A Study on Bacteriological Profile of Urinary Tract Infection in Diabetes Mellitus Patients in a Tertiary Care Hospital

B. Natesan¹* and Thasneem Banu²

¹Institute of Microbiology, Madras Medical College and RGGGH, Chennai, Tamil Nadu, India
²Institute of Microbiology, MMC and RGGGH, Chennai, Tamil Nadu, India
*Corresponding author

ABSTRACT

Urinary Tract Infection (UTI) is an inflammatory response of the urothelium to bacterial invasion that is usually associated with bacteriuria and pyuria. UTI is up to three times more common in diabetic than in non-diabetic women and increases with age. Urine from 60 diabetic patients with UTI was collected and subjected to Gram staining, culture & sensitivity by routine methods. Among Diabetic patients, the males constituted 51.66% and were predominant. The maximum number of isolates was present in 51-60yr age group with 35% and next was 41-50yrs with 20%. In Diabetes mellitus, E. coli was the predominant isolate with 36.6% followed by Klebsiella spp, Pseudomonas spp & Acinetobacter spp. In Diabetic patients, Imipenem, Amikacin and Nitrofurantoin had greater sensitivity than other antibiotics. In Gram positive cocci isolated from Diabetic patients, Amikacin and cephalexin had a greater sensitivity. This alarmingly high resistance rate has to be approached cautiously, by formulating an antibiotic drug policy. This has to include giving effective drugs after the culture & sensitivity and ensuring that the patients receive full course of antibiotics.

Keywords
UTI, Diabetic patients, Drug resistance, Imipenem, E. coli

Introduction

Urinary Tract Infection (UTI) is an inflammatory response of the urothelium to bacterial invasion that is usually associated with bacteriuria and pyuria. Urinary tract is the second most common site for bacterial infection in human. Bacterial virulence factors play a subsidiary part in the genesis of disease.

UTI refer to those infections that occur in the presence of anatomic or functional abnormalities in the kidney, bladder or collecting systems; obstruction to normal urine flow (including renal, ureteric and bladder calculi and Benign Prostatic Hypertrophy); cystic renal disease; specific diseases like Diabetes Mellitus and abnormalities in host defense mechanisms and those infections that follow surgery or procedures done in urinary tract.

UTI is up to three times more common in diabetic than in non-diabetic women and increases with age.

Many factors that predispose the diabetic patient to infections in the urinary tract have been described. Diabetes mellitus is associated with increased risk of these infections as a result of poorly controlled
plasma glucose concentrations, which in turn may impair granulocyte function and cell-mediated immunity. Also, the neurologic dysfunction associated with diabetic neuropathy may result in a neurogenic bladder with incomplete bladder emptying, urinary stasis, and retention. The increased likelihood of urethral instrumentation may predispose these patients to infection, as may diabetic microangiopathy, which can contribute to local ischemia and impaired host defences (Rayfield EJ et al., 1982, Wheat et al., 1980).

Asymptomatic bacteriuria has been described as occurring two to four times more frequently in diabetic women (Wheat et al., 1980; Forland, 1977) and as being more prevalent in diabetic women than men (Kass et al., 1956). Other renal parenchymal complications of UTI in diabetic patients include Pyelonephritis, Emphysematous pyelonephritis, papillary necrosis and Perinephric abscesses; these conditions should be considered in the evaluation of nonresponse to appropriate antibiotic therapy for urinary infection in diabetic patients.

Most of the bacteria responsible for urosepsis in diabetics are Gram-negative rods, with *E. coli* and *Klebsiella* spp, accounting for about 70%. *Klebsiella* spp are isolated twice as frequently in diabetic patients with bacteremic urinary infections, and a large proportion of these patients had indwelling urinary bladder catheters.

Madras Medical College and Rajiv Gandhi Government Hospital Chennai is a tertiary care hospital and a referral centre to the hospitals in the surrounding districts. Knowledge of the microbial organisms and antibiotic susceptibility pattern of Diabetic patients with UTI is essential for defining empirical treatment. Hence the present study focuses on the bacteriological profile and its resistance patterns in cases of UTI in Diabetic patients for a better clinical approach.

The main objectives of this study includes: To determine the Bacteriological profile in Diabetic patients with Urinary Tract Infection. To determine the Antibiotic susceptibility pattern using Kirby Bauer Disc diffusion method. And to analyse the drug resistant pattern in uropathogens in Diabetic patients with UTI.

**Materials and Methods**

**Sample collection**

**Midstream urine specimens**

Urine samples were most commonly collected by sampling the midstream flow by the clean-catch technique. Urine collection from women by this technique requires personal supervision for best results.

**Laboratory methods**

**Urine microscopic analysis**

Five ml of the urine specimen was centrifuged at 2500 rpm. Supernatant was removed and sediment used for microscopy analysis. The sediment was transferred on the clean slide and viewed for the presence of epithelial cells, red cells and casts.

**Gram staining**

Gram staining of urine smear was done and the presence of Gram negative bacilli or Gram positive cocci was initially observed. The presence of pus cells were also noted.

**Urine culturing and bacterial identification**

One ml of diluted (1/1000) urine specimen was used for culturing on CLED, Blood, and
Mac Conkey agar. Specimen was inoculated using a calibrated loop. The plate was incubated at 35°C for 24 hrs-48 hrs.

Specimens with more than $10^5$ colony forming unit [CFU]/ml were considered as positive samples. The isolates were identified based on colony morphology on culture plates, Gram’s staining and by standard biochemical tests. Antibiotic susceptibility testing was done by standard methods according to CLSI guidelines.

**Antimicrobial susceptibility testing**

Antibiotic susceptibility testing was performed by the Kirby Bauer disc diffusion method on MHA (Mueller Hinton Agar) according to CLSI protocols. The diameters of zone of inhibition were interpreted according to CLSI standards for each organism. Media and disks were tested for quality control with standard strains.

**Results and Discussion**

The study undertaken at the Institute of Microbiology, Madras Medical College, Chennai among samples received from Diabetic patients of Rajiv Gandhi Government General Hospital, Chennai with UTI showed the following results. Sixty patients were included in this study.

Among diabetic patients, the males constituted 51.66% and were predominant. The male to female prevalence ratio is 1.06:1 (Table 1). This was in comparison with the study conducted by Sibi *et al.*, (2011) where the males were affected with UTI more than women in Diabetic patients.

In Gram positive cocci (GPC) isolated from Diabetic patients, Amikacin and cephalexin had a greater sensitivity. The majority of the patients presented with dysuria and was found in 37.5% patients. The next presentation was with fever in 30.8%; followed by pain abdomen, frequency of micturition, hematuria, and oliguria in the decreasing order of presentation. These symptoms were comparable with the study by Mahesh *et al.*, (Mahesh *et al.*, 2010).

The *E. coli* was the commonest organism isolated with 36.6% (Table 3). The study conducted by Sibi *et al.*, (2011) also had *E. coli* accounting for 39.14% and another study reported 47% of *E. coli* in their isolate (Andy *et al.*, 2003). These results were in comparison with the present study.

The *Klebsiella pneumoniae* 20%, *Klebsiella oxytoca* 5%, *Pseudomonas aeruginosa* 11.6%, *Acinetobacter* spp 10%, *Staphylococcus aureus* 6% and *Citrobacter freundi* 5% and *Enterococcus faecalis* 5% were the other isolates in these diabetic patients (Table 3). The study by Sibi *et al.*, (2011) had *Klebsiella* spp 15.7% which was comparable to this study.

The *E. coli* isolated in these patients had higher sensitivity 90.9% for Amikacin and 81.80% for Nitrofurantoin. But the resistance to cephalosporins and Fluoroquinolones were high, 75% and 80% respectively. The Imipenem was 100% sensitive (Table 4). Shill *et al.*, (2010) in his study also reported 66% resistance to cephalosporins 79% resistance to Fluoroquinolones; 3% resistance to Amikacin and 11.9% resistance to Nitrofurantoin and 100% sensitive to Imipenem. This study results were similar to the present study. Yet the resistance pattern to Cephalosporins and Fluoroquinolones in these patients is highly alarming and Amikacin and Imipenem offer promise in treating these *E. coli* infected Diabetes mellitus patients.

The *Pseudomonas aeruginosa* was the third commonest isolate in these patients. They were 42.8% sensitive to Amikacin and
Cephalosporin, 14.2% sensitive to Fluroquinolones (Table 4).

In a similar study by Mahesh et al., (2010) 74.5% resistance rate to Fluoroquinolones and 64.7% resistance to Amikacin and Gentamicin were noted for Pseudomonas spp. This was in comparison to the present study. In the present study, Pseudomonas spp were 100% sensitive to Imipenem whereas 70% of the isolates were sensitive to Carbapenems in the study by Mahesh et al., This is not coherent with the present study.

**Table.1 Gender distribution in diabetes mellitus**

| Gender   | Male | Female |
|----------|------|--------|
| No of patients | 31   | 29     |
| Percentage   | 51.66% | 48.33% |

**Table.2 Distribution of patients with diabetes mellitus according to age group [n=60]**

| Age groups | No of patients | Percentage |
|------------|----------------|------------|
| 12-20      | 6              | 10%        |
| 21-30      | 4              | 6%         |
| 31-40      | 7              | 11.6%      |
| 41-50      | 12             | 20%        |
| 51-60      | 21             | 35%        |
| 61-70      | 4              | 6%         |
| 71-80      | 6              | 10%        |
| Total      | 60             |            |

The maximum number of isolates were present in 51-60yrs with 35% and next was 41-50yrs age group with 20%

**Table.3 Uropathogens isolated in diabetes mellitus**

| Name of the organisms       | No of patients | Percentage |
|-----------------------------|----------------|------------|
| E.coli                      | 22             | 36.6%      |
| K pneumoniae                | 12             | 20%        |
| K oxytoca                   | 3              | 5%         |
| Pseudomonas aeruginosa      | 7              | 11.6%      |
| Acinetobacter spp           | 6              | 10%        |
| Citrobacter freundii        | 3              | 5%         |
| Staph.aureus                | 4              | 6%         |
| Enterococcus faecalis       | 3              | 5%         |
| Total                       | 60             |            |

In Diabetes mellitus, E. coli was the predominant isolate with 36.6% followed by Klebsiella spp, Pseudomonas spp and Acinetobacter spp.
Table.4 Gram negative bacilli - antibiotic sensitivity in diabetes mellitus patients (n =53)

| Antibiotics      | E. coli n=22 | Klebsiella pneumoniae n=12 | K.oxytoca n = 3 | Pseudomonas aeruginosa n=7 | Acinetobacter spp n = 6 | Citrobacter freundii n =3 |
|------------------|--------------|----------------------------|-----------------|-----------------------------|--------------------------|---------------------------|
| Amikacin         | 20 90.9%     | 6 50%                      | 3 100%          | 3 42.8%                     | 6 100%                   | 3 100%                    |
| Nitrofurantoin   | 18 81.8%     | 6 50%                      | -               | -                           | 2 33.3%                  | 3 100%                    |
| Norfloxacin      | 4 18.1%      | 3 25%                      | 1 33.3%         | 3 42.8%                     | 3 50%                    | 3 100%                    |
| Cefazidime       | 7 31.8%      | 3 25%                      | 3 100%          | 3 42.8%                     | 4 6.6%                   | 3 100%                    |
| Ciprofloxacin    | 2 9.09%      | 1 8.3%                     | -               | 1 14.2%                     | 2 33.3%                  | 3 100%                    |
| Ofloxacin        | 4 18.1%      | 3 25%                      | -               | -                           | 2 33.3%                  | 3 100%                    |
| Cotrimoxazole    | 9 40.9%      | -                          | 1 33.3%         | 1 14.2%                     | 1 16.6%                  | -                         |
| Gentamicin       | 4 18.1%      | 3 25%                      | 3 100%          | 3 42.8%                     | 6 100%                   | -                         |
| Imipenem         | 22 100%      | 12 100%                    | 3 100%          | 7 100%                      | 6 100%                   | 3 100%                    |

In Diabetes patients, Imipenem, Amikacin and Nitrofurantoin had greater sensitivity than other antibiotics.

Table.5 Gram positive cocci – antibiotic sensitivity in diabetes mellitus patients (n=7)

| Antibiotics          | Staphylococcus aureus [n= 4] | Enterococcus. faecalis [n=3] |
|----------------------|------------------------------|------------------------------|
| Amikacin             | 3 [75% ]                     | 2 [66.6% ]                   |
| Amoxy-clavulanic acid| 2 [50% ]                     | 2 [66.6% ]                   |
| Erythromycin         | -                            | -                            |
| Cephalexin           | 2 [50% ]                     | -                            |
| Amoxicillin          | 1 [ 25% ]                    | -                            |
| Cotrimoxazole        | 1 [25% ]                     | -                            |
| Ciprofloxacin        | 2 [50% ]                     | -                            |
| Nitrofurantoin       | -                            | 3 [100%]                     |

Out of the Gram positive cocci isolated, Staphylococcus aureus constituted the majority followed by Enterococcus faecalis. Staphylococcus aureus was found to be sensitive to Amikacin (75%) and Cephalexin (50%) and resistant to cotrimaxazole, amoxicillin and Ciprofloxacin. Enterococcus faecalis was found to be 66.6% sensitive to Amikacin and amoxyclavulanic acid and 100% to Nitrofurantoin. The poorly controlled glucose concentration may lead to decreased granulocyte function and cellular immunity. Diabetic neuropathy results in urinary stasis. Diabetic microangiopathy leads to impaired host...
defenses. All these reasons contribute to the colonization of these resistant uropathogens.

To summarise, Among Diabetic patients, the males constituted 51.66% and were predominant.

The maximum number of isolates was present in 51-60yrs with 35% and next was 41-50yrs age group with 20% (Table 2). In Diabetes mellitus, *E. coli* was the predominant isolate with 36.6% followed by *Klebsiella spp*, *Pseudomonas spp* and *Acinetobacter spp*.

In Diabetes patients, Imipenem, Amikacin and Nitrofurantoin had greater sensitivity than other antibiotics. In GPC isolated from Diabetic patients, Amikacin and cephalexin had a greater sensitivity. This alarmingly high resistance rate has to be approached cautiously, by formulating an antibiotic drug policy. This has to include giving effective drugs after the culture and sensitivity and ensuring that the patients receive full course of antibiotics.

An ongoing surveillance of UTI should be encouraged for an updated knowledge about the uropathogens causing infection and their antibiotic resistance pattern to keep the medical community informed about the emerging antibiotic resistance.

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