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Original Research Article

A comparative study on prevalence of uropathogens and their antibiogram in diabetics and non-diabetics attending a tertiary care hospital

Tanmay Anne*, Vijayadurga Suryadevara, Anuradha B.

Department of Microbiology, Mamata Medical College, Khammam, Telangana, India

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***Correspondence:**
Dr. Tanmay Anne,
E-mail: doctanmayanne@gmail.com

ABSTRACT

Background: Urinary tract infection (UTI) is a significant problem in both diabetics and non-diabetics. High glucose may create a culture medium for growth of the virulent organisms. Diabetics are at greater risk for developing complications of UTI. Extensive and improper use of antibiotics has caused widespread anti-microbial resistance among uro-pathogens. Indiscriminate use of antibiotics during Covid-19 pandemic might lead to more resistant uro-pathogens which might further complicate the treatment of UTI. This study will help to determine resistance patterns of common uro-pathogens, which is essential for proper patient care.

Methods: Clean voided midstream urine samples were collected from 91 patients (67 diabetic and 24 non-diabetic). Urine cultures were performed using semi-quantitative technique and pathogens were identified using phenotypic methods. Those with colony forming units (CFU) $\geq 10^5$ CFU/ml were subjected to antibiotic sensitivity testing by Kirby-Bauer disk diffusion method and the isolates were classified as sensitive, and resistant according to CLSI guidelines.

Results: *E. coli* (53.84%) and *Enterococci* (29.67%) were the most commonly isolated pathogens of UTI in both diabetics and non-diabetics. *E. coli* resistance to imipenem was statistically more in diabetics when compared to non-diabetics (p=0.012). Resistance patterns of other organisms were similar in both the groups.

Conclusions: *E. coli* was the most common pathogen isolated in both groups followed by *Enterococci* and *Klebsiella*. Diabetics showed statistically significant higher resistance (100%) to imepenem than non-diabetics. Other organisms isolated in this study did not show any statistically significant difference in their antibiogram.

Keywords: Antibiotic resistance, Diabetic and non-diabetics, Urinary tract infections, Uropathogens

INTRODUCTION

The prevalence of diabetes mellitus (DM) is becoming a serious public health problem globally. The high prevalence of diabetes has important social, financial and development implications especially in low- and middle-income countries.[1] Urinary tract infections are a significant problem both among diabetics and non-diabetics with a higher risk among diabetics.[2] Most of the urinary tract infections (UTIs) in diabetic patients are relatively asymptomatic, which can lead to severe kidney damage and renal failure if left unattended.[3,4]

Bacteriuria is more common in diabetics than in non-diabetics due to a combination of host and local risk factors.[4] Studies have showed that *Escherichia coli* (*E. coli*), *Klebsiella*, *Proteus*, *Streptococcus*, *Coagulase-negative staphylococci* (CoNS), *S. aureus*, *Enterococcus* spp, *Enterobacter*, *Citrobacter*, *Serratia* spp, pseudomonas and Candida species are responsible for UTI among diabetics.[5-8]

With increase of antibiotic resistance the treatment of urinary tract infection has become challenging both among diabetics and non-diabetics. The trends of antibiotic resistance change over time.

The Covid-19 pandemic drug practices pose a threat to this world as they might increase the risk of antibiotic resistance.[9] Studies on current antibiotic sensitivity pattern can help to identify the drugs that the organisms are resistant to and help tailor empirical treatment. With proper knowledge on current antibiotic susceptibility pattern, rational empirical and definitive treatment of urinary tract infections among the various groups can be ensured.

Though retrospective studies amidst the Covid-19 pandemic have given data on antibiotic sensitivity patterns, a cross-sectional study would offer more information on current status of the resistance.

A cross-sectional study to identify the antibiotic sensitivity pattern among diabetics and non-diabetics will help in understanding the current resistance patterns of the organisms.

METHODS

This was cross-sectional study conducted at Mamata General Hospital, Khammam, Telangana for 2 months (July 2022 - August 2022). The study was approved by Mamata Medical college institutional research and ethical committee. Total 91 (diabetics - 67, non-diabetics - 24) patients were included.

Inclusion criteria

Culture positive urinary tract infections were included.

Exclusion criteria

Culture negative urinary tract infections, and patients with age <18 years were excluded.

Collection of samples

Clean voided midstream urine samples were collected in sterile containers of wide mouth with airtight lids provided to the patients after giving proper instructions and samples were processed in the laboratory within 2 hours of collection.

Microbiological methods

Culture of all the collected urine samples was done. The specimens were processed in the department of microbiology.

Urine cultures were performed using semi-quantitative technique whereby urine samples were inoculated on MacConkey agar and blood agar plates with a calibrated loop (0.001ml) and incubated at 37°C for 18-24 hours.

The pathogens were identified using phenotypic methods including biochemical testing like catalase, oxidase, coagulase, triple sugar iron agar, sulphide, indole, motility, citrate, urease etc.

Those growths were considered positive where colony forming units (CFU) were $\geq 10^5$ CFU/ml and subjected to antibiotic sensitivity testing on Muller-Hinton agar by Kirby-Bauer disk diffusion method.

The inoculated plates were incubated at 37°C for 18-24 hours. Diameter of the zone of inhibition around the disc was measured to the nearest millimetre using a Vernier calliper and the isolates were classified as sensitive, and resistant according to CLSI guidelines.

Data analysis

The final data was analysed using statistical package SPSS. The percentages in different categories were compared using chi square test.

RESULTS

Out of total 301 samples received, 142 samples showed growth in culture. Fungal infections (*Candida* =18) and those with insignificant data (33) were excluded in the study.

This study included 24 diabetics (11 males and 13 females) and 67 non-diabetics (26 male and 41 female). The mean age among diabetic and non-diabetic patients was 45 years and 51.3 years respectively. Among diabetics majority belonged to the age group of 50-59 years (37.5%) and among non-diabetics majority (31.5%) belonged to 30-39 years age group as shown in Table 1.

Table 1: Age distribution of diabetics and non-diabetics with UTI.

Age (in years)	Diabetics (%)	Non-diabetics (%)
18-29	1 (4.2)	9 (13.5)
30-39	1 (4.2)	21 (31.5)
40-49	8 (33.4)	15 (22.5)
50-59	9 (37.5)	9 (13.5)
60-69	4 (16.8)	4 (6)
70-79	1 (4.2)	6 (9)
>80	0	3 (4.5)
Total	24	67

There was no statistically significant risk pertaining to age in our study. The most common complaints the patients came to the hospital were fever (62.3%), dysuria

(57.14%), and some were asymptomatic (42.8%). 2.19% had prior catheterisation in previous 2 months and 9.89% used antibiotics in previous 6 months. *E. coli* was the most common isolated pathogen in both diabetics and non-diabetics followed by *Enterococci*. Other bacteria isolated are *Klebsiella*, *Pseudomonas*, *Streptococcus viridans* (S.viridans), Methicillin resistant coagulase negative streptococci (MRCONS), *Providencia* and a mixed gram negative growth as shown in Table 2.

Table 2: Distribution of uropathogens isolated in diabetics and non-diabetics.

Organism	Diabetics		Non-diabetics		Total	
	N	%	N	%	N	%
E. coli	12	50	37	55.2	49	53.8
Enterococci	5	20.8	22	32.8	27	29.7
Klebsiella	3	12.5	6	9	9	9.9
Pseudomonas	2	8.3	0	0	2	2.2
S.viridans	1	4.2	0	0	1	1.1
MRCONS	1	4.2	0	0	1	1.1
Providencia	0	0	1	1.5	1	1.1
Mixed	0	0	1	1.5	1	1.1
Total	24	100	67	100	91	100

For the gram negative isolates the antibiotics used to test for antibiotic sensitivity patterns were - Ampicillin (AMP), Fosfomycin (FO), Nitrofurantoin (NIT), Levofloxacin (LE), Doxycycline hydrochloride (DO), Ciprofloxacin (CIP), Meropenem (MRP), Amoxicillin/Clavulanic acid (AMC), Cotimoxazole (COT), Ofloxacin (OF), Gentamicin (G), Ceftriaxone (CTR), Cefepime (CPM), Piperacillin/Tazobactam (PT), Cefazolin (CZ), Ampicillin/Sublactum (AS), Amikacin (AK), Imepenem (IPM), Cefixime (CFM), Ceftazidime (CAZ).

The gram-positive isolates were tested against Ampicillin (AMP), Fosfomycin (FO), Nitrofurantoin (NIT), Levofloxacin (LE), Doxycycline hydrochloride (DO), Ciprofloxacin (CIP), Vancomycin (VA), Linezolid (LE), Teicoplanin (TE), High level streptomycin (HLS), Cotrimoxazole (COT), Gentamicin (G), Penicillin (P), Rifampicin (RIF), Ofloxacin (OF), Ceftriaxone (CTR) for assessing their antibiotic sensitivity patterns.

E. coli is the most common pathogen isolated from the samples both among diabetics and non-diabetics. Diabetics showed more resistance to IPM than non-diabetics (p=0.0012). Among other antibiotics there was no statistically significant variation among the two groups. The *E. coli* isolates were most sensitive to fosfomycin and least to cefixime as depicted in Figure 1.

Enterococci was the 2nd most common organism isolated from the population. The antimicrobial resistance pattern was similar in both diabetic and no-diabetic subjects in *Enterococci* with maximum sensitivity to linezolid and least to teicoplanin and there is no statistically significant difference as shown in Figure 2.

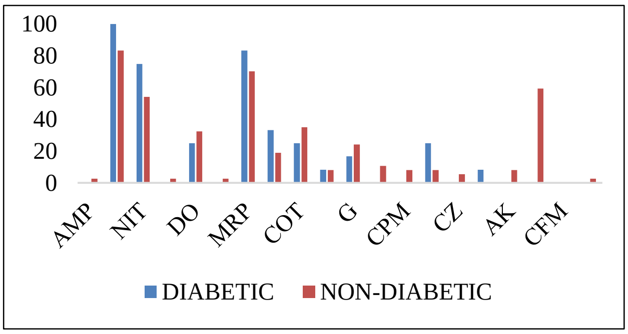

Figure 1: Comparison of antibiotic sensitivity to *E. coli* (percentage distribution).

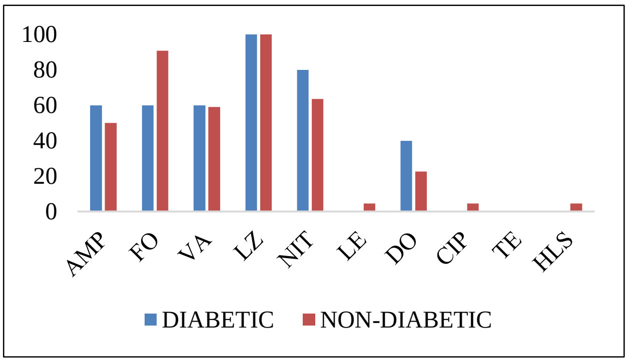

Figure 2: Comparison of antibiotic sensitivity to *Enterococci* (percentage distribution).

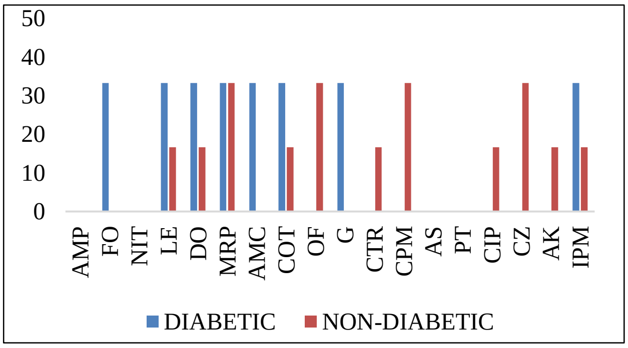

Figure 3: Comparison of antibiotic sensitivity to *Klebsiella* (percentage distribution).

The antimicrobial resistance pattern was similar in both diabetic and no-diabetic subjects in *Klebsiella* with least sensitivity to ampicillin, nitrofurantoin, piperacillin-tazobactam, ampicillin-sublactumand there is no statistically significant difference as depicted in Figure 3.

Providencia and a mixed growth of gram negative organisms (*E. coli* and *Klebsiella*) were isolated among the non-diabetic group showing the sensitivity pattern as shown in Figure 4 and Figure 5, respectively.

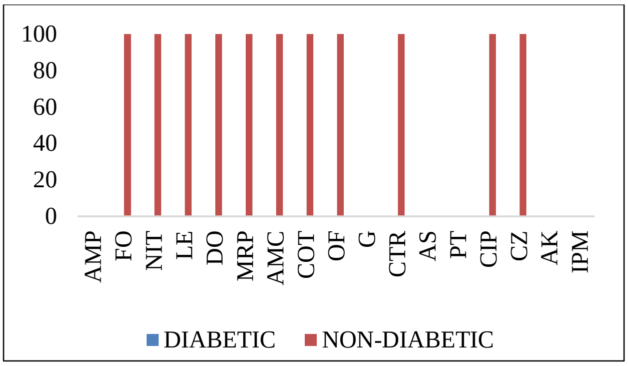

Figure 4: *Providencia* sensitivity (percentage distribution).

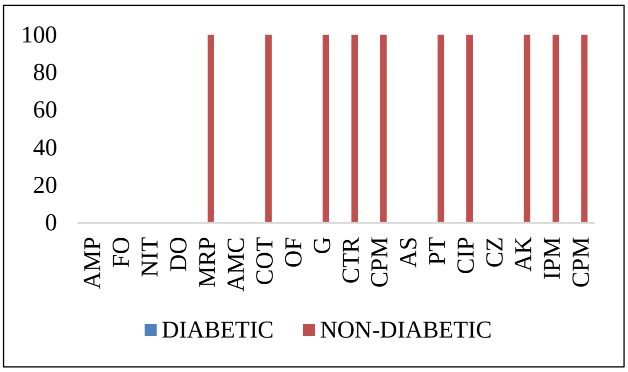

Figure 5: Mixed growth sensitivity (percentage distribution).

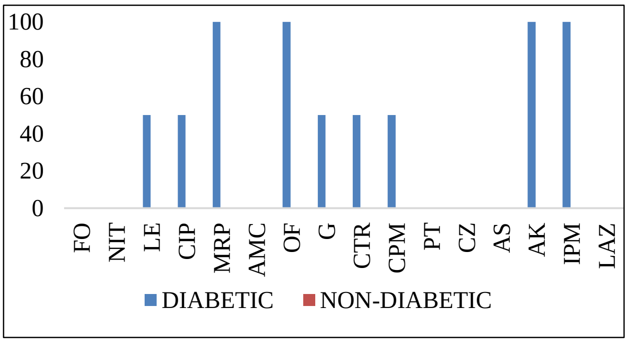

Figure 6: *Pseudomonas* sensitivity (percentage distribution).

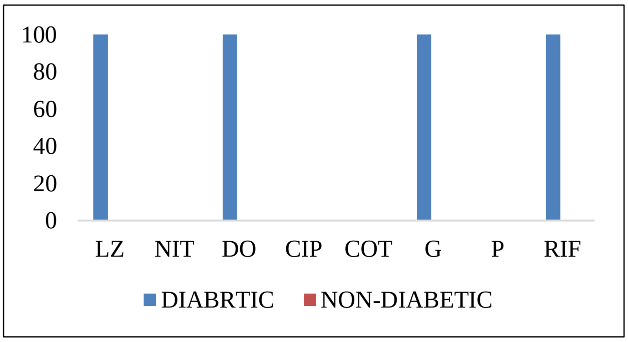

Figure 7: MRCONS sensitivity (percentage distribution).

Pseudomonas, *MRCONS* and *S. viridans* were isolated only from the diabetic group with the sensitivity pattern as shown in Figure 6, Figure 7 and Figure 8, respectively.

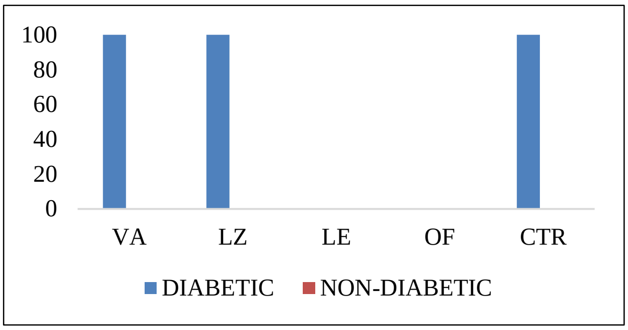

Figure 8: *S. viridans* sensitivity (percentage distribution).

DISCUSSION

The present study included 24 diabetic and 64 non-diabetic patients with culture positive urinary tract infections. In this study, we have tried to determine whether there are differences in the microbiological patterns in UTI and the antibiotic sensitivity patterns of the pathogens concerned with diabetic and non-diabetic patients. Mean age among diabetic and non-diabetic was 45 and 51.3 years respectively. There was no significant correlation between age of patient and the incidence of UTI in both diabetic and non-diabetic patients.

In our study we found that *E. coli* (53.84%) and *Enterococci* (29.67%) were the most commonly isolated organisms which is consistent with the observation made in many other studies.[5-8,11-15]

Pseudomonas was more common in diabetics in Rajana et al, however such a conclusion couldn't be drawn from our study even though there were 2 isolates (8.3%) from diabetic group as there were no *Pseudomonas* isolates from non-diabetic group.[11]

The UTI causing organisms from this study showed maximum resistance to ciprofloxacin (68.1%), levofloxacin (64.8%) and maximum sensitivity to fosfomycin (74.7%), and nitrofurantoin (52.7%)

The isolates from diabetic group showed maximum resistance to ciprofloxacin (75%), ceftraixone (62.5%), cefazolin(62.5%), ampicillin-sublactum (58.3%), ofloxacin (54.2%) ampicillin (54.2%) and maximum sensitivity to fosfomycin (66.7%), nitrofurantoin (54.7%) and meropenem (54.2%) and the organisms isolated from the non-diabetic group showed maximum resistance to levofloxacin (71.6%), ciprofloxacin (70.1%), ampicillin/sulbactam (61.2%) and maximum sensitivity to fosfomycin (77.6%) and nitrofurantoin (52.2%) our findings are similar with findings of studies done by Rajana et al, Kattel et al and Acharya et al.[11,14,15]

In Bonadio et al it's concluded that diabetics had more resistance to various antibiotics, in our study *E. coli* isolates from diabetics showed significantly more resistance to imipenem (p = 0.0012) than non-diabetics.[8] No other organisms showed statistically significant increased resistance in a certain group which is in agreement with Rajan et al.[11] According to antibiotic policy UTI's should be started after sensitivity testing, but urinary tract infections are usually treated empirically and culture and susceptibility test are often requested only when the patients fail to improve after the administration of one or more antibiotics.[16] This trend engenders drug resistance in the pathogens. The responsible bacteria especially *Pseudomonas aeruginosa*, *Acinetobacter* and *Enterococcus* which are very deft at developing resistance by exploiting various mechanisms can be hard to manage.[16]

The time constraint of 2 months for this study limited the number of samples which in our opinion is the reason that our study did not elicit much statistically significant results. This is a cross-sectional study and hence the outcomes of the treatment were not included. Further cross-sectional studies will help identify current trends in resistance and prospective studies will help in finding out the treatment outcomes of the patients suffering from drug resistant bacteria.

CONCLUSION

In our study it is concluded that *E. coli* (53.84%) and *Enterococci* (29.67%) were the most commonly isolated pathogens of UTI in both diabetics and non-diabetics. *E. coli* resistance to Imipenem was statistically more in diabetics when compared to non-diabetics (p=0.012). Resistance patterns of other antibiotics in *E. coli* were similar in both diabetics and non-diabetics. Resistance patterns of other organisms were similar in both the groups.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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