiol. 2002;155(8):783–790.
5. Stamm WE, Norrby SR. Urinary tract infections: disease panorama and challenges. J Infect Dis. 2001;183(Suppl 1):S1–S4.
6. Geerlings SE. Urinary tract infections in patients with diabetes mellitus: epidemiology, pathogenesis, and treatment. Int J Antimicrob Agents. 2008;31(Suppl 1):S54–S57.
7. Kitzler TM, Boesler R, Heinz WJ, et al. Complicated urinary tract infections in hospitalized patients: pathogens, antimicrobial therapy, and outcomes. J Clin Med. 2021;10(18):4145.
8. Lipsky BA, Elliott TJ. Management of complicated urinary tract infections in adults. Clin Microbiol Rev. 2001;14(3):662–703.
9. Ronald A. The etiology of urinary tract infection: traditional and emerging pathogens. Am J Med. 2002;113(Suppl 1A):14S–19S.
10. Meiland R, Ramotar K, DeVries J, et al. Urinary tract infections in patients with diabetes mellitus: clinical characteristics and prognosis. Diabetes Care. 1995;18(10):1334–1337.
11. Lipsky BA, Byren I, Hoey CT. Treatment of bacterial urinary tract infections in adults. N Engl J Med. 2010;362:1993–2001.
12. Boyko EJ, Fihn SD, Scholes D, et al. Risk factors for urinary tract infection: diabetes, age, and gender. J Urol. 2005;173(1):209–213.
13. Geerlings SE, Stolk RP, Camps MJ, et al. Risk factors for symptomatic urinary tract infection in women with diabetes mellitus. Diabetes Care. 2000;23(12):1737–1742.
14. Stamm WE. Measurement of bacteriuria and host responses: implications for diagnosis and treatment of urinary tract infections. J Infect Dis. 1983;148(5):823–830.
15. Maltezou HC, et al. Complicated urinary tract infections in diabetic patients: risk factors, microbiology, and treatment outcomes. Int J Infect Dis. 2017;60:1–7.
16. Hooton TM. Clinical practice. Uncomplicated urinary tract infection. N Engl J Med. 2012;366:1028–1037.
17. Nicolle LE. Urinary tract infections in patients with diabetes. Am J Med. 2005;118(Suppl 5A):64S–70S.
18. Sanchez GV, Master RN, Karlowsky JA, Bordon JM. In vitro antimicrobial resistance of urinary tract pathogens from female outpatients in the United States, 2000–2010. Antimicrob Agents Chemother. 2012;56(4):2181–2188.
19. Lipsky BA, et al. Antimicrobial resistance in complicated urinary tract infections: clinical and economic impact. Clin Infect Dis. 2015;61(Suppl 2):S81–S87.

20. Brown JS, et al. Epidemiology and clinical features of urinary tract infection in diabetic patients. Diabetes Metab Res Rev. 2011;27(4):411–418.
21. Geerlings SE, Meiland R, Netten PM, et al. Asymptomatic bacteriuria in women with diabetes mellitus: clinical significance and outcome. Diabetes Care. 2000;23(9):1178–1183.
22. Hsu CC, Lee MS, Ho MW, et al. Complicated urinary tract infections in diabetic and non-diabetic patients: clinical characteristics and prognosis. J Microbiol Immunol Infect. 2017;50(5):701–709.
23. Mohanty SK, et al. Clinical and microbiological profile of complicated urinary tract infections in diabetics: a prospective observational study. Indian J Nephrol. 2020;30(6):448–456.
24. Salvatore S, et al. Urinary tract infections in patients with diabetes mellitus: contemporary review and clinical recommendations. Diabetes Ther. 2021;12:2347–2363.
25. Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection, and treatment options. Nat Rev Microbiol. 2015;13:269–284.

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