

Original Research Article

Recent trends in the antimicrobial susceptibility patterns of urinary pathogens in type II diabetes mellitus

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ABSTRACT

Background: Diabetes mellitus is one of the most frequently encountered diseases in clinical practice and since the diabetic patients are at an increased risk of infections specially those of the urinary tract it is imperative for a physician to be aware of the prevalence and antibiotic susceptibility patterns of urinary pathogens. Thus, in this study we assess the recent trends in antimicrobial susceptibility patterns of urinary pathogens in type II diabetes mellitus.

Methods: Ninety-three eligible type II diabetes mellitus cases without genitourinary symptoms or abnormalities along with 93 non-diabetic healthy controls were recruited. Mid-stream urine was collected after taking informed consent and each sample tested using the dipstick, microscopy and culture techniques. Isolates were identified using standard biochemical tests.

Results: Prevalence of asymptomatic bacteriuria (ASB) in our study was found to be 34.4% among cases of type II diabetes mellitus while it was 6.45% among non-diabetic healthy controls. *E. coli* was the most common urinary pathogen isolated. *E. coli* susceptibility towards amikacin was 85.71%, towards ceftriaxone and nitrofurantoin was 71.73% and for meropenem and doxycycline 66.67% susceptibility was observed. In the one case where pseudomonas was cultured, it was susceptible to meropenem, gentamycin, cefoperazone-sulbactam and cefuroxime. In an isolated case where Proteus species was grown, it showed susceptibility to meropenem, norfloxacin, levofloxacin and co-trimoxazole. Enterobacter species which was grown, showed susceptibility to meropenem, vancomycin, amikacin, nitrofurantoin, norfloxacin, levofloxacin and co-trimoxazole. Gram positive bacteria mainly showed susceptibility to ceftriaxone, teicoplanin, vancomycin and doxycycline.

Conclusions: The prevalence of bacteriuria is significantly higher in diabetics as compared to non-diabetics and with the recent trends suggestive of emerging resistance among urinary pathogens to some of the commonly used antimicrobials it is of utmost importance to carry out regular surveillance of bacterial profile and their anti-microbial susceptibilities to formulate updated guidelines for effectively treating urinary infections in diabetic patients.

Keywords: Asymptomatic bacteriuria, Antibiotic sensitivity, Diabetes, UTI, Antibiotic sensitivity

INTRODUCTION

Diabetes is long term degenerative disease with severe micro and macrovascular complications.¹ Based on the pathogenic process, DM has two broad categories. Type I diabetes is the result of complete or near-total insulin

deficiency whereas type II DM is a heterogeneous group of disorders characterized by variable degrees of insulin resistance, impaired insulin secretion, and increased glucose production.² DM is a worldwide public health problem considering its high prevalence and extremely high economic and social costs.³ Urinary Tract Infection (UTI) is a common infection observed in patients with

diabetes mellitus.¹ The emergence of resistant bacterial strains pose a continued challenge to treat and control the spread of infections. Moreover, indiscriminate use of antibiotics often results in the increased resistance of urinary pathogens to most commonly used antimicrobial agents.⁴

Though there is an increased prevalence of UTIs in diabetics, anti-microbial chemoprophylaxis is not recommended as it leads to unnecessary prolonged antimicrobial dosing which can contribute to development of resistance due to selection pressure.⁵ With a steep rise in the incidence of diabetes mellitus (DM) throughout the world and more so in the developing countries, the emerging patterns of antimicrobial resistance over the past decade or so has had a significant impact on clinical decision making specially with regards to the empirical use of antibiotics in diabetics.

The topographical variations in the antibiotic susceptibility patterns of urinary pathogens in diabetes mellitus underscores the importance of determining the area specific and institution specific antibiogram of bacteria causing urinary tract infections in diabetic patients. Hence this study was designed to ascertain the recent antibiogram of urinary pathogens in diabetes mellitus type II patients.

METHODS

This hospital based observational, descriptive, comparative analysis was carried out as a cross sectional prospective study recruiting 93 type II diabetes mellitus cases and same no. of non-diabetic healthy controls. The screening of patients was done by applying inclusion and exclusion criterion and the selected groups were subsequently evaluated for ASB and the antibiotic susceptibility of the isolated urinary pathogens.

Inclusion criterion

- 18-75 years of age,
- Type II diabetes documented as per ADA criterion,
- Presented in the Department of Internal Medicine as indoor and outdoor patients at S.M.S. Hospital, Jaipur,
- Willing to be a part of the study.

Exclusion criterion

- Pregnancy,
- Recent hospitalization or surgery (within the past 4 months),
- Known urinary tract abnormalities (including cystopathy),
- Recent urinary tract instrumentation (in last 6 weeks),
- Symptoms of UTI (presence of dysuria, frequency, urgency, stranguria, abdominal discomfort or fever).

RESULTS

A total of 93 subjects were studied in both the case (diabetics) and control (healthy non-diabetics) groups. Urine culture was positive in 32 (34.41%) subjects out of 93 diabetic patients (cases) compared to 6 (6.45%) subjects out of 93 non-diabetic healthy controls. This association was found to be highly significant with $p < 0.05$. The most common organism isolated was *E. coli* in 21 (22.58%) subjects among cases and in 5 (5.38%) subjects among healthy control group. Other organisms found among cases were, 4 (4.30%) subjects with Coagulase Negative *Staphylococcus*; 2 (2.15%) subjects each with Coagulase Positive *Staphylococcus* and *Enterococcus* and a single (1.08%) subject with *Enterobacter*, *Proteus vulgaris* and *Pseudomonas*. Among the healthy controls a single (1.08%) subject grew Coagulase Negative *Staphylococcus* in their urine culture. In totality, among the 93 cases, 32 (34.4%) were culture positive (ASB), and out of the 32 ASB cases, 75% cases were due to gram negative microorganisms and 25% due to gram positive microorganisms (Figure 1).

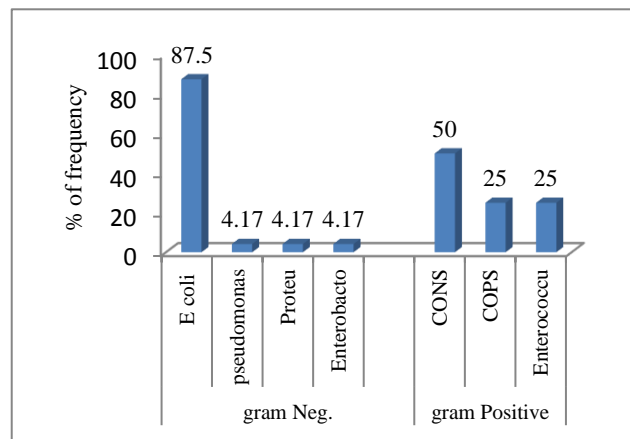


Figure 1: Distribution of microorganisms grown on urine culture.

E. coli susceptibility towards amikacin was 85.71%, towards ceftriaxone and nitrofurantoin was 71.73% and for meropenem and doxycycline 66.67% susceptibility was observed. In the one case where *pseudomonas* was cultured, it was susceptible to meropenem, gentamycin, cefoperazone-sulbactam and cefuroxime. In an isolated case where *Proteus* species was grown, it showed susceptibility to meropenem, norfloxacin, levofloxacin and co-trimoxazole. *Enterobacter* species which was grown, showed susceptibility to meropenem, vancomycin, amikacin, nitrofurantoin, norfloxacin, levofloxacin and co-trimoxazole. Gram positive bacteria mainly showed susceptibility to ceftriaxone, teicoplanin, vancomycin and doxycycline (Table 2).

DISCUSSION

Seble Worku et al, in their study observed that the predominant gram-negative bacteria isolated from the

urinary samples of diabetics, *E. coli*, showed high resistance to amoxicillin (100%) and low-level resistance

to tetracycline (37.5%) and ampicillin (37.5%).⁶

Table 2: Antibiotic sensitivity pattern of the various microorganisms.

	<i>E. coli</i> (n=21)		CONS (4)		COPS (2)		Pseudomonas (1)		Proteus (1)		Enterococcus (2)		Enterobacter (1)	
Chlormphenicol	5	23.81	2	50	2	100	0	0	0	0	2	100	0	0
Meropenem	14	66.67	0	0		0	1	100	1	100	0		1	100
Teicoplanin	6	28.57	4	100	2	100	0	0	0	0	2	100	0	0
Vancomycin	1	4.762	4	100	2	100	0	0	0	0	2	100	1	100
Gentamicin	9	42.86	2	50	2	100	1	100			0			0
Amikacin	18	85.71	0	0		0			0	0	1	50	1	100
Ceftriaxone	15	71.43	4	100	2	100	0	0	0	0	2	100	0	0
Ampicillin	6	28.57	0	0	2	100					2	100		0
Augmentin	5	23.81	0	0	2	100					2	100		0
Azithromycin	5	23.81	2	50		0	0		0		0			0
PnG	1	4.762	0	0		0	0		0		0			0
Doxycycline	14	66.67	4	100	2	100	0		0		2	100		0
Nitrofurantoin	15	71.43	2	50		0	0		0		0		1	100
Norfloxacin	5	23.81	2	50		0	0	1	100		0		1	100
Levofloxacin	5	23.81	0	0		0	0	1	100		0		1	100
Cefo+salbact	0	0	0	0		0	1	100		0	1	50	1	100
Linezolid	5	23.81	2	50	2	100			0		0			0
Cefoxitin	2	9.524	2	50	2	100			0		0			0
Ceftazime	9	42.86	0	0		0	0		0		0		1	100
Cefuroxim	5	23.81	0	0		0	1	100		0	0		1	100
Cotrimoxazole	0	0	0	0		0	0		1	100	0		1	100

All of the isolates of *E. coli* were 100% sensitive to gentamicin, chloramphenicol, and ceftriaxone and were also found sensitive to nitrofurantoin (87.5%), cotrimoxazole (87.5%), and tetracycline (66.6%). We however found that *E. coli* isolates were maximally susceptible to amikacin (85.71%) followed by ceftriaxone and nitrofurantoin (71.73%) and meropenem and doxycycline (66.67%). Thus, the results of the two studies are comparable in most regards with slight differences in susceptibility and resistance patterns probably reflecting the region/institution specific variations in antibiogram.

Anejo-Okopi JA et al, in their study reported that significant bacteria were isolated in 40/100 (40%); (65%) and (35%) of symptomatic and asymptomatic diabetic patients respectively with prevalence of bacteria isolated among the symptomatic patients.⁷ *E. coli* (19.2%), CNS (46.15%), *K. pneumoniae* (19.23%), *S. aureus* (3.84%), and *Streptococcus spp.* (11.53%) while that of the asymptomatic was; *E. coli* (31.25%), CNS (18.75%), *S. aureus* (31.35%), and *Streptococcus spp.* (6.25%). The antimicrobial susceptibility patterns of gram negative bacterial isolates showed that *E. coli* was susceptible to ciprofloxacin (60%), streptomycin (100%), but resistant to ofloxacin, amoxiclav, gentamycin, cefalexin, nalidixic acid, co-trimoxazole and ampicillin. *K. pneumoniae* was susceptible to streptomycin (100%), while resistant to most of the antibiotics tested. CNS is susceptible to

ciprofloxacin (86.6%), norfloxacin (60%), gentamycin (93.3%), amoxicillin (86.66%), streptomycin (100%), rifampicin (100%), erythromycin (80%), chloramphenicol (66.6%), ampiclox (80%) and levofloxacin (100%) whereas the gram positive showed; *S. aureus* is susceptible to ciprofloxacin (83.33%), norfloxacin (50%), gentamycin (83.33%), amoxicillin (83.33%), streptomycin (100%), rifampicin (100%), erythromycin (100%), chloramphenicol (75%), ampiclox (100%), and levofloxacin (100%).

Kebamo S et al, in their study isolated thirty-three bacterial uropathogens, with *S. aureus* (24.2%) and CN *Staphylococcus* (24.2%), *E. coli* (12.1%) and *K. pneumoniae* (12.1%) being the most common isolates.⁸ The microbes showed highest level of resistance to penicillin G (97.0%), and ampicillin (93.9%); and lowest level of resistance to ceftriaxone (50.0%) and vancomycin (52.9%). They thus concluded that majority of isolated bacteria were resistant to antibiotics used in the study setting and called for attention of health professionals to consider the resistance pattern in their clinical practice.

Al Mously N et al, in their study on 3,967 patients with *E. coli* UTIs observed, 1,086 (27.4%) of patients had ESBL *E. coli*.⁹ The percentage of hospital-acquired ESBL *E. coli* was 64.5%, while outpatient-acquired was 35.5%. Overall, 75.1% of ESBL *E. coli* were resistant to

trimethoprim/sulfamethoxazole, (69.8%) to ciprofloxacin and (40%) to gentamicin. However, high sensitivity to imipenem and meropenem was reported (99.8% each). Their study highlighted the antimicrobial susceptibility pattern of ESBL *E. coli*. And suggested that since bacterial multidrug resistance is an increasingly existing problem, periodical monitoring of antimicrobial susceptibility, rotating the use of effective antimicrobial drugs, and research for finding novel drugs and their rational use should be considered.

May Sewify et al, in their study done in Kuwait observed that *E. Coli*, which was the most commonly isolated uropathogen displayed relatively high anti-microbial resistance rates against most of the tested antibiotics, that is, cephalothin (58%), trimethoprim-sulfamethoxazole (48%), ciprofloxacin and ampicillin/sulbactam (34%), cefotaxime (28%), ceftazidime (26%), amoxicillin/clavulanate (20%), nitrofurantoin (4%), and amikacin (2%).¹⁰ The findings of our study signifying that most of the isolates of *E. coli* in our geographic region are still susceptible to nitrofurantoin and amikacin calls for a cautious and rationale approach to be adopted while prescribing these agents so that the emergence of resistance to these anti-microbials can be prevented.

CONCLUSION

The prevalence of bacteriuria is significantly higher in diabetics as compared to non-diabetics and with the recent trends suggestive of emerging resistance among urinary pathogens to some of the commonly used antimicrobials it is of utmost importance to carry out regular surveillance of bacterial profile and their anti-microbial susceptibilities to formulate updated guidelines for effectively treating urinary tract infections in diabetic patients.

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