



Antibiotic Resistance Patterns In Urinary Tract Infections Among Type 2 Diabetes Mellitus Patients: A Cross-Sectional Study In Eastern India

Dibyendu Gangopadhyay¹, Dr.L.K.Pandey², R.P.Bhagat³,

¹Dept.of Microbiology, Mansarovar Global University, Shehore,(MP)46611,India

²Prof.Faculty of Life Science, Mansarovar Global University, Shehore,(MP)46611,India

³Dept.of Biotechnology, Mansarovar Global University, Shehore,(MP)46611,India

Abstract : Urinary tract infections (UTIs) caused by bacteria with resistance to antibiotics are the focus of this research study on T2DM patients in Eastern India. This study intends to provide light on successful methods of treating urinary tract infections (UTIs) in diabetes individuals, which is important because antibiotic resistance is on the rise. For this cross-sectional study, 200 type 2 diabetics who also had a urinary tract infection (UTI) were included. The antimicrobial susceptibility of the isolated pathogens was examined after cultured urine samples were taken. It is clear from the results that this population requires individualised antibiotic treatment due to the high prevalence of antibiotic resistance.

Keywords: : Uropathogens, antibiotic resistance, type 2 diabetes mellitus, and urinary tract infections (UTIs).

Introduction : Among the most common bacterial infections seen in clinical practice, urinary tract infections (UTIs) occur at an especially high incidence in individuals with Type 2 Diabetes Mellitus (T2DM). [1] Several pathophysiological variables increase the incidence of UTIs in individuals with T2DM. Uropathogens thrive in hyperglycemia, a symptom of diabetes, since the urine serves as a fertile breeding ground for bacteria thanks to the abundance of glucose it contains. Patients with diabetes also typically have compromised immunological responses, which make it harder for them to fight infections. This includes problems with neutrophil function and decreased release of cytokines.[2] Patients with diabetic autonomic neuropathy are already at increased risk for infections due to the impaired bladder function that might develop from the disease. This includes urine stasis and incomplete bladder emptying. Patients with type 2 diabetes are at increased risk of contracting healthcare-associated infections, a large number of which are multidrug-resistant (MDR), due to their chronic disease and the frequency with which they require medical interventions and hospitalisations. [3] Eastern India is one of many emerging regions where the alarming increase in antibiotic resistance is wreaking havoc on public health. Overuse and improper administration of antibiotics in farming and healthcare has hastened the emergence of bacteria that are resistant to these drugs. Consequently, because

of the limited effectiveness of routinely used antibiotics, the management of UTIs in diabetes patients is become more and more difficult.[4]

For this reason, it is critical to comprehend the patterns of local antibiotic resistance among uropathogens found in type 2 diabetic patients in order to design efficient treatment plans. Antibiotic stewardship policies can be better formulated with this kind of data, and empirical therapy can be better informed, as well as the selection of appropriate antibiotics.[5] Both the body's innate and adaptive immune systems are weakened by diabetes. Glycosylation of proteins occurs in hyperglycemia, a feature of diabetes that might hinder the activity of immune cells such T-lymphocytes, macrophages, and neutrophils. Diabetic people have a harder time fighting off infections, especially uropathogens, because their immune systems aren't as strong. In addition, the nerves that regulate the bladder might be affected by autonomic neuropathy, a typical consequence of diabetes, which can result in malfunction. Because of this, you may have symptoms including urinary retention, incomplete bladder emptying, and a rise in residual urine volume. These conditions foster the growth of germs and can lead to infections.[6] Glucosuria, a byproduct of high blood glucose levels in diabetic individuals, is a breeding ground for bacteria, which in turn increases the likelihood of infection due to the enhanced proliferation of germs. [7] Also, typical urinary tract flora can be changed by hyperglycemia, making it easier for harmful bacteria to colonise and infect. Uropathogens that cause urinary tract infections (UTIs) in people with diabetes can range from common to opportunistic. The bacteria that are most commonly found in soil samples include: *Escherichia coli*, *Klebsiella*, *Proteus mirabilis*, *Enterococcus*, and *Candida*. The most common bacteria causing UTIs is *E. coli*, however diabetic patients frequently encounter more aggressive and antibiotic-resistant strains of this bacteria, which makes treatment more difficult.[8]

In 2015, Nitzan Orna Urinary tract infections are more common in patients with type 2 diabetes mellitus and can have serious complications. More often than not, they originate from resistant microbes. Autonomic neuropathy causes insufficient bladder emptying, poor metabolic regulation, and immune system inadequacies; these factors may make these people more prone to UTIs. There is no evidence that the new class of anti-diabetic medications that block sodium glucose cotransporter 2 significantly increases the likelihood of developing a symptomatic UTI. While diabetic neuropathy patients and those without the condition may present with varied clinical signs, the symptoms of a UTI are the same in both groups. The treatment plan is based on a number of factors, including the patient's symptoms, the severity of systemic symptoms, the location of the infection (bladder vs. kidney), urologic abnormalities, metabolic changes that occur at the same time, and renal function. It is not necessary to treat diabetic patients who have asymptomatic bacteriuria. Additional research is necessary to improve the treatment of individuals with type 2 diabetes and urinary tract infections.[9]. Bishara J et al. (2012) looked at the outcomes of individuals with *Staphylococcus aureus* bacteraemia that was either hospital-acquired (HA) or healthcare-associated (HCA). proving that HA and HCA contributed to the transmission of methicillin-resistant *Staphylococcus aureus* (MRSA) bacteraemia in healthcare facilities. [10]. They found and proved antibiotic resistance in relation to chest infections, according to the article of Kumar A et al. (2012). Findings from the study on antibiotic susceptibility in respiratory tract infections (RTIs) patients revealed that penicillin's are losing their efficacy, cephalosporins

are highly vulnerable to gram-negative bacteria, and monobactams are susceptible to pseudomonas but resistant to Klebsiella. the eleventh

Materials and Methods

Study Design and Setting : From August 2020 to October 2020, researchers from the General Medicine Department's Out-patient Department and Diabetes Clinic, along with the JNM Hospital at WBUHS in Kalyani, West Bengal, India, performed this cross-sectional study. Examining uropathogen antibiotic resistance trends in type 2 diabetic individuals with urinary tract infections (UTIs) was the primary objective.

Study Population : Two hundred type 2 diabetics with acute urinary tract infections (UTIs) were enrolled in the research. The following criteria were used to choose the participants

Inclusion Criteria :

Patients aged between 18 and 75 years.

Confirmed diagnosis of Type 2 Diabetes Mellitus (T2DM).

Clinical diagnosis of urinary tract infection (UTI), confirmed by symptoms and urine culture.

Exclusion Criteria :

Recent antibiotic use within the past month.

Hospitalization within the last month.

Patients with chronic kidney disease or other severe comorbid conditions that might affect immune function.

Pregnant women.

Ethical Considerations : All of the participating hospitals' institutional review boards gave their stamp of approval for the study's ethical conduct. All participants were asked to provide their informed permission before to registration.

Collecting Data :-

Medical Records :

A systematic questionnaire was used to gather demographic and clinical data. Subject demographics included age, gender, diabetes duration, haemoglobin A1c levels, and a history of urinary tract infections (UTIs) during the past year.

Sterile containers were used to collect midstream urine samples from every patient. In order to reduce the possibility of contamination, patients were educated on how to correctly collect samples.

Examination in the Lab :-

Analysis of Urine :

Cells were grown on MacConkey agar and Cystine Lactose Electrolyte Deficient (CLED) agar using urine samples as cultures. After 24 to 48 hours, the plates were placed in an incubator set at 37 degrees Celsius. There was a quantification of bacterial growth, and bacteriuria was considered substantial when there were at least 10^5 colony-forming units (CFU) per millilitre of urine.

Detection of Infectious Agents :

The following biochemical tests were used to identify isolated colonies:

Staining for Gramme

Examining catalase and oxidase

Indole manufacturing

Use of citrate

A urine test

Tests for the Resistance of Microorganisms (AST) :

We utilised the Kirby-Bauer disc diffusion method to conduct antimicrobial susceptibility testing. We looked at the following drugs because of their prevalence and potential usefulness in treating UTIs:

Ciprofloxacin

Cotrimoxazole (trimethoprim-sulfamethoxazole)

Amoxicillin-clavulanate

Nitrofurantoin

Fosfomycin

Gentamicin

Ceftriaxone

The procedure began with inoculation of Mueller-Hinton agar plates using a 0.5 McFarland standard bacterial solution.

Media for Antibiotics : On the surface of the inoculated agar were inserted discs that were impregnated with antibiotics.

Heating:

The plates were heated to 37 degrees Celsius for 16 to 18 hours.

Procedure:

The inhibition zones surrounding each disc were measured and analysed in accordance with the parameters set out by the Clinical and Laboratory Standards Institute (CLSI).

To guarantee the precision and dependability of the AST findings, control strains of *Staphylococcus aureus* ATCC 25923 and *Escherichia coli* ATCC 25922 were utilised.

Analysis of Data :

Using SPSS software, the data were examined. We utilised descriptive statistics to summarise the research population's demographic and clinical features. The frequencies and percentages displayed the prevalence of several uropathogens together with their resistance patterns. A p-value of less than 0.05 was deemed statistically significant when comparing resistance rates among various groups using chi-square testing.

Result and discussion:**Table 1: Demographic and Clinical Characteristics of the Study Population**

Characteristic	Frequency (n=200)	Percentage (%)
Age (years)		
18-35	40	20.0
36-50	80	40.0
51-65	60	30.0
66-75	20	10.0
Gender		
Male	120	60.0
Female	80	40.0
Duration of Diabetes		
<5 years	50	25.0
5-10 years	100	50.0
>10 years	50	25.0
HbA1c Levels		
<7%	60	30.0
7-9%	100	50.0
>9%	40	20.0

Table 2: Prevalence of Uropathogens in T2DM Patients with UTIs

Pathogen	Frequency (n=200)	Percentage (%)
Escherichia coli	120	60.0
Klebsiella pneumoniae	40	20.0
Proteus mirabilis	20	10.0
Enterococcus faecalis	10	5.0
Pseudomonas aeruginosa	6	3.0
Staphylococcus saprophyticus	4	2.0

Table 3: Antibiotic Resistance Patterns of Isolated Uropathogens

Antibiotic	E. coli (n=120)	K. pneumoniae (n=40)	P. mirabilis (n=20)	E. faecalis (n=10)	P. aeruginosa (n=6)	S. saprophyticus (n=4)
Ciprofloxacin	84 (70.0%)	30 (75.0%)	14 (70.0%)	6 (60.0%)	4 (66.7%)	1 (25.0%)
Cotrimoxazole	78 (65.0%)	26 (65.0%)	12 (60.0%)	5 (50.0%)	3 (50.0%)	1 (25.0%)
Amoxicillin- clavulanate	66 (55.0%)	24 (60.0%)	11 (55.0%)	4 (40.0%)	2 (33.3%)	1 (25.0%)
Nitrofurantoin	18 (15.0%)	8 (20.0%)	4 (20.0%)	1 (10.0%)	1 (16.7%)	0 (0.0%)
Fosfomycin	12 (10.0%)	6 (15.0%)	2 (10.0%)	1 (10.0%)	1 (16.7%)	0 (0.0%)
Gentamicin	30 (25.0%)	12 (30.0%)	6 (30.0%)	3 (30.0%)	2 (33.3%)	1 (25.0%)
Ceftriaxone	48 (40.0%)	20 (50.0%)	10 (50.0%)	5 (50.0%)	3 (50.0%)	1 (25.0%)

Patients with type 2 diabetes mellitus (T2DM) were represented in the study by a wide variety of demographic and clinical variables; the majority were male, aged 36–50, and had suffered from the disease for 5–10 years. [12] This group gives a full picture of the problem in Eastern India since they are typical of the people who have UTIs in type 2 diabetics.

The predominance of uropathogens reveals that *Escherichia coli*, *Klebsiella pneumoniae*, and *Proteus mirabilis* are the most frequent pathogens, accounting for 60% of infections. in [13] This is in line with the current worldwide trend of *E. coli* being the most common cause of UTIs. *Klebsiella pneumoniae* and *Proteus mirabilis* are relatively common, so it's important to treat them with specific antibiotics. Resistant strains of routinely used antibiotics including ciprofloxacin, cotrimoxazole, and amoxicillin-clavulanate are showing up in the antibiotic resistance patterns. In the case of ciprofloxacin, resistance rates in *E. coli* and *Klebsiella pneumoniae* can reach 70-75%. [14] The difficulties in treating UTIs in T2DM patients and the possibility of treatment failures with standard empirical medicines are brought to light by this high level of resistance. On the other hand, the low resistance rates observed for nitrofurantoin and fosfomycin indicate that these medications are still effective and could be used as first-line therapies for this group.

This study's results highlight the absolute necessity of antibiotic stewardship programmes and ongoing monitoring of antibiotic resistance trends. To keep treatments effective, these programmes should emphasise the careful use of antibiotics while taking local resistance tendencies into account. [15] In order to improve treatment outcomes and lessen the impact of antibiotic resistance, doctors treating patients with type 2 diabetes should use resistance data as a reference when choosing empirical therapy for urinary tract infections (UTIs).

CONCLUSION:

Patients with type 2 diabetes who get urinary tract infections (UTIs) in Eastern India are more likely to have uropathogens that are resistant to antibiotics, according to this study. *Klebsiella pneumoniae*, *Proteus mirabilis*, and *Escherichia coli* continue to rank as the top three most common pathogens. Antibiotics like nitrofurantoin and fosfomycin should be explored for empirical treatment because to the high resistance rates to ciprofloxacin, cotrimoxazole, and amoxicillin-clavulanate. In order to effectively address the increasing problem of antibiotic resistance, it is crucial to implement antibiotic stewardship programmes that are particular to each region and to assess resistance levels on a regular basis.

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