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ASSOCIATION BETWEEN URINARY TRACT INFECTIONS AND DIABETES MELLITUS IN PATIENTS VISITING A TERTIARY CARE HOSPITAL

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Abstract

OBJECTIVE: *To determine the association between urinary tract infections and diabetes mellitus in patients visiting a tertiary care hospital.*

METHODOLOGY: *This observational case-control study was conducted at Dr. Ziauddin Hospital to investigate the association between urinary tract infections (UTIs) and diabetes mellitus. A sample of 282 participants (consisting of 141 individuals diagnosed with diabetes and 141 who were not) aged between 20 and 65 years was selected through a non-probability consecutive sampling technique. Stringent exclusion criteria were implemented. Clinical symptoms and laboratory tests validated UTI diagnoses, whereas the UTISA questionnaire was utilized to assess the severity of the symptoms. Data were collected using standardized instruments and analyzed using SPSS version 26. Descriptive statistics, Chi-square tests, and odds ratios with 95% confidence intervals were utilized to determine the association between diabetes and UTIs.*

RESULTS: *The investigation encompassed a total of 282 subjects, exhibiting a mean age of 55.67 ± 7.52 years within the diabetic cohort and 52.66 ± 10.66 years within the non-diabetic cohort. A predominant proportion of participants were female, constituting 69.5% of the diabetic population and 72.3% of the non-diabetic population. The incidence of urinary tract infections (UTIs) was significantly elevated among individuals with diabetes (37.6%) in comparison to those without diabetes (25.5%), yielding an odds ratio of 1.757 ($p = 0.029$), thereby signifying a statistically significant correlation. Escherichia coli emerged as the most prevalent uropathogen in both cohorts (60.4% in diabetics, 66.7% in non-diabetics), succeeded by Klebsiella (24.5% vs. 13.9%) and Enterococcus species (9.4% vs. 8.3%). The findings suggest an extended array of uropathogens present in diabetic patients.*

CONCLUSION: *This investigation revealed a statistically significant association between diabetes mellitus and an elevated risk of urinary tract infections. Patients with diabetes not only demonstrated a higher incidence of*

UTIs but also displayed a more extensive variety of uropathogenic organisms. Escherichia coli persisted as the predominant pathogen; however, Klebsiella and Enterococcus species were observed with greater frequency in diabetic individuals. These observations underscore the necessity for meticulous screening, strategic antibiotic administration, and enhanced glycemic regulation to mitigate the burden of UTIs within diabetic cohorts.

INTRODUCTION

Urinary tract infection is one of the most common bacterial infections, affecting more than 150 million people annually [1]. Urinary tract infection (UTI) is more common in females than males, which is due to short urethra [2]. Diabetes mellitus (DM) is associated with urinary tract infection (UTI) due to an immunocompromised state resulting from uncontrolled hyperglycemia [3]. There is a change in the immune response of a diabetic host, which could be the potential reason for increased susceptibility to develop UTI in diabetics [4]. There is increased adherence of the microorganism to the uroepithelial cells and granulocyte dysfunction results from an abnormal intracellular calcium metabolism. UTI may be symptomatic or asymptomatic. The common symptoms include burning micturition, urgency, dysuria, cramping in the lower abdomen, back or flank pain, chill, nausea, fever, vomiting fatigue and weakness [5]. UTIs may be complicated or uncomplicated [6]. Uncomplicated UTIs mostly occur in women and may not require antibiotic therapy [7]. While complicated UTIs can be more severe in nature and are difficult to treat. Recurrent UTIs could either be relapse in which the same pathogen is involved, or it may be re-infection in which different uropathogens are involved. E. Coli is the most common pathogen leading to UTI, whereas other microorganisms involved in UTIs are Klebsiella spp., Mycoplasma spp., Enterobacter spp., and Staphylococcus aureus or Candida albicans [8]. Studies have been performed to assess the difference in clinical characteristics of UTI in diabetic and non-diabetic patients.

Drekonja et al. conducted a study on the prevalence of diabetes in patients diagnosed with urinary tract infections (UTIs) and reported that 38.9% of the UTI patients had diabetes as a comorbidity, while 61.1% were non-diabetic [9]. Similarly, Nieuwkoop et al, in their study, found that among 357 patients diagnosed with UTI, 15.12% of patients had diabetes while 88.88% of patients were non-diabetics [10].

McAteer et al, reported that 1099 patients were diagnosed with UTI in their study. 35.5% of these patients had diabetes as comorbid, while 64.5% of patients didn't give a history of diabetes [11]. Another study reported the incidence of UTI in participants of the diabetic group was higher than those in the non-diabetic group (57.4% vs 42.6%) [12].

It is evident from the literature that patients with diabetes are particularly at high risk of developing complicated UTI due to their immunocompromised state and increased prevalence of asymptomatic bacteriuria which is not only associated with significant morbidity on the patient but also puts a considerable burden on healthcare resources [13-15].

Urinary tract infections (UTIs) are among the most common bacterial infections worldwide, with a higher incidence and more severe clinical outcomes in diabetic patients due to their immunocompromised state. Diabetes mellitus (DM), particularly when poorly controlled, leads to immune dysfunction, increasing the risk of infections, including UTIs. This association between diabetes and UTI presents a significant clinical challenge, as diabetic patients are more prone to complicated UTIs, including pyelonephritis and urosepsis, which contribute to greater morbidity and healthcare burden. This study aims to explore the association between diabetes mellitus and the frequency of urinary tract infections among patients visiting a tertiary care hospital. By comparing diabetic and non-diabetic patients, the study seeks to provide valuable insights into how diabetes influences the risk, severity, and clinical presentation of UTIs. These findings will contribute to improved management and targeted interventions, enhancing patient outcomes and reducing the healthcare burden associated with UTIs in both diabetic and non-diabetic populations.

METHODOLOGY

This observational case-control study was executed at Dr. Ziauddin Hospital, situated in North Nazimabad, with the aim of investigating the association between urinary tract infections (UTIs) and diabetes mellitus. A total of 282 participants were recruited, consisting of 141 individuals with a validated diagnosis of diabetes mellitus and 141 non-diabetic subjects who functioned as a control group. The selection process for participants was conducted using a non-probability consecutive sampling technique, in alignment with established inclusion and exclusion criteria. Participants ranging in age from 20 to 65 years, regardless of gender, were eligible for inclusion in the study. The case group comprised individuals diagnosed with diabetes mellitus, while the control group included non-diabetic subjects. The exclusion criteria were meticulously delineated and encompassed individuals with a documented history of antibiotic therapy within the preceding 28 days, those with a prior renal transplant or currently receiving renal replacement therapy, as well as individuals diagnosed with medical conditions such as benign prostatic hyperplasia, urethral strictures, urolithiasis, or urinary tract neoplasms, in addition to those possessing foreign objects within the urinary tract, including urethral catheters, double-J stents, or percutaneous nephrostomy tubes. Furthermore, individuals with compromised immune systems, including those diagnosed with active malignancies, tuberculosis, or those receiving immunosuppressive therapies, were precluded from participation in the study. In addition, women who were either pregnant or breastfeeding were similarly excluded from this research endeavor. The inquiry commenced with a rigorous compilation of foundational demographic and clinical data, which encompassed variables such as age, gender, living conditions, and the duration of the symptoms presented. A standardized instrument was employed to meticulously record this data. The diagnosis of diabetes was corroborated through an array of diagnostic assessments, including fasting plasma glucose, 2-hour plasma glucose, random plasma glucose, or HbA1C evaluations. The classification of diabetes was conducted in alignment with the operational definition specifically formulated for the objectives of this research. To substantiate a diagnosis of a urinary tract infection, the manifestation of one or more significant clinical symptoms was mandated.These symptoms encompassed increased urinary frequency (exceeding 8 episodes within a 24-hour period), urgency (the inability to postpone urination for more than 5 minutes), dysuria (painful urination with a Visual Analog Scale (VAS) score exceeding 3), vesical tenesmus (a persistent sensation of incomplete bladder emptying after at least 50% of urinations), suprapubic pain (lower abdominal discomfort lasting more than 30 minutes with a VAS score of 4 or greater), or back pain (intense pain in the lower back or renal area with a VAS score exceeding 7, persisting for more than 1 hour). Any patient exhibiting these symptoms was required to obtain laboratory confirmation, which necessitated the growth of $\geq 10^5$ colony-forming units (CFU) per milliliter of microorganisms from a clean-catch, midstream urine sample collected under aseptic conditions. This was subsequently validated through culture in a clinical laboratory setting.

The study employed the validated Urinary Tract Infection Symptom Assessment (UTISA) Questionnaire to systematically evaluate symptoms, with each symptom being assigned a score reflecting its severity and the degree of bother experienced. A score of 2 (moderate) or 3 (severe) was deemed significant for the identification of a symptom. The data that were collected underwent comprehensive analysis to ascertain the prevalence of UTIs within both the diabetic and non-diabetic groups, thereby evaluating the association between diabetes and urinary tract infections. The collected data was entered and analyzed through SPSS version 26. Descriptive statistics were calculated for quantitative and qualitative variables in terms of mean ± standard deviation and frequency with percentage respectively. The Chi-square test was applied to compare both the groups with 5% level of significance. Furthermore, odds ratios (OR) accompanied by 95% confidence intervals (CI) were computed to evaluate the robustness of the association between categorical variables.

RESULTS

As illustrated in Table I, the foundational characteristics of the study participants across both cohorts exhibited comparability. The average age of

individuals in Group A (diabetic) was 55.67 ± 7.52 years, which is marginally elevated relative to that of Group B (non-diabetic), recorded at 52.66 ± 10.66 years. The mean Body Mass Index (BMI) was found to be diminished in the diabetic cohort (25.91 ± 3.47 kg/m²) in comparison to the non-diabetic cohort (27.29 ± 4.24 kg/m²). In both cohorts, the preponderance of participants were female, comprising 69.5% in Group A and 72.3% in Group B. Concerning residential status, a slightly greater proportion of individuals in both cohorts inhabited urban locales (56.0% in Group A and 58.2% in Group B). A significant majority of participants were married in both cohorts (66.7% in Group A and 70.2% in Group B), with comparable distributions across the unmarried, widowed, and divorced categories. These observations suggest that the two cohorts were predominantly balanced with respect to demographic and foundational clinical characteristics.

As delineated in Table II, a markedly elevated incidence of urinary tract infections (UTIs) was noted within the diabetic cohort (Group A) relative to the non-diabetic cohort (Group B). Specifically, UTIs were identified in 37.6% of diabetic patients (n = 53) in contrast to 25.5% of non-diabetic patients (n = 36). The derived odds ratio was 1.757 (95% CI: 1.056–2.923), signifying those diabetic individuals possessed approximately 1.8 times greater odds of experiencing a UTI compared to their non-diabetic counterparts. This disparity reached statistical significance (p = 0.029), implying a substantial correlation between diabetes and an augmented risk of UTI within the studied population.

As delineated in Table III, Escherichia coli emerged as the most frequently isolated uropathogen in both cohorts, representing 60.4% of infections among diabetic patients and 66.7% among non-diabetic individuals. Klebsiella species were identified as the second most prevalent, with isolation rates of 24.5% in diabetic subjects and 13.9% in their non-diabetic counterparts. Additional organisms that were isolated included Enterococcus species (9.4% in diabetics compared to 8.3% in non-diabetics) and Citrobacter species (3.8% versus 2.8%, respectively). Proteus species were exclusively identified in non-diabetic patients (5.6%), while Candida albicans was detected in both groups at minimal frequencies (1.9% in diabetics and 2.8% in non-diabetics). These results suggest that although E. coli continues to be the principal uropathogen irrespective of diabetic status, Klebsiella and Enterococcus species were observed with greater frequency among diabetic patients, indicating a potential transition toward a more diverse array of uropathogens within this demographic.

DISCUSSION

Urinary tract infections (UTIs) represent a significant health concern among individuals diagnosed with diabetes mellitus (DM), attributable to the complex interaction of multiple factors, including hyperglycemia, immune dysfunction, and alterations within the urogenital tract. The escalating incidence of diabetes mellitus on a global scale has been associated with a corresponding increase in UTIs, particularly in nations such as Pakistan, Egypt, and India, where the prevalence of diabetes continues to rise. Numerous scholarly investigations have explored the association between diabetes and UTIs, providing critical insights into the underlying mechanisms, prevalence rates, and therapeutic approaches concerning this condition. Azeem et al. [16] underscored the rising prevalence of diabetes in Pakistan, characterizing it as a "silent killer." They observed that the growing population of individuals with diabetes in Pakistan correlates with an increase in various complications, including UTIs. This correlation is predominantly attributed to the impact of diabetes on immune system functionality. Hyperglycemia, a defining characteristic of diabetes, compromises the body's immune response, thereby diminishing its capacity to combat infections. In addition, high levels of blood sugar provide a favorable environment for the growth of bacteria in the urinary tract. Patients who have diabetes, especially those with poorly controlled blood glucose, are known to be at higher risk for repeat infections due to impaired immune function. Increased incidence of urinary tract infections (UTIs) in patients with diabetes is not limited to certain demographic groups, but in diabetic women, susceptibility is increased due to additional anatomical and physiological factors. Shah et al. [17] conducted a systematic investigation to assess the prevalence and correlating determinants of UTIs

among individuals with diabetes, revealing a significant correlation between diabetes and the incidence of urinary tract infections.Their results showed that diabetic women have a high vulnerability to recurrent urinary tract infections (UTIs). The authors mention a number of potential factors driving the higher risk including poor glycemic control, the presence of other comorbid conditions and changes in urinary tract-related factors including bladder dysfunction and neuropathy that occur frequently in patients with chronic diabetes. These results align with findings from other scholarly investigations, including Desouky et al. [18], who examined diabetic patients in Egypt and reported a substantial prevalence of UTIs within this demographic. Their research concentrated on the bacterial etiology and patterns of antimicrobial resistance, indicating that Escherichia coli is the predominant pathogen implicated in UTIs among diabetic individuals. Furthermore, the study highlighted critical concerns regarding antimicrobial resistance, observing a decline in the effectiveness of commonly prescribed antibiotics such as ampicillin and ciprofloxacin. Akhand et al. [19] executed a comparative study in central India to evaluate the incidence of UTIs among diabetic and non-diabetic populations.The empirical evidence derived from the research underscored that individual afflicted with diabetes exhibited a markedly higher prevalence of urinary tract infections (UTIs) when contrasted with their non-diabetic counterparts. Furthermore, the research elucidated that the length of time since the diagnosis of diabetes demonstrates a positive correlation with the likelihood of urinary tract infection (UTI) occurrence. This finding underscores the considerable impact of sustained hyperglycemia in fostering an environment conducive to bacterial proliferation. Moreover, the presence of altered glycemic urogenital microbiota in addition to the compromised immune responses of diabetic patients increases the predisposition to urinary infections. Along the same line, Nabi [20] observed patients with a diagnosis of type 2 diabetes, and, in this prospective study among symptomatic urinary tract infections (UTIs), it was confirmed that glycemic figures being disregulated were associated with higher severity and complications with UTIs. This research underscored the critical significance of effective glycemic control in mitigating both the incidence and severity of urinary tract infections. Priyadarshini et al. [21] investigated the prevalence and patterns of antibiotic susceptibility of uropathogens isolated from diabetic individuals suffering from UTIs. Their findings revealed a troubling pattern of antibiotic resistance among uropathogens, thus complicating the effective management of these infections. The research illustrated that individuals with diabetes are more likely to possess antibiotic-resistant bacterial strains, which further complicates the treatment of UTIs in this population. This highlights the necessity for careful antibiotic selection and underscores the importance of tackling the rising issue of antimicrobial resistance in individuals with diabetes. In the current study, the prevalence of UTI was significantly elevated within the diabetic group (37.6%) in comparison to the non-diabetic group (25.5%). McAteer et al. documented that 1,099 patients were diagnosed with UTI in their study, of which 35.5% were identified as having diabetes [11]. Another investigation reported that the incidence of UTI among participants in the diabetic group was greater than that observed in the non-diabetic group (57.4% vs 42.6%) [12]. Akhand A et al. documented the incidence of urinary tract infections (UTIs) in 34% of individuals diagnosed with diabetes, in contrast to 27% among their non-diabetic counterparts [19]. Concurrently, the investigation led by Ahmed AE et al. revealed that UTIs were prevalent in 39.3% of the patient population examined [22]. While the studies reviewed here offer significant insight into the link between diabetes and increased susceptibility to urinary tract infections, they do have specific methodological limitations. Many of these studies were cross-sectional, which limits the ability to infer a causal relationship between diabetes and UTIs. In addition, possible biases in our findings might stem from the use of self-reported data. The other common restriction is the lack of longitudinal follow-up, which significantly prevents an assessment of the long-term effects of recurrent UTIs in diabetic patients. In addition, some other studies in academia have indeed analyzed trends of antibiotic resistance quite severely, but fail to adequately explore the root causes of this resistance in order to examine other treatment options. In alignment with the analyses derived from the reviewed literature, several

recommendations have been articulated to optimize the management and prevention of urinary tract infections (UTIs) among patients diagnosed with diabetes mellitus.The paramount suggestion relates to the necessity for improved glycemic regulation. Empirical investigations, encompassing research undertaken by Nabi [20] and Azeem et al. [16], highlight that sustaining blood glucose concentrations within a specified target range markedly diminishes the likelihood of infections. A systematic evaluation of blood glucose levels alongside adherence to prescribed pharmacological treatments constitutes essential factors in the prevention of UTIs.Moreover, the comprehensive assessment of urinary tract infections (UTIs) in individuals suffering from diabetes, especially those afflicted with type 2 diabetes mellitus, represents a critical guideline. Moreover, the comprehensive assessment of urinary tract infections (UTIs) in individuals with diabetes, especially those diagnosed with type 2 diabetes mellitus, represents a critical guideline. The prompt identification of infections facilitates immediate therapeutic measures, thus preventing complications and the emergence of antimicrobial resistance. Such initiatives can assist healthcare practitioners in determining the most suitable antibiotics in accordance with prevailing local resistance patterns. Additionally, patient education plays a crucial role in promoting awareness regarding the signs and symptoms of UTIs, the significance of maintaining adequate hydration, and the necessity for appropriate personal hygiene practices to diminish the risk of infections. In conclusion, the correlation between diabetes mellitus and urinary tract infections is thoroughly documented, with diabetes acting as a contributory factor to both an elevated risk of infection and subsequent complications. The preservation of optimal glycemic control, routine screening for UTIs, and the implementation of antibiotic stewardship protocols are imperative for alleviating the repercussions of UTIs in diabetic patients. Ongoing academic inquiry into the fundamental mechanisms that underline infection and resistance phenomena will further augment our capacity to effectively manage and avert UTIs within this susceptible population.

CONCLUSION

This investigation revealed a statistically significant association between diabetes mellitus and an elevated risk of urinary tract infections. Patients with diabetes not only demonstrated a higher incidence of UTIs but also displayed a more extensive variety of uropathogenic organisms. Escherichia coli persisted as the predominant pathogen; however, Klebsiella and Enterococcus species were observed with greater frequency in diabetic individuals. These observations underscore the necessity for meticulous screening, strategic antibiotic administration, and enhanced glycemic regulation to mitigate the burden of UTIs within diabetic cohorts.

Table I: Baseline Characteristics of Study Participants (n=282)

Variables		Groups	
		A (n=141)	B (n=141)
Age in years, Mean ± SD		55.67 ± 7.52	52.66 ± 10.66
Body Mass Index in kg/m^2, Mean ± SD		25.91 ± 3.47	27.29 ± 4.24
Gender	Male, *n* (%)	43 (30.5)	39 (27.7)
	Female, *n* (%)	98 (69.5)	102 (72.3)
Residential Status	Urban, *n* (%)	79 (56.0)	82 (58.2)
	Rural, *n* (%)	62 (44.0)	59 (41.8)
Marital Status	Married, *n* (%)	94 (66.7)	99 (70.2)
	Unmarried, *n* (%)	27 (19.1)	28 (19.9)

	Widowed, *n* (%)	6 (4.3)	5 (3.5)
	Divorced, *n* (%)	14 (9.9)	9 (6.4)

Group A: *Diabetic,* ***Group B***: *Non-Diabetic*

Table II: Association of Urinary Tract Infection (UTI) Between Diabetic And Non-Diabetic Groups (n=282)

Variables		Groups			P-Value
		A (n=141)	B (n=141)	Odd Ratio (95% C. I)	
UTI	Yes, *n* (%)	53 (37.6)	36 (25.5)	1.757 (1.056-–2.923)	0.029
	No, *n* (%)	88 (62.4)	105 (74.5)		

Group A: *Diabetic,* ***Group B***: *Non-Diabetic*

Table III: Comparison of Uropathogens in UTI Patients Between Groups (n=282)

Uropathogens	Groups	
	A (n=53)	B (n=36)
Escherichia Coli, *n* (%)	32 (60.4)	24 (66.7)
Klebsiella Sps, *n* (%)	13 (24.5)	5 (13.9)
Enterococcus Sps, *n* (%)	5 (9.4)	3 (8.3)
Citrobacter Sps, *n* (%)	2 (3.8)	1 (2.8)
Proteus Sps, *n* (%)	0 (0.0)	2 (5.6)
Candida Albicans, *n* (%)	1 (1.9)	1 (2.8)

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