

PREVALENCE OF URINARY TRACT INFECTIONS IN DIABETIC PATIENTS

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Abstract

Background and aims: There is evidence that patients with diabetes have an increased risk of asymptomatic bacteriuria and urinary tract infections (UTIs). UTI is the most common bacterial infection in diabetic patients. The aim of this study was to assess the prevalence of UTIs among hospitalized diabetic patients and to identify the most frequent bacteria responsible for UTI. **Material and methods:** The study population included 1470 diabetic patients (847 women and 623 men), admitted to the Diabetes Clinic of the Emergency Clinical County Hospital Timișoara, between January and December 2012. We collected patients' personal history data and performed urine cultures. For statistical analysis we used Graph Pad Prism 5; the significance of the difference between the percentage values was assessed using Fisher's exact test. **Results:** From the total number of patients, 158 had positive urine cultures, meaning 10.7%. Out of the total number of 158 UTIs, 124 (78.4%) were asymptomatic bacteriuria. The most frequent bacteria involved in UTI was *Escherichia coli* (68.9%). **Conclusion:** UTIs are frequent in diabetic patients. Because of the great proportion of asymptomatic forms among diabetic patients, the urine culture should be performed in all hospitalized patients with diabetes.

key words: diabetes mellitus, urinary tract infection, asymptomatic bacteriuria.

Background and aims

The prevalence of diabetes mellitus has increased over the past decades, and it is now approaching epidemic proportions [1]. Worldwide, 371 million people have diabetes [2] and it is estimated that by 2030 this number will reach 552 millions [3]. Changes in lifestyle, aging of the population and the

increasing prevalence of obesity are responsible for this dramatic situation [1]. The number of treated diabetic patients in Romania is around 800,000. In Timis County, more than 22,000 people with type 1 and type 2 diabetes are registered.

Diabetes is one of the top ten causes of death in the world [4] and this fact is due

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especially to its complications. Diabetic kidney disease occurs in 45% of patients with diabetes in the United States of America [5] and it is the leading cause of end-stage renal disease [6]. With the growing number of diabetic patients, the prevalence of diabetic kidney disease will also increase [7]. Hyperglycemia and hypertension are the major risk factors for initiation of chronic kidney disease [8] but other factors, such as repeated episodes of acute kidney injury (infections, drugs, or nephrotoxins) can also contribute to its progression.

In diabetic patients, it is generally accepted that infections are frequent causes of morbidity and mortality [9]. Immunologic defects contribute to the increased risk for infection: impaired neutrophil function, low levels of prostaglandin E, thromboxane B₂, leukotriene B₄, decreased T cell-mediated immune response, etc. [9-11]. Other conditions such as incomplete bladder emptying due to autonomic neuropathy and high glucose concentration in the urine allow urinary colonization by microorganisms [11,12]. There is evidence that patients with diabetes have an increased risk of asymptomatic bacteriuria and urinary tract infections (UTIs) [10,11], UTIs being the most common bacterial infections in diabetic patients [13]. Moreover it is important to recognize and to treat UTIs in diabetic patients because of their possibly severe complications, including bacteremia, renal abscess, renal papillary necrosis [11,12,14]. To treat UTI in diabetics is difficult because of its frequent recurrence, involving greater costs for the medical system and for the patient himself.

The *aim* of the present study was to assess the prevalence of UTI among hospitalized

diabetic patients and to identify the most frequent bacteria responsible for it.

Material and methods

Study population. We performed a hospital-based study conducted at the Diabetes Clinic of the Emergency Clinical County Hospital Timișoara, involving patients admitted in 2012 (January - December). The study was approved by the Ethics Committee of the hospital.

We collected for urine culture 570 urine samples from a total number of 1470 hospitalized diabetic patients (847 women and 623 men), with both type 1 and type 2 diabetes mellitus. Urine culture was performed in patients with a suspected UTI: symptoms suggesting UTI (dysuria, urgency, frequency, supra-pubic pain or tenderness, fever) or urinalysis with the presence of nitrite, leukocyte esterase, more than 5 white blood cells per high power field. We also collected patients' personal history data.

Definitions. *Significant bacteriuria* was defined as the presence of $\geq 10^5$ colony-forming units (CFU) per milliliter of urine. A *symptomatic urinary tract infection* was defined as the presence of bacteriuria in a patient with fever or urinary symptoms. *Asymptomatic bacteriuria* (ASB) was defined as bacteriuria without fever or urinary symptoms.

Lower UTI (cystitis) was diagnosed in the presence of dysuria, urgency, frequency of urination, suprapubic pain or tenderness. *Upper UTI (pyelonephritis)* was characterized by the presence of fever (without another obvious etiology) with or without the above mentioned symptoms.

Diabetes was defined according to the World Health Organization's criteria as a fasting plasma glucose ≥ 7.0 mmol/l (126 mg/dl) or a 2-h plasma glucose ≥ 11.1 mmol/l (200 mg/dl) during an OGTT [15,16].

Urine analysis. Urine specimens were collected during hospitalization. The criteria for ordering an urine culture were: urinary symptoms (dysuria, urgency, frequency or suprapubic pain or tenderness) with or without fever at presentation or during hospitalization, modified urinalysis (positive nitrite, positive leukocyte esterase, more than 5 white blood cells per high power field), fever or high leukocyte count of unknown etiology.

Urine was collected in sterile uricols as clean-catch midstream samples and transported to the laboratory within one hour of collection. Quantitative bacterial culture of a urine specimen was performed by inoculating culture media (Columbia agar supplemented with 5% sheep blood and MacConkey agar) with a measured amount of urine with calibrated loop designed to deliver a known volume. The identification of germs was based on colonial appearance and biochemical characteristics. Final bacterial identification was performed using the automatic Vitek2 Compact System (bioMérieux France).

Statistical analysis. Patients' data were collected using an Excel worksheet database. Statistical analysis was performed in Graph Pad Prism 5. Prevalence is expressed as percentage from the studied population having the specified condition. The significance of the difference between percentage values was assessed using Fisher's exact test. $P < 0.05$ was considered statistically significant.

Results

We evaluated the frequency of UTI in the diabetic patients of our study group. Out of the total number of hospitalized patients, 158 (10.7%) had UTI.

In order to estimate if there is a difference regarding the prevalence of UTI in type 1 and type 2 diabetes patients, we collected the data shown in [Table 1](#).

Table 1. The prevalence of UTI by type of diabetes.

	Type 1 DM	Type 2 DM	Total
With UTI	16 (12.8%)	142 (10.5%)	158
Without UTI	109 (87.2%)	1203 (89.5%)	1312
Total	125	1345	1470

We observed that 12.8% of type 1 and 10.5% of type 2 diabetic patients had UTI. The difference was not statistically significant ($p = 0.45$).

Regarding the difference between genders, 15.3% of women and 4.5% of men developed UTI, an extremely significant difference ($p < 0.0001$) ([Table 2](#)).

Table 2. The prevalence of UTI by genders.

	Women	Men	Total
With UTI	130 (15.3%)	28 (4.5%)	158
Without UTI	717 (84.7%)	595 (95.5%)	1312
Total	847	623	1470

Out of the total number of 158 UTIs, 22 (13.9%) were lower UTIs, 12 (7.6%) were upper UTIs and 124 (78.4%) were ASBs.

From all 1470 hospitalized diabetic patients, lower UTI occurred in 1.5%, acute pyelonephritis in 0.8%, and ASB in 8.4% of the cases. There was no significant difference between the certain localizations of UTI in patients with type 1 and type 2 diabetes ([Table 3](#)).

Table 3. The prevalence of UTIs by site of infection and type of diabetes.

	Type 1 DM (%)	Type 2 DM (%)	<i>p</i>
Lower UTI	2.4	1.4	0.4
Upper UTI	1.6	0.8	0.27
ASB	8.8	8.3	0.8
Total (%)	12.8	10.5	

The prevalence of lower UTI, upper UTI and ASB in women was: 2%, 1.1% and 12.2%, respectively. In men, the proportions were: 0.8%, 0.5% and 3.2%, respectively (Table 4). The difference between genders can be explained by the fact that, due to anatomical differences of the urinary tract, usually, the prevalence of UTIs in men is lower than in women. If present, an UTI in men is leading to symptoms, ASB being a very rare condition.

Table 4. The prevalence of UTI by site of infection and by gender.

	Women (%)	Men (%)	<i>p</i>
Lower UTI	2	0.8	0.08
Upper UTI	1.1	0.5	0.2
ASB	12.2	3.2	<0.0001
Total (%)	15.3	4.5	

If considering the most frequent bacteria involved in UTI, we found that 109 (68.9%) were with *E. coli*, 22 (13.9%) with *Klebsiella species* (spp.) and the remaining 17.2% with other microorganisms: *Candida* spp. 10 (6.4%), *Proteus* spp. 6 (3.8%), *Enterococcus* spp. 4 (2.6%), *Streptococcus* spp. 2 (1.3%), *Pseudomonas* spp. 2 (1.3%), *Citrobacter* spp. 1 (0.6%), *Acinetobacter* spp. 1 (0.6%), *Staphylococcus* spp.1 (0.6%) (Figure 1).

Distribution of the microorganisms implicated in UTI

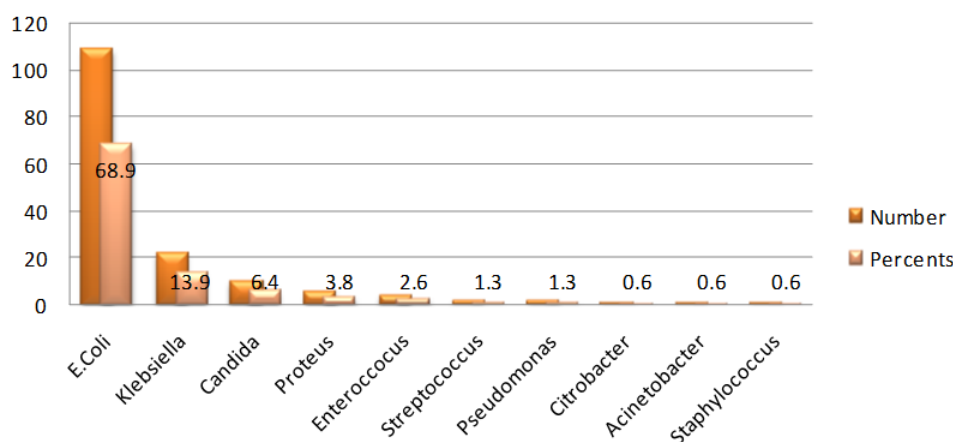


Figure 1. Distribution of the microorganisms encountered in UTI.

Regarding the 109 UTI with *E. coli*, 14 (13%) were lower UTI, 11 (10%) upper UTI and 84 (77%) ASB. From the total number of 22 UTI with *Klebsiella* spp. 5 (22.8%) were lower UTI, 1 was upper UTI (4.5%) and 16 (72.7%) were ASB.

Out of the total number of lower UTI, *E. coli* was responsible for 14 (63.6%) and

Klebsiella spp. for 5 (22.7%) of them ($p = 0.014$). When upper UTIs were analyzed (12 cases), we saw that *E. coli* was responsible for 11 (91.7%) and *Klebsiella* spp. for 1 (8.3%) of the cases ($p = 0.0001$). It is obvious that these two bacteria caused all the upper UTIs from the studied group. From the total number of ASB, *E. coli* determined 84 (67.7%) positive

urine cultures and *Klebsiella* spp. 16 (12.9%), with $p < 0.0001$.

Discussions

The prevalence of ASB among diabetic patients in our study, was 8.4%, higher in women (12.2%) than in men (3.2%). Our result is similar to the one noted in a meta-analysis of twenty-two studies regarding ASB in diabetic patients, which found a prevalence of ASB of 12.2%, with 14.2% in women and 2.3% in men [17]. Another study conducted in Manitoba, Canada, which enrolled 1,072 out-patient diabetic women, showed a prevalence of ASB of 7.9% [18]. In a study conducted at the University-Hospital of Pisa (Italy), that included 10,221 diabetic and non-diabetic patients, the prevalence of ASB in diabetic women was 14.97% [19].

The bacteria associated with UTI were predominantly *E. coli* (68.9%) and other *Enterobacteriaceae* (20.2%). These findings are similar to those observed by Boyko et al. [11] on 218 diabetic postmenopausal women indicating that the prevalence of *E. coli* was 74.4% and of *Klebsiella* spp. 7%. Another case-control study, conducted in New Delhi, India, that evaluated the prevalence of UTI and renal scarring in 155 patients with diabetes, also found that *E. coli* was the most commonly involved organism (64.3%), followed by *Staphylococcus aureus* (21.4%) and *Klebsiella pneumoniae* (14.3%) [20].

We found a high prevalence of UTI caused by fungi (*Candida* species). It is known that diabetes is a predisposing factor for fungal infections of the urinary tract. One of the most important explanations for this predisposition is glycosuria [21]. The majority

of UTIs caused by fungi are clinically asymptomatic. In our study group, 9 of 10 *Candida* infections were ASB and only one could be classified as cystitis.

In our study, 15.3% of diabetic women developed an UTI, result that is similar to the one obtained by Geerlings and coworkers [14] who found a prevalence of 20% in women.

Our study shows that the prevalence of UTI in diabetic patients is three fold higher in women than in men. This important difference can be explained by a variety of men-related factors, such as the greater length of the urethra, the greater distance between the urogenital meatus and the anus, and the antibacterial properties of the prostatic fluid [22].

One of the limitations of this study could be the fact that the urine culture wasn't performed to all hospitalized patients, therefore some positive results could have been omitted, decreasing the real prevalence of UTI.

Conclusions

UTIs are frequent in patients with diabetes. The most frequent uropathogen is *E. coli*, but fungal infections are also common in diabetic patients. Many UTIs are asymptomatic, especially in women. Because of the great proportion of asymptomatic UTIs among diabetic patients, we suggest that urine culture should be performed in all hospitalized diabetic patients. In addition, considering the high prevalence of ASB in diabetics, this condition could represent one of the causes leading to an unexplained worsening of the glycemic control in some patients.

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