Bacteriological profile of urinary tract infections in type-2 diabetes mellitus patients in a tertiary care hospital

Baruah SK1, Islam M2, Medhi J3
Address for correspondence:
1 Professor
Mobile:+919435015668
Email: drskbaruah1@gmail.com
2Senior Resident
(Mobile: +919707214600
Email: moinul.jncotton@gmail.com
3Registrar
Department of Medicine
Gauhati Medical College
and Hospital, Guwahati, Assam

Article received: 04-08-2021
Received (revised): 01-06-2022
Editorial approval: 23-06-2022
Checked for plagiarism: Yes
Peer-reviewed: Double-blinded
Peer review comments: Three
Editor who approved: Prof (Dr.) Putul Mahanta

ABSTRACT
Background and aims: People with Diabetes mellitus, a highly prevalent endocrine disorder, are prone to various infections, including urinary tract infections. E. Coli causes the vast majority of urinary tract infections. This paper aims to evaluate the bacteriological profile of urinary tract infections among patients with type 2 diabetes mellitus in a tertiary care hospital. Materials and methods: The institution-based observational study was conducted on 95 patients attending the outpatients and inpatient departments of Medicine and Endocrinology at Gauhati Medical College and Hospital (GMCH). All patients had undergone urine routine and microscopy, urine culture and sensitivity with colony counts, FBS, PPBS, Glycosylated Hemoglobin, Renal function test, Ultrasound abdomen and X-ray KUB & CT Scan of the abdomen, if necessary. Results: The study showed that in the urine culture, 70.5% of the patients had E. Coli, 10.5% had Klebsiella, 5.3% had Proteus, 4.2% had Enterococci, 3.1% had candida and 1.1% each had Pseudomonas and Staphylococcus aureus. At the same time, the urine culture of 4.2% of patients had shown no growth. Antibiotic sensitivity based on urine culture evaluation showed that most E.coli were sensitive to Meropenem, followed by Piperacillin-Tazobactum and Nitrofurantoin. Klebsiella was sensitive to Meropenem, Ampicillin and Piperacillin-Tazobactum. Proteus were sensitive to Piperacillin-Tazobactum and Meropenem. Conclusion: E. coli was the most typical organism isolated from urine cultures of patients with Type 2 Diabetes mellitus, followed by Klebsiella. Most strains were sensitive to Nitrofurantoin, Ampicillin, Piperacillin-Tazobactum and Meropenem.

Keywords: E. Coli; Klebsiella; urine culture; nitrofurantoin.

INTRODUCTION
Diabetes mellitus is a common endocrine disorder. Changing lifestyle and urbanization has amplified the incidence of this disease. According to WHO’s Global Report on Diabetes 2014, the prevalence of Diabetes in Southeast Asia is around 8.6%.1 In India, Diabetes is a chief health hazard. India, with the largest number of diabetic subjects in the world, had earned the dubious distinction of being termed the “Diabetic capital of the world”.2 Infections are also of particular concern for diabetic patients. People with diabetes are especially prone to various infections.3 Urinary tract infections are more frequent and severe in patients with Diabetes Mellitus. Age, metabolic control, and long-term complications, particularly diabetic kidney disease and cystopathy, are general host factors that increase the risk for urinary tract infections in people with diabetes.4 E. coli is the most frequent cause of urinary tract infection accounting for 85% of community-acquired and 50% of hospital-acquired infections. Other gram-negative
enterobacteria include Proteus and Klebsiella and gram-positive Staphylococcus, saprophyticus and Enterococcus faecalis.\textsuperscript{5}

Awareness of the disease and knowledge of the spectrum of bacteria and their sensitivity to antibiotics will help reduce morbidity and mortality associated with urinary tract infections. Though many studies have been reported from India and abroad, there is a shortage of these studies in this part of the region. So this study has been taken up to evaluate the bacteriological profile of urinary tract infections in type 2 diabetes mellitus patients in a tertiary care hospital.

**MATERIAL AND METHODS**

This institution-based observational study was carried out from Jul 1 2019, to Jun 30 2020, including all the type 2 diabetes mellitus patients with symptoms of urinary tract infections attending the outpatients and inpatients departments of Medicine and Endocrinology at Gauhati medical college and hospital (GMCH), Assam.

**Inclusion Criteria:** Patients aged over 12 years with Type 2 Diabetes Mellitus and coming with features of urinary tract infection were included in the study.

**Exclusion Criteria:** Patients having a history of receiving antibiotics within two weeks before culture and patients on continuous indwelling catheters were excluded from the study. Menstruating women, gestational diabetes patients, Type 1 diabetes mellitus patients, those with immunocompromised states like HIV, patients on steroids, malignancy and transplant recipients were also not included. Specific types of diabetes are brought on by other factors like monogenic diabetes syndromes (such as maturity-onset diabetes of the young [MODY]), exocrine pancreas diseases (such as cystic fibrosis and pancreatitis), drug- or chemical-induced diabetes (such as with the use of glucocorticoids in the treatment of HIV/AIDS or after organ transplantation), latent autoimmune diabetes in adults (LADA), etc. are also excluded. Moreover, patients with ages below 12 years and those not willing to give consent were also omitted from the study.

All patients who fulfilled the inclusion criteria of the study underwent a physical examination and had undergone urine routine microscopy, urine culture and sensitivity with colony counts, fasting blood sugar, post-prandial blood sugar, Glycosylated Hemoglobin, Renal function test, Ultrasound abdomen and X-ray KUB & CT Scan Abdomen, if necessary.

**RESULTS**

A total of 95 patients with Type 2 Diabetes Mellitus having features of urinary tract infection presenting to Gauhati Medical College and Hospital (GMCH) during the study period and fulfilling the inclusion criteria were included in the study.

In this study, the maximum number of Type 2 Diabetes patients with urinary tract infections was 55-64 years (37.89%). The mean age of presentation was 56.3 years, as shown in Table 1.

| Age (in Years) | No. of Patients(n=95) | Percentage (%) |
|---------------|-----------------------|----------------|
| 25-34         | 1                     | 1.05           |
| 35-44         | 13                    | 13.68          |
| 45-54         | 24                    | 25.26          |
| 55-64         | 36                    | 37.89          |
| 65-74         | 19                    | 20.00          |
| 75-84         | 2                     | 2.10           |

The majority, 56% of the patients, were male, with a male-to-female ratio of 1:0.79 (Figure 1).

As seen in Table 2, out of the 95 patients, 4 had no growth of organisms in urine culture. E-coli was the most common organism isolated in urine culture observed in 70.5% of the cases, followed by Klebsiella (10.5%). Proteus (5.3%) and Enterococci (4.2%).

| Organisms in urine culture | No.of Patients (N=95) | Percentage (%) |
|----------------------------|-----------------------|----------------|
| E. Coli                    | 67                    | 70.5           |
| Klebsiella                 | 10                    | 10.5           |
| Proteus                    | 5                     | 5.3            |
| Enterococci                | 4                     | 4.2            |
| Candida                    | 3                     | 3.1            |
| Pseudomonas                | 1                     | 1.1            |
| Staphylococcus aureus      | 1                     | 1.1            |
| No growth                  | 4                     | 4.2            |
Antibiotic sensitivity was assessed by evaluation of urine culture. The majority of E.coli infected patients were sensitive to Meropenem (90.7%), Piperacillin-Tazobactum (89.7%) and Nitrofurantoin (73.7%). E.coli was also found sensitive to Ampicillin (52.4%), Co-trimoxazole (41.1%) and Fluroquinilones (40.7%). Klebsiella was primarily sensitive to Meropenem (91.5%), Ampicillin (89.7%) and Piperacillin-Tazobactum (88.7%). Proteus was sensitive to Piperacillin-Tazobactum (93.1%), Meropenem (88.7%), Nitrofurantoin (62.7%) whereas, Enterococcus was primarily sensitive to Gentamicin (60.7%) and Amikacin (57.9%). Pseudomonas showed 100% sensitivity to Piperacillin-Tazobactum and Meropenem. Staphylococcus aureus was sensitive to Amoxyclav (100%), Fluoroquinolone (100%), Nitrofurantoin (100%) and Gentamicin (100%), as shown in Table 3.

Table 3 Antibiotic sensitivity of various organisms isolated in urine culture

| Antibiotics         | Organisms (n=88)* |
|---------------------|-------------------|
|                     | E.coli(67, 70.5%) | Klebsiella(7, 10.5%) | Proteus (5, 5.3%) | Enterococcus (4, 4.2%) | Pseudomonas (1, 1.1%) | Staphylococcus aureus (1, 1.1%) |
| Nitrofurantoin %    | 73.7              | 57.3               | 67.2              | 100                   |
| Ampicillin %        | 52.4              | 89.7               | 51.6              | 23.7                  |
| Cefuroxime %        | 20.7              | 19.4               |                   |                       |
| Ceftriaxone %       | 12.7              | 13.5               | 11.2              | 12.5                  |
| Amoxy Clav %        | 30.4              | 15.4               | 22.6              | 100                   |
| Fluroquinilones %   | 40.7              | 29.4               | 20.4              | 100                   |
| Gentamicin %        | 6.1               | 17.8               | 5.1               | 60.7                  | 100                   |
| Cotrimoxazole %     | 41.1              | 16.7               | 39.4              | 32.8                  |
| Amikacin %          | 10.1              | 19.4               |                   | 57.9                  |
| Meropenem %         | 90.7              | 91.5               | 88.7              | 100                   |
| Piperacillin + tazobactum % | 89.7 | 88.7 | 93.1 | 100 |

*Candida isolate not included.

**DISCUSSION**

In this study, the mean age of the patients was 56.3 years ranging from 25 to 84 years. The male: female ratio of patients was 1:0.79.

Out of the 95 patients, 67(70.5%) showed the presence of E.Coli in urine culture. Klebsiella (10.5%), Proteus (5.3%), Enterococci (4.2%), Candida (3.1%), Pseudomonas (1.1%) and staphylococcus aureus (1.1%) were the other organisms found in the present study. Four (4.2%) patients had no growth. This finding is similar to another study which reported E.coli as the most common cause of UTI, accounting for 85% of community-acquired and 50% of hospital-acquired infections. Other gram-negative Enterobacteriaceae include Proteus and Klebsiella & gram-positive Staph. saprophyticus and Enterococcus faecalis. These findings are also concordant with the study done by Goswami et al., at AIIMS in 2001 on the prevalence of UTI and renal scars in Diabetics and healthy controls, which also concluded that E.coli was the most common isolate (64.3%) followed by Staph. aureus (21.4%) & Klebsiella (14.3%). Increased incidence of E.coli (54.1%) in diabetic patients with bacteriuria was also reported in another study. Various authors have reported E Coli as the most common organism similar to our findings.

Klebsiella was the second most common organism isolated (35.71%) in our study. The findings match with observations by Zhanel et al., Vigg et al., and Shah BV et al.. However, O’Sullivan et al., and Huvos et al., reported Proteus as the second most common organism in their studies.

Diabetes patients are prone to urinary tract infections caused by fungi, particularly by Candida species. In this study, Candida was found in 3.1% of diabetic patients. This finding is consistent with the study done by Fisher JF et al., where Candida was isolated among 5% of patients. Another study by Yismaw G et al., revealed that Candida was present in 7.5% of symptomatic urinary tract infections in diabetes.

Antibiotic sensitivity based on evaluation of urine culture showed that the majority of E.coli infected patients were sensitive to Meropenem (90.7%), Piperacillin-Tazobactum (89.7%), Nitrofurantoin (73.7%), Ampicillin (52.4%), followed by Co-trimoxazole (41.1%) and Fluroquinilones (40.7%). Klebsiella is found to be sensitive to meropenem (91.5%), Ampicillin (89.7%), and Piperacillin-Tazobactum (88.7%). Proteus is primarily sensitive to Piperacillin-Tazobactum (93.1%), Meropenem (88.7%), and Nitrofurantoin (62.7%) while, Enterococcus was to Gentamicin (60.7%) and Amikacin (57.9%). Pseudomonas was 100% sensitive to Piperacillin-Tazobactum, Meropenem and Staph. aureus was sensitive to Amoxyclav (100%), fluoroquinolone (100%), Nitrofurantoin (100%) and Gentamicin (100%).

Studies done by Bonadio et al., Shah BV et al., and Zhanel et al., states that E.coli were susceptible to Nitrofurantoin, Ampicillin, Fluroquinolone, Meropenem, Piperacillin-Tazobactum. This was in contrast to the study by Sobel JD et al., where E.coli were found resistant to fluoroquinolones. A study by Sharma S et al., reported that E. coli was the most common organism, followed by Klebsiella. Further, most of these organisms were susceptible to Nitrofurantoin and Imipenem, indicating that they could
be the preferred antimicrobial agents in treating urinary tract infections.

CONCLUSION
The present study found that E.coli was the most common organism isolated from a urine culture, followed by Klebsiella among Type 2 Diabetes mellitus patients with urinary tract infections. Nitrofurantoin, Ampicillin, and Piperacillin-Tazobactumand Meropenem were good antimicrobial agents for treating urinary tract infections since most strains were sensitive to these substances.

Conflicts of interest: None declared.

Funding statement: This research did not receive any funding.

Acknowledgements: We acknowledge the department’s staff members who have helped us complete this project by providing the department’s necessary infrastructures.

Ethical clearance: Taken from the institutional ethics committee of Gauhati medical college and hospital, Guwahati, vide ref no: MC/190/2007/pt-11/MAR-2019/PG/53.

REFERENCES
1. World Health Organization. Global status report on noncommunicable diseases. World Health Organization 2014:15:1:39.
2. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. Diabetes Res Clin Pract 2019 Nov; 157:107843.
3. Chin-Hong PV. Infections in patients with diabetes mellitus: the importance of early recognition, treatment, and prevention. Adv Stud Med 2006;6(2):71–81.
4. Fünfstück R, Nicolle LE, Hanefeld M, Naber KG. Urinary tract infection in patients with diabetes mellitus. Clin Nephrol 2012 Jan;77(1):40-8.
5. Lee DS, Lee SJ, Choe HS. Community-Acquired Urinary Tract Infection by Escherichia coli in the Era of Antibiotic Resistance. Biomed Res Int 2018 Sep 26;2018:7656752.
6. Hall LM, Duke B, Urwin G, Guiney M. Epidemiology of Enterococcus faecalis urinary tract infection in a teaching hospital in London, United Kingdom. J Clin Microbiol 1992 Aug; 30(8):1953-7.
7. Goswami R, Bal CS, Tejaswi S, Punjabi GV, Kapil A, Kochupillai N. Prevalence of urinary tract infection and renal scars in patients with diabetes mellitus. Diabetes Res Clin Pract 2001 Sep;53(3):181-6.
8. Bonadio M, Meini M, Gigli C, Longo B, Vigna A. Urinary tract infection in diabetic patients. Urol Int 1999; 63(4):215-9.
9. Shah BV, Jadhav KP, Acharya VN. Study of urinary tract infection in diabetic subjects. J Assoc Physicians India 1984 Dec;32(12):1037-40.
10. Zhanel GG, Nicolle LE, Harding GK. Prevalence of asymptomatic bacteriuria and associated host factors in women with diabetes mellitus. The Manitoba diabetic urinary infection study group. Clin Infect Dis 1995 Aug; 21(2):316-22.
11. O’sullivan DJ, Fitzgerald MG, Meynell MJ, Malins JM. Urinary tract infection. A comparative study in the diabetic and general populations. Br Med J 1961 Mar 18; 1(5228):786-8.
12. Vigg B, Rai V. Asymptomatic bacteriuria in diabetes. J Assoc Physicians India 2007;51:374 -76.
13. Geerlings SE, Hoepelman AI. Immune dysfunction in patients with diabetes mellitus (DM). FEMS Immunol Med Microbiol 1999 Dec;26(3-4):259-65.
14. Huvos A, Rocha H. Frequency of bacteriuria in patients with diabetes mellitus: a controlled study. N Engl J Med 1959 Dec 10;261:1213-6.
15. Shah BV, Jadhav KP, Acharya VN. Study of urinary tract infection in diabetic subjects. J Assoc Physicians India 1984 Dec;32(12):1037-40.
16. Fisher JF, Newman CL, Sobel JD. Yeast in the urine: solutions for a budding problem. Clin Infect Dis 1995 Jan; 20(1):183-9.
17. Yismaw G, Asrat D, Woldeamanuel Y, Unakal C. Prevalence of candiduria in diabetic patients attending Gondar University Hospital, Gondar, Ethiopia. Iran J Kidney Dis 2013 Mar;7(2):102-7.
18. Sobel, J.D. Candiduria. Drug Treatment in Urology 2009; 9:149.
19. Sharma S, Govind B, Naidu SK, Kinjarapu S, Rasool M. Clinical and laboratory profile of urinary tract infections in Type 2 diabetics aged over 60 years. J Clin Diagn Res 2017 Apr;11(4):OC25-OC28.