ORIGINAL ARTICLE

Correlation between children with type-1 DM and occurrence of UTI

Khaled M. Zayed [a], Ahmed S. I. Mansour [a], Mohamed A. A. Shaheen [b], Mohamed M. L. El-Taher [a,*]

[a] Department of Pediatrics, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt
[b] Department of Clinical Pathology, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt

Abstract

Background: ***Urinary tract infection (UTI) is a prevalent bacterial infection that frequently occurs in childhood.***

Aim: ***To evaluate the correlation between the occurrence of UTI in kids with uncontrolled and controlled type-1 diabetes mellitus.***

Patients and methods: ***This prospective research was conducted on a hundred kids with diabetes mellitus type-1 to detect UTIs. Patients were taken from the outpatient clinic of Al-Azhar University Hospitals and the National Institute of Diabetes in Cairo.***

Results: ***According to urine culture, ten percent were positive, E. coli was the commonest cause of UTI (70.0%). A statistically significant relation was observed between UTI and non-UTI children according to fasting blood glucose and two-hour postprandial glucose. No statistically significant positive association was observed between CRP and glucose. According to type and symptoms of UTI, five percent of cases had ASB, one percent of cases had uro-sepsis, three percent of cases had Cystitis and one percent of cases had Pyelonephritis and according to symptoms, ten percent of cases had burning micturition, nine percent of cases had frequent micturition, seven percent of cases had abdominal pain, five percent of cases had loin pain, six percent of cases had Fever and eight of cases had nausea and vomiting.***

Conclusion: ***The prevalence of UTI was elevated among kids aged four to twelve years with T1DM, and those with unregulated glucose levels in their T1DM were more susceptible to developing UTIs, as a higher percentage of UTI was found in diabetic children with uncontrolled Diabetes (70%).***

Keywords: T1DM; pyelonephritis; urinary tract infection

1. Introduction

A Urinary Tract Infection is defined as a prevalent bacterial infection that frequently occurs in childhood.[1] The infection can impact either the upper urinary tract, known as Pyelonephritis, or the lower urinary tract, known as Cystitis. Unfortunately, it can be difficult to differentiate Pyelonephritis from Cystitis based only on signs and clinical symptoms, particularly in young children and newborns.[2]

UTI is a significant concern for clinicians, parents, and children. It is crucial to provide prompt diagnosis and appropriate treatment in order to decrease the morbidity associated with this condition.[3]

The correlation between Diabetes mellitus (DM) and infections is a topic of significant interest and a cause for considerable discussion in the medical literature. Various studies have examined this correlation; however, several studies have also examined the influence and frequency of infections in adolescents and children with diabetes mellitus. It has been found that, in addition to the usual community-acquired infections, certain infections are more prevalent in cases with Diabetes, and other prevalent infections may be more aggressive in these cases. In cases with DM, there is evidence that adequate glycemic control enhances immune function and reduces the mortality and morbidity associated with severe infections in cases with diabetes mellitus.[4]

Accepted 10 February 2025.
Available online 30 April 2025

* Corresponding author at: Pediatrics, Faculty of Medicine for Boys, Al-Azhar University, Cairo, Egypt.
E-mail address: mohamedlabeb1977@gmail.com (M. M. L. El-Taher).

https://doi.org/10.21608/aimj.2025.446502

Some immune system disorders in pediatric patients with Diabetes, when combined with high glycemia, elevate the risk of infections and their severity, and it is essential that these disorders be promptly treated and identified. Pediatricians should be aware that the presence of an infectious disease might elevate blood glucose levels and raise the risk of decompensation. Therefore, they should be cautious in intensifying monitoring and insulin treatment to prevent the risk of DKA. It is important to note that numerous infections can be prevented and avoided with adequate vaccine coverage.[5]

Urinary tract infections (UTIs) are more prevalent in cases with DM, and they can lead to severe complications and symptoms. Several factors lead to an increased susceptibility to urinary tract infections: incomplete bladder emptying caused by autonomic neuropathy in cases with T2DM, the compromised host immunological response, and altered metabolic regulation contribute to an increased risk of colonization by pathogenic microbes in the urine, which is further facilitated by raised urine glucose levels.[6]

A recent study revealed why UTIs frequently occur in cases with DM. Insulin controls the activity of an antimicrobial peptide (AMP) that is inhibited in those cases.[7]

The objective of this research has been to assess the correlation between UTI occurrence in kids with uncontrolled and controlled T1DM.

2. Patients and methods

This prospective research has been conducted on a hundred children with T1DM for the detection of UTI. cases were taken from the outpatient clinic of Al-Azhar University Hospitals and National Institute of Diabetes in Cairo.

Inclusion criteria: cases diagnosed with type-1 DM, cases aged between four and twelve years, number of years since diagnosis, and physically free from any other chronic co-morbidities (Thalassemia, cystic fibrosis, IBD, Immunodeficiency, BPD, etc.).

Exclusion criteria: cases with type-2 DM, cases = or > 12 years and cases with other co morbidities.

Ethical considerations

All cases provided written informed consent to participate in the research. The techniques conducted in studies including human participants are consistent with the ethical standards set by the institutional and national research committee, as well as the 1964 Helsinki Declaration and its subsequent revisions or similar ethical standards. The procedures were conducted in compliance with the criteria outlined in the Declaration of Helsinki guidelines, involving any relevant details.

Methods

All cases were subjected to: Complete physical examination and history taking.

Blood analysis: Venous blood samples were obtained from all cases and analyzed for fasting blood glucose, two-hour postprandial blood glucose, and glycated hemoglobin (HbA1c). The HbA1c levels were measured using spectrophotometry using HbA1c test kits. HbA1c levels below seven percent were considered indicative of good metabolic management, whereas levels above 7.5% were considered poor control, as per the guidelines set by the American Diabetes Association.8

Imaging studies (renal ultrasound was used to assess structural anomalies, vesicoureteral reflux, dysfunctional voiding, or other conditions requiring further evaluation and treatment).

Urine analysis: Cases were asked to produce a fresh, early morning mid-stream urine sample, which was promptly sent for urine analysis that involved WBC count, pH, RBC count, and testing for the presence of bacteria and culture. A urine sample was analyzed for the presence of microalbuminuria. All cases provided urine samples using the clean voided midstream procedure, which were collected in twenty milliliter calibrated sterile screw-capped containers. The sample container was marked with the time of collection, the sample number, and the date, then transmitted to the microbiology laboratory for the purpose of performing biochemical testing, culture, drug-resistance testing, and isolation. Prior to the cultural period, urine samples were maintained in a refrigerator at a temperature range of two to eight degrees Celsius.

Uropathogens identification of urine samples: The urine samples were subjected to culturing on MacConkey agar, Cysteine Lactose Electrolyte Deficient Agar (CLED), and blood agar. The plates were then placed in an incubator at a temperature of thirty-seven degrees Celsius for a duration of twenty-four hours. Significant bacteriuria has been described as urine cultures grew more than 105 colony-forming units per milliliter of midstream urine.[9]

Antimicrobial sensitivity testing: The antimicrobial sensitivity testing of all isolates was conducted on sensitivity test agar utilizing disc diffusion techniques, following the definition provided by the National Committee of Clinical Laboratory Standards (NCCLS).[10]

Statistical analysis

The collected data were organized, tabulated, and statistically analyzed using the statistical package for social sciences (SPSS) version 21 (SPSS Inc., Chicago, USA). Frequency and percentage distributions have been calculated for qualitative data. Standard

deviation, mean, minimum, and maximum were calculated for the quantitative data. The independent samples test was used to compare two groups. Significance was assigned to all tests with a p-value below 0.05.

3. Results

Table 1 shows, the average age of examined cases has been 8.35 (±2.04 standard deviation) with range (4-12) and between the examined cases there were forty-seven percent women and fifty-three percent men and mean Weight of the examined cases was 28.67 (±7.19 SD) with range (13.2-46.56), mean Height was 135.4 (±15.3 SD) with range (85.9-162.35) and mean BMI of cases was 15.6 (±3.2 SD) with range (9.4-25.1).

Table 1. distribution of general characteristic in the examined patients.

	SUBJECTS N=100	
AGE (YEAR) MEAN ± SD	8.35±2.04	
RANGE	(4 -12)	
SEX	N	%
MALE	53	53.0
FEMALE	47	47.0
WEIGHT (KG) MEAN ± SD	28.67±7.19	
RANGE	(13.2-46.56)	
HEIGHT (CM) MEAN ± SD	135.4±15.3	
RANGE	(85.9-162.35)	
BMI (KG/M2) MEAN ± SD	15.6±3.2	
RANGE	(9.4-25.1)	

Table 2 shows, the mean of pus in the studied cases was 5.95 (±13.04), the mean of RBCs was 1.71 (±1.02) and in the studied cases there were 98% positive in glucose and 2% were negative.

Table 2. Distribution of urine analysis in the studied cases.

	SUBJECTS N=100	
GLUCOSE	N	%
POSITIVE	98	98.0
NEGATIVE	2	2.0
PUS MEAN ± SD	5.95±13.04	
RBCS MEAN ± SD	1.71±1.02	

Table 3 shows that, 10% were positive in urine culture, E. coli was the commonest reason for Urinary Tract Infection (70.0%), subsequently Klebsiella sp. (20%) and 10.0% was due to staphylococcus and 90% had no growth in urine culture.

Table 3. Distribution of Urine culture (growth) in the studied cases.

	SUBJECTS N=100	
	n	%
POSITIVE	10	10.0
E-COLI	7	70.0
STAPH	1	10.0
KLEBSIELLA	2	20.0
NO GROWTH	90	90.0

According to type and symptoms of UTI, table 4 shows that five percent of cases had ASB, one percent of cases had uro-sepsis, three percent of cases had cystitis and one percent of cases had pyelonephritis and according to symptoms ten percent of cases had burning micturition, nine percent of cases had Frequent micturition, seven percent of cases had abdominal pain, five percent of cases had loin pain, six percent of cases had fever and eight percent of cases had nausea and vomiting.

Table 4. Distribution of type and symptoms of UTI in the studied cases.

	SUBJECTS N=10	
	n	%
TYPE OF UTI		
ASB	5	5.0
UROSEPSIS	1	1.0
CYSTITIS	3	3.0
PYELONEPHRITIS	1	1.0
SYMPTOMS		
BURNING MICTURITION	10	10.0
FREQUENT MICTURITION	9	9.0
ABDOMINAL PAIN	7	7.0
LOIN PAIN	5	5.0
FEVER	6	6.0
NAUSEA AND VOMITING	8	8.0

Table 5 shows that statistically insignificant relation was observed among studied groups regarding HB, RBCs, PLT, HbA1C, albumin creatinine ratio. While statistically significant relation was observed according to WBCs, neutrophils, lymph, fasting blood glucose and two hour postprandial glucose.

Table 5. Relation between UTI and Laboratory data.

	UTI N=10	NO UTI N=90	T	P VALUE
HB MEAN± SD	12.4± 0.7	12.4± 0.7	0.121	0.9
RBCS MEAN± SD	4.4± 0.36	4.4± 0.36	0	1
WBCS MEAN± SD	16.5± 1.17	9.2± 3.2	7.17	<0.001
NEUTROPHILS MEAN± SD	61.5± 7.2	46.1± 8.1	5.75	<0.001
PLT MEAN± SD	265± 38.3	296.5± 60.9	1.59	0.113
LYMPH MEAN± SD	29.5± 7.2	46.4± 8.5	6.04	<0.001
FASTING BLOOD GLUCOSE MEAN± SD	181.3± 37.07	233.8± 50.7	3.17	0.002
2-HOUR POSTPRANDIAL GLUCOSE MEAN± SD	273± 65.4	328.2± 55.9	2.97	0.004
HBA1C MEAN± SD	10.57± 3.06	10.5± 1.9	0.103	0.9
ALBUMIN CREATININE RATIO MEAN± SD	18.7± 15.3	14.1± 6.14	1.84	0.06

Table 6 demonstrates, highly statistically significant variance was observed among examined groups regarding to pus, statistically significant variance was observed among examined groups regarding to RBCs and no statistically significant variance was observed among examined groups regarding to glucose.

Table 6. Relation between UTI and urine analysis.

	UTI N=10		NO UTI N=90		TEST	P VALUE
GLUCOSE	n	%	n	%	0.227	0.63
POSITIVE	10	100	88	97.8		
NEGATIVE	0	0	2	2.2		
PUS MEAN ± SD	43.2±11.99		1.81±1.18		32.64	<0.001
RBCS MEAN ± SD	2.35±1.7		1.64±0.9		2.128	0.035

P value < 0.05 statistically significant.

Table 7 shows that statistically insignificant positive correlation was observed among CRP and glucose.

Table 7. Correlation between CRP and glucose.

	GLUCOSE	
CRP	r	P value
	0.048	0.638

4. Discussion

The present research reported which the average age of the examined cases was 8.35 ±2.04 years, in the age range of four to twelve years, forty-seven percent patients have been women, and 53% cases have been men, the average weight has been 28.67 ±7.19 ranging from 13.2 to 46.56 kg, mean height was 135.4 ±15.3 ranging from 85.9 to 162.35 and the mean BMI was 15.6 ±3.2 kg/m2 ranging from 9.4 to 25.1 kg/m2.

The current research in agreement with Ntege,[11] who evaluated the burden of UTIs between kids and adolescents with T1DM. They reported that their research included 118 T1DM children aged from 1 to 18 years, the median age (IQR) was ten (six to fifteen years) and sixty-four (fifty-four percent) cases were females.

As regards urine analysis, our outcomes demonstrate that the mean pus in the examined cases was 5.95 ±13.04, the mean RBCs was 1.71 (±1.02), and 98% of cases were positive for glycosuria, and 2% were negative.

Also, our results are consistent with Kumar et al.,[12] who reported that two (5.7%) cases of diabetic patients had hematuria (Hematuria was characterized by the presence of RBCs above 5 per high-HPF. And seven (twenty percent) cases had Pyuria (Pyuria was defined as WBC >10/HPF).

According to urine culture (growth), our study revealed that ninety percent had no growth in urine culture, ten percent of cases had positive urine culture, Seventy percent of organisms were Escherichia coli, which was the most prevalent reason for UTI, followed by Klebsiella sp. (twenty percent), then Staphylococcus (ten percent).

Similarly, our research is in accordance with Yenepalli et al.,[13] who found that forty-six. Kids had positive urine cultures and were diagnosed with urinary tract infections; 396 kids had negative urine cultures and had no UTIs, and the occurrence of UTIs was 10.4% among the studied population. The researchers discovered that the predominant organism identified in urine cultures was Escherichia coli, which was isolated in twenty cases (43.3%) of kids with urinary tract infections. This was followed by Klebsiella pneumoniae, which was isolated in eighteen cases (39.1%). Other isolates involved Pseudomonas aeruginosa (8.6%) and Staphylococcus aureus (8.6%).

In contrast, our results disagreed with Walelgn et al.,[14] who determined the factors and magnitude impacting the UTIs between diabetic cases. They revealed that eighty (22.3%) cases were positive for urinary tract infections based on microscopic urine analysis, while 77.70% were negative. This disagreement can cause a larger sample size in their research than ours.

As regards type and symptoms of UTI, our study reported that five percent of cases had ASB, one percent of cases had Urosepsis, three percent of cases had Cystitis, and one percent of cases had Pyelonephritis. We found that ten percent of cases had Burning micturition, nine percent of cases had Frequent micturition, seven percent of cases had Abdominal pain, five percent of cases had Loin pain, six percent of cases had Fever, and eight percent of cases had Nausea and vomiting.

The present investigation is in accordance with Shah et al.,[15] who assessed The occurrence of UTIs between cases with DM and the correlation of glycemic control with UTIs. They revealed that Cystitis 43.6% and ASB 39.3% were the most prevalent types of Urinary Tract Infection followed by Urosepsis 5.7%, Prostatitis 3.6%, Pyelonephritis 7.9%.

Also, our findings are in agreement with those of Ahmed et al.,[16] who studied the occurrence of UTIs and identified the factors that contribute to an elevated risk of Urinary Tract Infections among people with Diabetes. Additionally, a multivariate analysis was conducted to discover the underlying causes of UTIs. They revealed that 117 (26.6%) cases had burning micturition, 84 (19.1%) cases had frequent micturition, 97 (22.0%) cases had abdominal pain, 71 (16.1%)

had loin pain, 27 (6.1%) had Fever, 32 (7.3%) had high Fever and 17 (3.9%) had Nausea and vomiting.

The present research reported that a statistically insignificant relation was observed among examined groups according to HB, RBCs, PLT, HbA1C, albumin creatinine ratio, while a statistically significant correlation was observed according to WBCs, neutrophils, lymph, fasting blood glucose, and two-hour postprandial glucose.

Also, our findings in agreement with Desouky et al.,[17] who observed which cases diagnosed with urinary tract infection had a significant greeter level of random blood glucose, serum creatinine HbA1c levels, and total leukocyte count in comparison to cases who do not have urinary tract infections.

Our research demonstrates that statistically insignificant variance was observed among diabetic children with controlled and uncontrolled Diabetes regarding the presence of UTI, with a higher percentage of UTI in diabetic children with uncontrolled Diabetes (seventy percent). At the same time, there was a significant negative correlation between CRP, fasting blood glucose, and postprandial blood glucose, while there was no significant correlation between CRP, HbA1c, and glycosuria.

In contrast, our results disagreed with Ntege,[11] who demonstrated that poorly controlled Diabetes xv sugar levels (HBA1C>7.5%) were significantly correlated with the presence of UTIs.

Also, our findings disagreed with Shah et al.,[15] who revealed that a significant correlation was observed among glycemic control and risk of getting UTI and cases with poor glycemic control have more risk of getting urinary tract infections than good glycemic control cases.

4. Conclusion

We concluded that the occurrence of urinary tract infection was elevated across kids aged four to twelve with type 1 diabetes mellitus, and those with poorly controlled glucose levels in T1DM were more susceptible to acquiring urinary tract infections, as a higher percentage of UTI was found in diabetic children with uncontrolled Diabetes (70%). These outcomes call for proper control of regular screening for infections, blood sugar levels, and UTIs, and clinicians could be educated about the appropriate antibiotic use based on culture results.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

Funding

No Funds : Yes

Conflicts of interest

There are no conflicts of interest.

References

1. Korbel L, Howell M, Spencer JD. The clinical diagnosis and management of urinary tract infections in children and adolescents. Paediatr Int Child Health. 2017;37(4):273-279.
2. Balighian E, Burke M. Urinary Tract Infections in Children. Pediatr Rev. 2018;39(1):3-12.
3. Awais M, Rehman A, Baloch NU, Khan F, Khan N. Evaluation and management of recurrent urinary tract infections in children: state of the art. Expert Rev Anti Infect Ther. 2015;13(2):209-231.
4. Abu-Ashour W, Twells L, Valcour J, Randell A, Donnan J, Howse P, et al. The association between diabetes mellitus and incident infections: a systematic review and meta-analysis of observational studies. BMJ Open Diabetes Res Care. 2017;5(1):e000336.
5. Calliari LE, Almeida FJ, Noronha RM. Infections in children with diabetes. J Pediatr (Rio J). 2020;96 Suppl 1(Suppl 1):39-46.
6. 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.
7. Stapleton A. Urinary tract infections in patients with diabetes. Am J Med. 2002;113 Suppl 1A:80S-84S.
8. Qaseem A, Wilt TJ, Kansagara D, Horwitch C, Barry MJ, Forciea MA, et al. Hemoglobin A1c Targets for Glycemic Control with Pharmacologic Therapy for Nonpregnant Adults with Type 2 Diabetes Mellitus: A Guidance Statement Update from the American College of Physicians. Ann Intern Med. 2018;168(8):569-576.
9. Bhugra A, Gachinmath S. Significant bacteriuria among requested repeat urine samples and its clinical correlation. Iran J Microbiol. 2021;13(5):592-601.
10. Heinze PA, Thrupp LD, Anselmo CR. A rapid (4--6-hour) urine-culture system for direct identification and direct antimicrobial susceptibility testing. Am J Clin Pathol. 1979;71(2):177-183.
11. Ntege P. The burden of urinary tract infections among children and adolescents with type 1 diabetes mellitus: bacterial profile and antimicrobial susceptibility (Doctoral dissertation, Makerere University).
12. Kumar R, Kumar R, Perswani P, Taimur M, Shah A, Shaukat F. Clinical and Microbiological Profile of Urinary Tract Infections in Diabetic versus Non-Diabetic Individuals. Cureus. 2019;11(8): e5464. Published 2019 Aug 22. doi:10.7759/cureus.5464
13. Yenepalli M, Spandana V, Priya BP, Kireeti AS, Kumar BS, Ravali Y. Patterns of antimicrobial resistance in urinary tract infections among children aged 1 to 5 years. Journal of cardiovascular Disease Research .2023; VOL. 14 NO. 3
14. Walelgn B, Abdu M, Kumar P. The occurrence of urinary tract infection and determinant factors among diabetic patients at Dessie Referral Hospital, South Wollo, Northeast Ethiopia. SAGE Open Med. 2021; 9:20503121211060614.
15. Shah MA, Kassab YW, Anwar MF, Al Dahoul HK, Menon S, Kaur HJ, et al. Prevalence and associated factors of urinary tract infections among diabetic patients. Health Science Journal. 2019;13(2):1-5.
16. Ahmed AE, Abdelkarim S, Zenida M, Baiti MA, Alhazmi AA, Alfaifi BA, et al. Prevalence and Associated Risk Factors of Urinary Tract Infection among Diabetic Patients: A Cross-Sectional Study. Healthcare (Basel). 2023;11(6):861.
17. Desouky DE, Gabr HM, El-Helbawy M, Hathout HM. Urinary tract infection: Prevalence, risk factors, bacterial etiologies and antimicrobial resistance profile among Egyptian diabetic patients: Urinary tract infection: Prevalence, risk factors, bacterial etiologies and antimicrobial resistance profile among Egyptians. European Journal of Medical and Health Sciences. 2020 Jul 28;2(4). doi: 10.24018/ejmed.2020.2.4.390