Research Article

Urinary tract infection in type 2 diabetic patients: risk factors and antimicrobial pattern

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ABSTRACT

Background: Diabetes increases the risk of infection and the commonest amongst them are the ones involving the genitourinary tract. Diabetic patients are found to have an increase in the risk of developing urinary tract infection (UTI) by 60%. The study aimed to determine the causative pathogens and their antimicrobial pattern, identify risk factors associated in type 2 diabetic subjects having UTI.

Methods: This was an observational study conducted in the medicine unit of a tertiary care hospital over a period of 8 months. A total of 619 (M:F 289:330) type 2 diabetic subjects were studied. History, clinical examinations, and the duration of diabetes were recorded in all patients at admission. Diabetes was diagnosed based on the WHO criteria. An immunoturbidimetric method was used to estimate glycosylated hemoglobin (HbA1C%). Diagnosis of UTI was made from midstream urine samples of patients if the urine cultures has $>10^3$ to $>10^5$ colony forming units (CFUs)/mL of a pathogen.

Results: Among the 619 diabetic patients 220 patients had pus cells in urine but 72 patients had insignificant colony count. 90 (60.8%) patients were more than 60 years old, 48 (32.4%) were in the age group of 40-60 years and 10 (6.7%) were less than 40 years old. Among the 148 patients studied 52 (35.1%) were males and 96 (64.9%) were females. 116 (78.4%) had diabetes for more than 15 years and the rest had a duration lesser than 15 years. The HbA1C of patients with and without UTI were 10.2 ± 1.6 and 8.4 ± 1.3 respectively. Gram negative bacilli were isolated from 129 (87.2%) patients which included E. coli in 75 (50.7%), Klebsiella in 30 (20.3%), Pseudomonas species in 12 (8.1%) and Citrobacter in 12 (8.1%). Gram positive cocci were responsible for UTI in 15(10.1%) of subjects including Enterococcus in 13 (8.9%) and Staphylococcus in 2 (1.3%). Gram negative bacilli including E. coli, the Klebsiella species, pseudomonas and Citrobacter had good response to piperacillin-tazobactum, cefoperazone sulbactum, imipenam and amikacin. Gram positive cocci (Enterococcus and Staphylococcus) responsible for UTI showed good susceptibility to vancomycin (81 and 94% respectively) but a high resistance to ciprofloxacin and tetracyclines (68 and 57% respectively).

Conclusions: Female gender, age and duration of diabetes were found to have increased risk factors for developing UTI in diabetes. Escherichia coli was the commonest organism causing UTI in diabetes which showed good response to piperacillin/tazobactum, cefoperazone-sulbactum, imipenam and amikacin.

Keywords: Urinary tract infection, Type 2 Diabetes, Risk factors, Antimicrobial pattern, Glycosylated hemoglobin

INTRODUCTION

Genito urinary tract infection is the commonest among infections affecting the diabetic patient. Diabetic patients are found to have an increase in the risk of urinary tract infection (UTI) by 60%.[1] UTI in diabetes involve the upper tract in 80%, are bilateral in most cases and are more prone for developing complications.[2] Changes in

host defence mechanisms, the presence of diabetic cystopathy and of microvascular disease in the kidneys may play a role in the higher incidence of UTI in diabetic patients.[3] Diabetic patients are at a high risk of development of UTIs, so it is recommended that special attention is paid to them especially for the management of bacterial UTIs.[4] Various risk factors such as sexual intercourse, age, duration of diabetes, glycemic control, and complications of diabetes are associated with UTI.[5] Hyperglycemia facilitates the colonization and growth of variety of organisms. Antimicrobial therapy should be guided both by in vitro sensitivity and clinical response. Resistance pattern for antibiotics in diabetic patients differ from non-diabetic patients.

Aim

The aim of the study was to determine the causative pathogens and their antimicrobial pattern, and identify risk factors associated in type 2 diabetic subjects having UTI.

METHODS

This was an observational study conducted in the medicine unit of a tertiary care hospital (M.E.S Medical College, Perithalmanna) in south India over for a period of 8 months. A total of 619 (M:F 289:330) type 2 diabetic subjects were studied during the period. Written informed consent was obtained from all the study subjects. History, duration of diabetes and clinical examinations, were recorded in all patients at admission. Diabetes was diagnosed based on the WHO criteria.[6] An immunoturbidimetric method was used to estimate glycosylated hemoglobin (HbA1C%). Diagnosis of UTI was made from Midstream urine samples of patients if the urine cultures has $>10^3$ to $>10^5$ colony forming units (CFUs)/mL of a pathogen. A pure culture of *Staphylococcus aureus* was considered to be significant regardless of the number of CFUs.

Statistical analysis

SPSS (Statistical Package for the Social Sciences) were used for data analysis. Chi-square test was applied to find the significance of difference between two proportions and a P value of less than 0.05 was considered to be statistical significant.

RESULTS

This observational study was conducted in the patients who were admitted in medical ward of a tertiary care hospital in south India for a period of 8 months. Among the 619 diabetic patients 220 patients had pus cells in urine but 72 patients had an insignificant colony count.

90 (60.8%) patients were more than 60 years old, 48 (32.4%) were in the age group of 40-60 years and 10 (6.7%) were less than 40 years old (Figure 1). Patients

older than 40 years had higher prevalence of UTI (χ^2 = 8.8753, P 0.002891). Among the 148 patients studied 52 (35.1%) were males and 96 (64.9%) were females (Figure 2). The male to female ratio was 0.54:1.00. Females with diabetes had a higher prevalence of urinary tract infection than men (χ^2 = 10.4303, P 0.00124) which was statistically significant. The majority patients 105 (72.4%) were symptomatic at presentation.
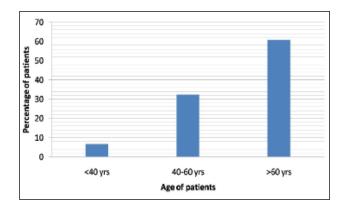

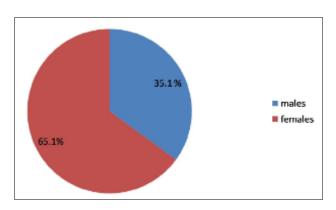**Figure 1: Age distribution of urinary tract infection patients with diabetes.**

Figure 2: Sex distribution of urinary tract infection patients with diabetes.

Among the 148 patients 116 (78.4%) had diabetes for more than 15 years and the rest had a duration lesser than 15 years (Figure 3). Duration of diabetes >15 years was found to be associated with increased risk of developing UTI, which was significant statistically (χ^2 = 5.6025, P 0.017935).

The HbA1C of patients with and without UTI were 10.2 ± 1.6 and 8.4 ± 1.3 respectively. 108 patients with UTI and 303 without UTI were having HbA1C >8 and 40 patients with UTI and 168 without UTI were having HbA1C <8. HbAC >8 was not found to be associated with UTI statistically (χ^2 = 3.7694, P 0.052198).

Gram negative bacilli were isolated from 129 (87.2%) patients which included *E. coli* in 75 (50.7%), *Klebsiella* in 30 (20.3%), *Pseudomonas* species in 12 (8.1%) and *Citrobacter* in 12 (8.1%) (Figure 4). Gram positive cocci

were responsible for UTI in 15 (10.1%) subjects including enterococcus 13 (8.9%) and staphylococcus in 2 (1.3%). *Candida* was isolated from 4 (2.7%) patients.
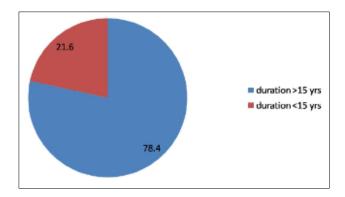

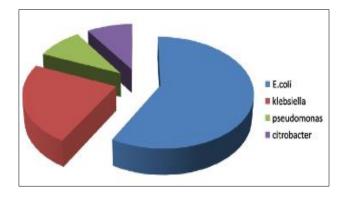**Figure 3: Duration of diabetes in urinary tract infection patients.**

Figure 4: Distribution of gram negative bacilli causing urinary tract infection in diabetes.

E. coli species was found sensitive to piperacillin-tazobactum combination in 55 (73.3%), ceftazidime in 40 (53.3%), cefoperazone-sulbactum in 59 (78.7%), imipenam in 68 (90.7%), amikacin in 60 (80%) and ciprofloxacin in 30 (40%) subjects studied.

Klebsiella was found sensitive to piperacillin-tazobactum combination in 17 (56.7%), ceftazidime in 12(40%), cefoperazone-sulbactum in 19 (63.3%), imipenam in 24 (80%), amikacin in 21 (70%) and ciprofloxacin in 10 (33.3%) subjects studied.

Pseudomonas and *Citrobacter* species were found sensitive to piperacillin-tazobactum (86 and 94% respectively), imipenam (89 and 97% respectively) and amikacin (83 and 79% respectively) in majority of the subjects studied.

Gram positive cocci enterococcus and staphylococcus responsible for UTI showed good susceptibility to vancomycin (81 and 94% respectively) but a high resistance to ciprofloxacin and tetracyclines (68 and 57% respectively).

DISCUSSION

Urinary tract is the second commonest site following respiratory tract, for bacterial infection. Diabetes increases the risk of infection and the commonest amongst them are the ones involving the genitourinary tract. 40% of the years of life lost in a diabetic patient on an average can be attributed to nonvascular conditions like cancers, infections, and neurodegenerative disorders.[7]

Patients older than 40 years had higher prevalence of UTI ($\chi2 = 8.8753$, P 0.002891) in our study. Females with diabetes had a higher prevalence of urinary tract infection than men ($\chi2 = 10.4303$, P 0.00124) which was statistically significant. Janifer et al. found that age, longer duration of diabetes, and poor glycemic control were significantly associated with UTI among subjects with diabetes.[8] Females had higher risk of UTI (RR = 6.102; CI = 4.343-8.573; P <0.001) compared to males in a study which showed prevalence of UTI was 25.3 % in total diabetic population and 7.2 and 41.1 % in males and females respectively.[9] UTI was found common among female patients with type 2 diabetes and older patients of both genders in a study which found that female gender was associated with an increased incidence [relative risk (RR) 3.4; 95% confidence interval (CI) 2.3-5.1] and also higher age [RR 2.5 (95% CI 1.4-4.8) for ages ≥70 years vs. 40-49 years].[10]

Duration of diabetes >15 years was found to be associated with UTI statistically ($\chi2 = 5.6025$, P 0.017935). HbA1C >8 was not found to be associated with UTI statistically ($\chi2 = 3.7694$, P 0.052198).

In a study of postmenopausal women diabetic patients with UTI no significant difference was seen in the OR for UTI in diabetic women with disease of shorter duration (<10 years, OR 1.9) or longer duration (≥10 years, OR 2.6) or in relation to HbA1C level.[11] The presence of asymptomatic bacteriuria for women with type 2 diabetes was identified as a risk factor in another study.[12] In another study females with previously diagnosed diabetes had a higher risk of UTI than those with recently diagnosed diabetes (within 6 months) (91.9/1000 person-years; 95% confidence interval [CI] 84.3-99.4, vs. 70.5/1000 person-years; 95% CI 68.2-72.8).[1] In a study of patients with type 2 diabetes it was found that 8.2% were diagnosed with UTI during 1 year (12.9% of women and 3.9% of men, with incidence increasing with age).[13] Hypertension (RR =1.202; CI = 1.061-1.361; P = 0.006), insulin therapy (RR = 1.411; CI = 1.262-1.578; P <0.001) and nephropathy (microalbuminuria) (RR = 1.417; CI = 1.036-1.939; P = 0.031) were found to be independent risk factors associated with UTI in diabetes.[9]

Gram negative enteric organisms commonly cause urinary tract infections, such as *E. coli*, the *Klebsiella* species, *Pseudomonas* and the *Proteus* species. Gram negative bacilli were isolated from 129 (87.2%) patients

which included *E. coli* in 75 (50.7%), *Klebsiella* in 30 (20.3%), *Pseudomonas* species in 12 (8.1%) and *Citrobacter* in 12 (8.1%). Gram positive cocci were responsible for UTI in 15 (10.1%) of subjects including Enterococcus in 13 (8.9%) and *Staphylococcus* in 2 (1.3%). Thus in our study Gram negative bacilli were found to be associated with majority of the cases of UTI. *E. coli* was the most commonly grown organism (64.3%), followed by *Staphylococcus aureus* (21.4%), and *Klebsiella pneumoniae* (14.3%) in an Indian study.[14]

Appropriate antibiotic therapy with effective diabetic management is prudent in diabetic patients with UTI. The higher incidence of complications and involvement of upper urinary tract makes the management of UTI in diabetic patients difficult. Knowledge regarding the local sensitivity pattern of the infecting organisms is essential for proper selection of antibiotics. We found that gram negative bacilli including *E. coli*, the *Klebsiella* species, pseudomonas and *Citrobacter* had good response to piperacillin-tazobactum, cefoperazone-sulbactum, imipenam and amikacin. Our patients with gram negative bacilli UTI had an increased resistance for ampicillin and fluoroquinolones.

Gram positive cocci like Enterococcus and *Staphylococcus* responsible for UTI showed good susceptibility to vancomycin (81 and 94% respectively) but a high resistance to ciprofloxacin and tetracyclines (68 and 57% respectively) in our study group.

In an Indian study amongst the Gram-positive isolates, *Enterococcus faecalis* was the most commonly isolated organism with 3.2 per cent resistance to vancomycin. Staphylococcus isolates were highly resistant to ciprofloxacin and tetracyclines but showed good susceptibility to vancomycin.[15]

We conclude that female gender, age, duration of diabetes were found have increased risk factors for developing UTI in diabetes. *Escherichia coli* was the commonest organism causing UTI in diabetes which showed good response to piperacillin/tazobactum, cefoperazone-sulbactum, imipenam and amikacin.

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