Asymptomatic bacteriuria, urinary tract infection and risk factors in women with type 2 diabetes mellitus and impaired glucose tolerance

Tip 2 Diyabet hastalığı ve bozulmuş glikoz toleransı olan kadınlarda asemptomatik bakteriüri ve üriner sistem enfeksiyonları

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ABSTRACT

Objective: We aimed to compare a type 2 diabetic women groups with a women group with impaired glucose tolerance (IGT) for the presence of urinary tract infection (UTI) and/or asymptomatic bacteriuria (ASB) and related risk factors [age, body mass index (BMI), serum HbA1c and creatinine levels, glomerular filtration rate (GFR), and urine microalbumin, urine leukocyte and glucose levels] associated therewith.

Methods: The study population consisted of 416 female patients and divided into two groups as the type 2 diabetes mellitus (DM, n=208) and the IGT (n=208) group. Serum HbA1c and creatinine levels and leukocyte counts, glucose level and microalbumin level in the urine, were measured in the biochemistry laboratory. GFR was calculated using the Cockcroft-Gault formula. Urine samples were inoculated on blood agar and Eosin-Methylene Blue agar medium and incubated for 24-48 hour at 37°C.

Results: ASB was determined in 5 patients (2%) in the DM group and in 15 patients (7%) in the IGT group. UTI was detected in 9 patients (4%) in the diabetic group and in 7 patients (3%) in the IGT group (p>0.05).

ÖZET

Amaç: Çalışmamızda; tip 2 diabetes mellitusu (DM) olan ve bozulmuş glikoz toleransı (BGT) olan iki kadın hasta grubunun üriner sistem infeksiyonu (ÜSİ) ve asemptomatik bakteriüri (ASB) varlığı ve ilişkili risk faktörleri açısından karşılaştırılması amaçlandı. Risk faktörleri olarak; yaş, vücut kitle indeksi (VKİ), serum HbA1c ve kreatinin seviyeleri, glomerüler filtrasyon oranı (GFR), idrardaki lökosit sayısı, glikoz miktarı ve mikroalbumin düzeyi seçildi.

Yöntem: Diyabetli 208 kadın hasta ve BGT'si olan 208 kadın hasta çalışmaya dahil edildi. Serum HbA1c ve kreatinin seviyeleri ve idrardaki lökosit sayısı, glikoz miktarı ve mikroalbumin düzeyi biyokimya laboratuvarında ölçüldü. GFR, Cockcroft-Gault formula kullanılarak hesaplandı. Hastalardan alınan orta akım idrarı mikrobiyoloji laboratuvarında kanlı agar ve EMB agara ekildi.

Bulgular: Diyabetli hasta grubunda beş (%2) hastada, BGT hasta grubunda 15 (%7) hastada ASB saptandı. ÜSİ; diyabetik grupta dokuz (%4) hastada , BGT hasta grubunda yedi (%3) hastada belirlendi (p>0.05). Piyüri; her iki hasta grubunda ASB ile ilişkili risk faktörü idi

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Pyuria was found as an ASB-related risk factor in both groups (p<0.05). BMI (p=0.041), creatinine (p=0.045) and GFR (p=0.035) were determined as UTI-related risk factors in the diabetic group. In addition, pyuria was found as UTI-related risk factors in IGT group (p=0.019). *Escherichia coli* was the most prevalent pathogen (89%).

Conclusion: We suggest that high BMI and creatinine levels and low GFR are risk factors for UTI in patients with type 2 DM. Additionally this is a first study to detect that UTI and ASB may develop in patients with IGT, just as in diabetic patients. Considering a similar frequency of UTI and ASB in patients with IGT and with type 2 DM, urine culture may be performed in IGT patients with pyuria.

Key Words: diabetes mellitus, impaired glucose tolerance, urinary tact infection, asymptomatic bacteriuria

(p<0.05). Diyabetli grupta; VKİ (p=0.041), kreatinin (p=0.045) ve GFR (p=0.035) ÜSİ ilişkili risk faktörü olarak saptandı. BGT hasta grubunda ise sadece piyüri; ÜSİ ile ilişkili (p=0.019) risk faktörü olarak belirlendi. Hem ASB'si olan hem de ÜSİ olan hastalarda en fazla *Escherichia coli* izole edildi (%89).

Sonuç: Yüksek VKİ ve serum kreatinin seviyesi ve düşük GFR'nin tip 2 diyabetes mellitusu olan hastalarda ÜSİ gelişimi açısından risk faktörü olduğunu düşünmekteyiz. Ayrıca bu çalışma; BGT olan hastalarda da hem ASB hem de ÜSİ gelişme riskinin diyabetli hastalar ile aynı olduğunu gösteren ilk çalışmadır. Her iki hasta grubunda ASB ve ÜSİ oranının benzer olduğu düşünülürse, özellikle pyüri saptanan BGT'si olan hastalarda da idrar kültürü yapılmasını önermekteyiz.

Anahtar Kelimeler: Diabetes mellitus, bozulmuş glikoz toleransı, üriner sistem infeksiyonu, asemptomatik bakteriüri

INTRODUCTION

Diabetes mellitus (DM) is a chronic disease, which is quite common in our country and around the world. DM affects the immune system of the patient, rendering the individual susceptible to many infections such as urinary tract infection (UTI). Decrease of polymorphonuclear leukocytes migration, phagocytosis and chemotaxis capabilities, increase in endothelial adhesion, diabetic nephropathy and neuropathic complications, reduction of bladder emptying and high glucose concentration of urine as a medium for bacterial proliferation cause urinary tract infections in diabetic patients (1-3).

There is also an intermediate group of individuals whose glucose levels do not meet the criteria for diabetes, but yet, the levels are higher than that considered normal. These individuals are defined as having impaired fasting glucose (IFG) [fasting plasma glucose (FPG) levels 100 mg/dl to 125 mg/dl] or impaired glucose tolerance (IGT) with impaired response to oral glucose intake [2-h values in the oral glucose tolerance test of 140 mg/dl to 199 mg/dl]. Patients with IFG and/or IGT have been referred to as having pre-diabetes, indicating the relatively high risk for the future development of diabetes and its complications like cardiovascular disease (4,5).

Asymptomatic bacteriuria (ASB) is the presence of bacteria higher than 105 CFU/ml in two urine cultures within 24 hours without urinary complaints. This condition demonstrates colonization of the lower urinary tract with microorganisms. In a meta-analysis that examined 22 different studies, the prevalence of ASB in diabetic patients was reported to be more than that in healthy controls. In addition to this, the incidence of microalbuminuria and

urinary tract infections is higher in diabetic patients with asymptomatic bacteriuria (6). In several studies (7,8), treatment of ASB has not been recommended in healthy people and in diabetic patients with metabolic control, but it has been recommended in diabetic patients without metabolic control. Detection of ASB is very important, especially in patients without metabolic control.

UTI and ASB in diabetic patients have been the subject of numerous studies, but there are no studies in the literature in patients with IGT. In this study, we aimed to compare the diabetic patient group and the patient group with IGT in terms of the presence of uncomplicated lower UTI, ASB and the related risk factors. The risk factors were determined as age, gender, body mass index (BMI), serum HbA1c and creatinine levels, glomerular filtration rate (GFR), and urine microalbumin, leukocyte and glucose levels. Therewith, antibiotic susceptibility tests were performed and the empirical treatment options were discussed.

MATERIAL and METHOD

Study design

This prospective study was carried out in X Hospital, Turkey, between April 2013 and July 2016. The study was in accordance with the principles outlined in the Declaration of Helsinki. Ethical approval was received from the local Human Research Ethics Committee (No: 2013/3). Written informed consent was obtained from all patients. The study population consisted of 416 female patients. The patients were diagnosed as type 2 DM and IGT according to the American Diabetes Association (ADA) criteria (4). The study population was divided into two groups as the DM (208 patients, mean age 56.5) and the IGT (208 patients, mean age 47) group. Children, pregnant women, patients who had recently undergone surgery, patients who had used antibiotics in the last 14 days, patients with urinary tract abnormalities, patients with urinary catheters, those with suppressed immune system, dialysis patients, and cancer patients were excluded from the study.

Sample collection and laboratory analysis

After an overnight fasting, venous blood samples were collected into an evacuated serum separator clot activator tube (Vacuette® Z Serum Sep Clot Activator, GreinerBio-One, Kremsmunster, Austria) for glucose and creatinine analyses between 9 and 10 a.m. The blood samples were centrifuged at 1500 × g for 10 min within 1 hour after collection. For HbA1C measurements, venous blood samples were collected into 2.0 mL dipotassium (K2) ethylene diamine tetraacetic acid (EDTA) vacuum tubes (BD Vacuteiner® BD-Plymouth, UK). After collecting the blood samples, HbA1C measurement was immediately performed without delay. Measurement of HbA1C was performed on the Roche Cobas 6000's module C501 (Roche Diagnostics GmbH, Mannheim, Germany) based on the turbidimetric inhibition immunological method using original reagents. The levels of serum fasting glucose and creatinine, and the levels of spot urine microalbumin were analyzed on the Roche Cobas 6000's module C501 using original reagents. The serum glucose levels were analyzed based on the hexokinase method, the creatinine levels were analyzed based on the Jaffe kinetic colorimetric method, and the spot urine microalbumin levels were analyzed based on the turbidimetric method. Corrected microalbumin was calculated using urinary the microalbumin-to-creatinine ratio. GFR was calculated using the Cockcroft-Gault formula (9).

Mid-stream urine samples were obtained using the midstream clean-catch technique. Either the evacuated sterile plastic containers for urine culture or the non-sterile plastic containers (Fırat Med, Ankara, Turkey) for rapid urinalysis and microalbumin were used for collection of the urine samples. Contaminated specimens were excluded from the study. All urine samples were collected on the morning of the examination, processed within 2 hours after collection, and within 30 minutes after

their submission to the laboratory. Automated urine analysis and quantitative culture were applied to all specimens. Urinalysis was performed by a trained technician in the biochemistry laboratory. Urine culture was performed in a microbiology laboratory, and bacterial concentrations were determined by a single microbiologist. A 5-milliliter sample was applied for rapid urinalysis. Urine glucose levels were analyzed on the Dirui FUS-200/H-800 automatic urinalysis system (Changchun Dirui Industry, Jilin, China) using the URISTIK H-11 Reagent Strips (Changchun Dirui Industry, Jilin, China). Microscopic examination of leukocytes was performed on the Dirui FUS-200/H-800 automatic urinalysis system. Leukocytes were counted per high-power field (hpf, 400 x magnification). The counts in every hpf correspond to particle/µL x 6.25. A leukocyte count of > 5/µL was considered pyuria (10).

Urine samples were inoculated on blood agar (RTA, Nazar Tip, Izmir, Turkey) and Eosin-Methylene Blue (RTA) agar medium and incubated for 24-48 hour at 37°C. Identification and antibiotic susceptibility tests were performed on the automated BD Phoenix system (BD Diagnostics, Sparks, MD) and evaluated according to Clinical and Laboratory Standards Institute (CLSI) Document M100-S24 (11). ASB was defined as the presence of >105 CFU/mL of one or two microorganism in two subsequent cultures of urine from patients without fever or urinary complaints. Uncomplicated lower urinary tract infection was defined as acute symptoms such as dysuria, urgency, pollakuria or suprapubic tenderness, and in the presence of a positive urine culture (> 104 CFU/ml of a urinary pathogen) (7,8).

Statistical analysis

Statistical analyses were performed using the SPSS 13.0 for Windows (SPSS Inc., Chicago, IL, USA). All data were tested for normality using the Kolmogorov-Smirnov test. The continuous variables were presented as median and interquartile ranges (IQR) or mean ± standard deviation (SD) according to the normality of the data. The categorical variables were expressed as percentages. The comparisons of the continuous variables between the study groups were made using the Mann Whitney-U or unpaired t test according to the normality of the data. The comparisons of categorical data were made using the Chi-square test. The risk factors that were effective on ASB and UTI were assessed by binary logistic regression analysis using the backward wald with the likelihood ratio method. The power of risk factors was expressed as the odds ratio (OR) with 95% confidence intervals (CI). In the binary logistic analysis, the following parameters were included as risk factors: gender, age, body mass index (BMI), HbA1c, creatinine, GFR, microalbumin, glucosuria and pyuria. A P value of less than 0.05 was considered statistically significant.

RESULTS

The study population consisted of 416 female patients who were diagnosed as type 2 DM (208 patients, mean age 56.5) and IGT (62 patient, mean age 47). The demographic data and the results of laboratory test parameters of the patients have been presented in Table 1. There was a difference between two groups for age (p<0.001, Table 1). The levels of HbA1c, GFR, microalbumin and glucosuria were different in DM group compared to the IGT group (p<0.001, p=0.008, p<0.001, p<0.001respectively, Table 1). No difference was determined between the study groups with regard to the other parameters (Table 1).

ASB was determined in five (2%) patients in the DM group and in 15 (7%) patients in the IGT group. UTI was detected in nine (4%) patients in the DM group and in seven (3%) patients in IGT group (p > 0.05, Table 1).

In the logistic regression analysis, pyuria was found as an ASB-related risk factor in the DM and the IGT groups (OR: 1.043; 95% CI: 0.994 to 1.828; p= 0.014, OR: 0.997; 95% CI: 0.814 to 1.688; p= 0.020, respectively, Table 2). BMI (OR: 1.460; 95% CI: 1.016

Table 1. Comparison of demographic data and laboratory test parameters of patients between DM and IGT group

Parameters	DMgroup (N = 208)	IGTgroup (N = 208)	Statistical Analysis P
Age (years)	56.5 (49.3 - 63.0)	47.0 (40.0 - 53.0)	< 0.001*
BMI (kg/m^2)	32.2 ± 5.7	32.9 ± 5.3	0.230
HbA1c (%)	7.8 (6.4 - 9.8)	5.7 (5.5 - 6.1)	< 0.001*
Creatinine (mg/dL)	0.79 (0.69 - 0.91)	0.77 (0.69 - 0.87)	0.247
GFR (mL/min)	107.0 (82.6 - 126.3)	113.8 (100.1 - 142.2)	< 0.001*
Microalbumin (mg/g crea)	12.0 (5.3 - 27.0)	6.0 (3.0 - 13.8)	< 0.001*
Glucosuria (mg/dL), N (%) Negative (< 50 mg/dL) + (> 50 - < 150 mg/dL) ++ (> 150 - < 500 mg/dL) +++ (> 500 mg/dL)	 194 (93) 2 (1) 2 (1) 10 (5)	 208 (100) 0 0 0	 < 0.001*
Pyuria (WBC/µL)* ≤ 5/µL > 5/µL	 182 (88) 26 (12)	 169 (81) 39 (19)	 0.09 0.684
ASB, N (%)	5 (2)	15 (7)	0.488
UTI, N (%)	9 (4)	7 (3)	0.210

Abbreviations: IQRs: Interquartile ranges, DM: Diabetes mellitus, IGT: Impaired glucose tolerance, BMI: Body mass index, GFR: Glomerular filtration rate, WBC: White blood cell, ASB: Asymptomatic bacteriuria, UTI: Urinary tract infection. Data were presented as median and interquartile ranges (IQR) or mean ± standart deviation (SD) according to the normality of data. The comparisons of continuous variables between study groups were analyzed with Mann Whitney-U or unpaired *t* test according to the normality of data. For categorical data, Chi-square test was used. A P value less than 0.05 was considered statistically significant.
*Cut-off value for leukocyte in microscopy is > 5 WBC/µL[10]

to 2.099; p = 0.041, Table 2), creatinine (OR: 1.341; 95% CI: 0.925 to 1.918; p= 0.045, Table3), and GFR (OR: 1.907; 95% CI: 1.129 to 2.493; p= 0.035, Table 3) were determined as UTI-related risk factors in the DM group. Furthermore, pyuria was found to be a UTI-related risk factors in the IGT group (OR: 2.103; 95% CI: 1.010 to 3.943; p= 0.019, Table 3).

Thirty-seven bacterial strains were isolated from 36 urine samples (Table 4). Each bacterium was found to more than 105 CFU/ml. Two different gram-negative bacilli (*Klebsiella pneumoniae, Escherichia coli*) were isolated in one diabetic patient with UTI. *E. coli* was the most prevalent pathogen (34/37, 91%) in diabetic subjects and in patients with IGT. *Streptococcus agalactiae* was isolated in one patient with IGT. *K. pneumoniae* was isolated in one woman with UTI in IGT group. Trimethoprim/Sulfamethoxazole (TMP/SXT) resistance was determined in Enterobacteriaceae as 24% (9/37), respectively, the ampicillin and amoxicillin/clavulanate resistance was determined as 16% (6/37), and the nitrofurantoin resistance as 5% (2/37). Extended spectrum beta lactamase (ESBL) production was found only in one of *E. coli* strain isolated from the IGT group with ASB. This strain was resistant to ampicillin, AMC, ciprofloxacin, ceftriaxone, ceftazidime, aztreonam, cefepime, and cefixime. *S. agalactia* was resistant only to TMP/SXT.

Table 2. Binary logistic regression analysis of ASB-related risk factors in the DM and the IGT groups

	DM (N = 208)				IGT (N = 208)			
Risk factors	OR	95% CI for OR		Logit P	OR	95% CI for OR		Logit P
		Lower	Upper			Lower	Upper	
Pyuria (WBC/µL)	1.043	0.994	1.828	0.014*	0.997	0.814	1.688	0.020*

Abbreviations: DM: Diabetes mellitus, IGT: Impaired glucose tolerance, OR: Odds ratio, CI: Confidence interval. Data were analyzed with logistic regression analysis using backward wald with likelihood ratio method. A P value less than 0.05 was considered statistically significant.

Table 3. Binary logistic regression analysis of ASB-related risk factors in the DM and the IGT groups

	DM (N = 208)				IGT (N = 208)			
Risk factors	OR	95% CI for OR		P (Logit)	OR	95% CI for OR		P (Logit)
		Lower	Upper			Lower	Upper	
BMI (kg/m^2)	1.460	1.016	2.099	0.041*	0.0	0.0	0.0	0.995
Creatinine (mg/dL)	1.341	0.925	1.918	0.045*	0.971	0.822	1.213	0.078
GFR (mL/min)	1.907	1.129	2.493	0.035*	0.738	0.501	1.088	0.125
Pyuria (WBC/µL)	0.0	0.0	0.0	0.998	2.103	1.010	3.943	0.019*

Abbreviations: DM: Diabetes mellitus, IGT: Impaired glucose tolerance, OR: Odds ratio, CI: Confidence interval, BMI: Body mass index, GFR: Glomerular filtration rate. The data were analyzed with logistic regression analysis using the backward wald with the likelihood ratio method. A P value of less than 0.05 was considered statistically significant.

Table 4. Bacterial strains isolated in DM and IGT groups

Bacteria	DM (n=208)		IGT (n=208)	
	UTI (N=9)	ASB (N=5)	UTI (n=7)	ASB (n=15)
E. coli	9	5	5	15
*K. pneumoniae**	1	0	1	0
S. agalactiae	0	0	1	0

Abbreviations: DM: Diabetes mellitus, IGT: Impaired glucose tolerance, ASB: Asymptomatic bacteriuria, UTI: Urinary tract infection.
*Two different gram-negative bacilli (Klebsiella pneumoniae, Escherichia coli) were isolated in one diabetic patient with UTI.

DISCUSSION

The prevalence of ASB and UTI and the related risk factors in diabetic patients have been investigated in several studies. Our study has focused on the ASB and UTI in patients with DM and IGT.

Considering the demographic data, a significant difference was determined between the two groups in terms of age. The risk of developing diabetes mellitus in later life is greater in individuals with IGT, also referred to as prediabetes (5). Therefore, a higher number of young individuals in the IGT group are an expected result. In this study, the patients who were selected were those who gave written informed consents regardless of gender. For this reason the number of women may have been higher in the IGT group.

The levels of HbA1c, GFR, microalbumin and glucosuria were different in the DM compared to the IGT group ($p<0.05$). This is an expected result and these values will be naturally higher in the DM group than the IGT group.

In the present study, we found ASB in five of 208 (2%) type 2 DM women, and in 15 of 208 (7%) patients with IGT. There was no significant difference in the ASB ratio between the two groups in our study ($p>0.05$). According to a meta-analysis, ASB was higher in diabetic individuals than the control groups (6). Furthermore, ASB was reported to be a risk factor for the development of UTI (12,13). There are also studies showing that there is no difference between DM patients and healthy control groups with regard to the ASB ratio (14-16). The frequency of ASB varied between 6% and 28% in previous studies (6,12,14). Our ASB frequency was lower than the rates reported in diabetic patients. To the best of our knowledge there is no study about this subject previously and for this reason, we could not compare the ASB frequency in patients with IGT. Due to the presence of similar results in ASB rates in the DM and the IGT groups, we believe that ASB in diabetic patients may occur in patients with IGT, and that this should be paid attention to.

It is a well known fact that the UTI frequency in diabetic patients is higher than that in healthy individuals (3,15,16). The UTI incidence in diabetic patients is approximately twice that of non-diabetic patients (14). In our study, the UTI frequencies were 4% (9/208) and 3% (7/208) in the DM group and the IGT group, respectively. Due to the statistically similar results ($p>0.05$), we consider that the risk of developing UTI in patients with IGT should not be underestimated.

In our study, the risk factors for ASB and UTI were determined as age, body mass index (BMI), serum HbA1c and creatinine levels, glomerular filtration rate (GFR), and urine microalbumin, leukocyte and glucose levels in the DM and the IGT groups. Pyuria, BMI, GFR, and creatinine levels were determined to be associated with UTI in the DM group. Only pyuria was found as an ASB-related risk factor in the IGT group.

Pyuria is a universal component accompanying symptomatic urinary tract infection. Turan et al. and Boroumond et al. demonstrated a positive relationship between pyuria and bacteriuria (17,18). However, pyuria is also present in other infectious diseases (*Chlamydia* and *Trichomonas* infections, etc), as well as in vaginal, bladder or renal conditions (stones, etc). There are several laboratory methods to test for the presence of pyuria, with variable sensitivity and specificity. These include a dipstick test to screen for leukocyte esterase, manual microscopy, and automated microscopy. The reported sensitivities of automated methods for detection of UTI range from 71 to 98%, with specificities of 55 to 92% (19). The latest guidelines agree that pyuria is consistent with, but not diagnostic for, acute uncomplicated UTI (20). In several studies, it has been reported that the presence of pyuria is not useful for differentiating between symptomatic or asymptomatic UTI (14,21,22). In the present study, pyuria was determined to be a significant risk factor for UTI in diabetic patients, as well as for ASB in the IGT group. Despite the numerous studies that have been carried out, the relationship between urinary tract infection and asymptomatic bacteriuria with pyuria and is still unclear.

Multiple potential mechanisms typical to diabetes may contribute to the increased risk of UTI in diabetic patients. A paper from Saudi Arabia found the following factors to be associated with an increased risk of UTI among patients with diabetes: female sex, hypertension, insulin therapy, BMI and nephropathy (microalbuminuria) (23). Wilke at al. determined that older age, the female gender, high HbA1c and low GFR levels increased the risk of UTI (24). In the present study, the BMI, GFR, and the creatinine levels were determined to be associated with UTI in diabetic patients. In particular, the determination of low GFR and high creatinine levels in the diabetic group explains that microvascular complications such as nephropathy lead to urinary tract infection.

Various risk factors associated with ASB in diabetic patients, especially in women, have been the subject of many studies. Although HbA1c appears to be the most frequent risk factor for ASB in diabetic women (17,25,26); serum creatinine levels, microalbuminuria (27), glycosuria (17,18), the female gender and older age are the other risk factors (27). In our study, only pyuria was determined as an ASB-related risk factor in the IGT group. The relationship between ASB/UTI and pyuria has been discussed above.

In our study, *E. coli* was the most frequently (89%) isolated bacteria. *E. coli* is still the most commonly isolated bacteria in DM and non-diabetic patients with ASB and UTI (23,28-30). In our study, there was no significant antibiotic resistance profile in the DM and the IGT groups. While Bonadio et al. did not find any difference in the resistance profile in DM and non-DM patients with ASB (31). Ravvat et al. determined antibiotic resistance mechanisms such as ESBL and AmpC in bacteria isolated from various clinical specimens in diabetic patients (28). Due to the small number of ASB and UTI in patients participating in our study, we cannot comment on the antibiotic therapy options. We just consider the detecting of ESBL in an *E. coli* isolate in the IGT group with ASB remarkable.

In diabetic patients with metabolic control, ASB does not require treatment, but it should be treated in diabetic patients without metabolic control (7,8). Certain other studies have found that diabetic women with ASB do not have an increased risk for a faster decline in renal function, and the treatment of ASB is unnecessary in diabetic women (32-34). It appears that there is yet no consensus on the treatment of diabetic patients with ASB. Based on our results, the

risk of developing ASB in patients with IGT should not be neglected as in diabetic patients.

This publication is the first study reporting that patients with impaired glucose tolerance may develop urinary tract infections and asymptomatic bacteriuria, just as in diabetic patients. A similar frequency of UTI and ASB was determined in patients with impaired glucose tolerance and those with type 2 diabetes. We suggest that high BMI and creatinine levels and low GFR are risk factors for UTI in patients with type 2 diabetes mellitus. *E. coli* is the most frequently isolated bacteria in patients with IGT and in diabetic patients with both ASB and UTI. Routine urine culture can be recommended in patients with diabetes mellitus, even when there is no urinary symptom, but when there is one or more of the risk factors such pyuria identified in this study. Despite no detection of risk factors other than pyuria, considering a similar frequency of UTI and ASB in patients with impaired glucose tolerance and with type 2 diabetes, in order to monitor the condition, urine culture may be performed in patients with impaired glucose tolerance when pyuria is detected.

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