International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Prevalence of Uropathogens and Its Antibiogram Among Diabetic and Non-Diabetic Patients.

Nilofar Pathan[1], P. C. Desai[2]

[1]Research Scholar, Department of Biotechnology, Bhagwan Mahavir Centre for Advance Research, Bhagwan Mahavir University, Surat, Gujarat-395007, India.
[2*]Assistant Professor, Bhagwan Mahavir University, Surat, Gujarat-395007, India.

Abstract

Objectives: The objectives of the research was to evaluate the prevalence of uropathogens, their resistance pattern, and association factors of UTI among diabetic and non-diabetic patients.

Material and Methods: A cross-sectional study was conducted during the year Sep-2022 to Jan-2024, among 1048 adult patients from SMIMER (Smimer Hospital and Medical college, Surat) and other private laboratory from Surat area. Using recommended culture methods, Clean-catch midstream urine samples were collected and examined for the presence of uropathogens and their antimicrobial susceptibility pattern.

Results: The highest prevalence of uropathogens were *Escherichia coli* (49%), *Klebsiella spp (39.2%)* and Candida (fungus) (13.2%). Most of the uropathogens were sensitive to nitrofurantoin, cefixime and amikacine in diabetic and most of the uropathogens were sensitive to meropenem, amikacine and levofloxacin in non-diabetic patients. Whereas resistant to Ampicillin/Sulbactam, Cefuroxime and Co-Trimoxazole (Sulpha/Trimethoprim) in diabetic patients, same as resistant to amikacin and netillin drug in non diabetic patients.

Conclusion: The prevalence of UTI and most commonly used antibiotics among diabetic and non-diabetic patients is compared with published paper. Urine analysis and culture should be performed in all diabetic and non diabetic patients. Most common uropathogens is *E.coli* in both groups.

Keywords: Diabetes mellitus, non-diabetic, glycated hemoglobin, urinary tract infection, Antibiotics.

Introduction

Diabetes is a worldwide health problem which increases day by day. It is one of the top ten causes of death in world and is due to its complications. It can lead to serious health complications affecting various organs and systems in the body. People of all ages are affected by diabetes.[1] Diabetes mellitus (DM) has recently been considered as a growing health problem worldwide. In 2019, the global prevalence of DM was estimated to be 9.3% (463 million people), it is expected to rise to 10.2% (578 million) by 2030 and 10.9% (700 million) by 2045.[2] Diabetic patients are at higher risk for all infections than non-diabetic patients. Different studies confirmed that high blood glucose levels that are not adequately controlled could provide a rich source of nutrients for bacteria. Additionally, weakened immune systems in diabetic patients, such as decreased T-cell-mediated immune response and impaired bladder emptying due to autonomic neuropathy, may raise the risk of UTIs in diabetic patients since urine stays in the bladder for too long and becomes a breeding ground for bacterial growth.[3] The study

was undertaken to investigate the prevalence of Uropathogens in clinically diagnosed patients with diabetes and non diabetic patients and antimicrobial resistance pattern of uropathogens isolated from Urine samples.

Objectives

To evaluate the prevalence of uropathogens in diabetic and non-diabetic patients, their resistance pattern, and association factors of UTI among diabetic and non-diabetic patients.

Material and Methods

This cross-sectional study was carried out between the year of 2022-2024 at SMIMER hospital and medical college, Surat. The study included total 1048 patients. Out of them 48 were excluded from the study. All tested with diabetics with fasting glucose>110mg/dl and postprandial (2hrs) glucose >150mg/dl were included in this study. Patients were history of diabetic were also included. Controls consisted of patients with comparable age and sex with no history of diabetes. After getting the consent of the patients, clinical data was collected using history performa. Patients were educated how to collect clean-catch mid-stream urine in a sterile wide mouth container and sample processed within 1 hour of collection. Using a standard qualitative loop, loopful of urine sample inoculated on Nutrient agar, blood agar and MacConkey agar plate. Streaked culture plates were incubated at 37°C for 24 h. On the next day, the bacterial growth on the media was observed and the total colony count was made. A single colony was picked and suspended into pepton and BHI broth which was incubated at 37°C for further identification.[5] The identification of the uropathogens was done by their colony characteristics on the respective media and pattern of biochemical reactions using the standard procedure.[4]Antimicrobial susceptibility testing was performed using the modified Kirby–Bauer disk diffusion method.[6] The bacterial suspension was prepared using pepton and BHI broth by peaking up 3–5 colonies from pure culture and inoculated onto Mueller-Hinton Agar (Oxoid, Ltd., England). Antibiotic discs were placed onto the surface of the culture medium using an automated disc dispenser. After 18–24 h of incubation at 37°C, the zone of growth inhibition was measured and interpreted according to the Clinical and Laboratory Standards Institute (CLSI) guideline as susceptible (S) or resistant (R).[7]All data of the study is tabulated and analyzed scientifically by statistical method SPSS version 7.0

Results and Discussion

Table-1.Pattern of urine culture in DM and NDM.

	DM(%)	NDM(%)	Total
Culture positive	242(55.1%)	106(18.9%)	348
Culture negative	197	455	652
Total	439	561	1000

Out of 1000 patients 348 sample has culture positive and 652 has culture negative. Among them 242 urine samples from diabetic patients 106 urine sample from non-diabetic patients. The prevalence of UTI in diabetic patients is 55.1% which is greater compared to 18.9% in non-diabetic patients.

Table -2.Pattern of Uropathogen isolates causing UTI.

Organism	**No. of isolates**					
	Diabetic			**Non Diabetic**		
	Male	**Female**	**Total(%)**	**Male**	**Female**	**Total(%)**
E.coli	44	54	94(38.9%)	20	30	50(47.1%)
Klebsiella spp.	12	22	34(14.0%)	08	08	16(15.0%)
Pseudomonas spp.	06	02	08(3.3%)	03	08	11(10.3%)
Citrobacter spp.	05	09	14(5.8%)	03	03	06(5.7%)
Acinatobacter spp.	04	05	09((3.7%)	00	02	02(1.8%)
Staphylococcus spp.	10	03	13(5.3%)	01	05	06(5.7%)
Staptococcus spp.	03	02	05((2.0%)	00	01	01(0.9%)
Enterococcus spp.	05	08	13(5.3%)	01	00	01(0.9%)
Enterobacter spp.	05	07	12(4.9%)	02	01	03(2.8%)
Candida spp.	17	19	36(14.9%)	05	05	10(9.4%)
Total	111	131	242	43	63	106

E.coli was found to be most predominant organism in both diabetic and non-diabetic patients. The most frequently isolated organism in case of diabetic were E.coli(38.9%),Klebsiella spp.(14.0%), Candida spp.(14.9%), Citrobacter spp.(5.8%). In case of non-diabetic patients , organisms isolated were E.coli(47.1%), Klebsiella spp.(15.0%), Candida spp.(9.4%), Staphylococcus spp.(5.7%).

Tabl-3.Socio-demographic characteristics of diabetic patients (n=242) and non diabetic patients (n=106) investigated for uropathogens.

Socio-demographic Characteristics	Classifications of variables	Frequency No(%) DM	NDM
Age	20-30	19 (7.8%)	23(21.6%)
	30-40	62(25.7%)	22(20.7%)
	40-50	74(30.7%)	31(29.2%)
	50-60	87(35.6%)	30(28.3%)
Sex	Male	108(44.3%)	42(39.6%)
	Female	134(55.6%)	64(60.3%)
IPD	Male	45(18.2%)	21(19.8%)
	Female	59(24.4%)	27(25.4%)
OPD	Male	64(26.1%)	21(19.8%)
	Female	75(31.1%)	37(34.9%)
Duration of Diabetes (Yrs)	<1	59(24.4%)	68(64.1%)
	1 to 2	135(55.6%)	14(13.2%)
	>2	48(19.9%)	24(22.6%)
History of Previous UTI	Yes	57(23.2%)	28(26.4%)
	No	185(76.7)	78(73.5%)
History of previous antibiotics	Yes	81(33.1%)	60(56.6%)

	No	161(66.8%)	46(43.3%)
Blood glucose level (mg/dL)	<126	34(13%)	Not applicable
	>126	208(86.3%)	Not applicable

The mean age of the study was 46.95±9.51 years (range, 20 to 60 years). From the total study participant 161/242(66.5%) of them were in the age group 40 years and above. About 48/242(19.9%) diabetic patients had at least 2 years history of diabetes. The blood glucose level of the study participant was <126 mg/dL in 34/242(13.6%) and >126 mg/dL in 208/242(86.3%) (Table-1) which is comparable with woldemariam et al. BMC Infectious Diseases.[9]

Table-4. Association among common gram –ve Uropathogens and their Sensitivity and Resistance pattern in diabetic and non-diabetic Patients.

Antibiotics	Pattern	*E.coli*		*Klebsiella spp.*		*Enterobacter spp.*		*Citrobacter spp.*		*Acinetobacter*	
		D	ND	D	ND	D	ND	D	ND	D	ND
A/S	S	33(34%)	37(74%)	12(35%)	5(31%)	3(25%)	0	3(21%)	1(17%)	1(11%)	0
	R	65(66%)	13(26%)	22(65%)	11(69%)	9(75%)	3(100%)	11(79%)	5(83%)	8(89%)	2(100%)
CFS	S	50(51%)	27(54%)	15(44%)	10(62%)	3(25%)	0	3(21%)	3(50%)	1(11%)	0
	R	48(49%)	23(46%)	19(56%)	6(38%)	9(75%)	3(100%)	11(79%)	3(50%)	8(89%)	2(100%)
CXM	S	30(31%)	39(78%)	7(21%)	3(19%)	0	0	4(28%)	1(17%)	1(11%)	0
	R	68(69%)	11(22%)	27(79%)	13(81%)	12(100%)	3(100%)	10(72%)	5(83%)	8(89%)	2(100%)
CFM	S	28(29%)	28(56%)	13(38%)	2(12%)	0	0	5(36%)	1(17%)	0	0
	R	70(71%)	12(44%)	21(62%)	14(88%)	12(100%)	3(100%)	9(64%)	5(83%)	9(100%)	2(100%)
COT	S	34(35%)	38(76%)	18(53%)	3(19%)	3(25%)	0	4(28%)	1(17%)	0	0
	R	64(75%)	12(24%)	16(47%)	13(81%)	9(75%)	3(100%)	10(72%)	5(83%)	9(100%)	2(100%)
CIP	S	33(34%)	40(80%)	20(59%)	6(38%)	3(25%)	0	4(28%)	2(33%)	1(11%)	0
	R	65(76%)	10(20%)	14(41%)	10(62%)	9(75%)	3(100%)	10(72%)	4(67%)	8(89%)	2(100%)
LE	S	41(42%)	27(54%)	21(62%)	10(62%)	3(25%)	2(67%)	3(21%)	4(67%)	1(11%)	0
	R	57(58%	23(46	13(38%)	6(38%)	9(75%)	1(33%)	11(79%	2(33%)	8(89%)	2(100%

		)	%)					)			)
OF	S	45(46%)	32(64%)	12(35%)	6(38%)	1(8%)	0	4(28%)	3(50%)	2(22%)	0
	R	53(54%)	18(36%)	22(65%)	10(62%)	11(92%)	3(100%)	10(72%)	3(50%)	7(78%)	2(100%)
AK	S	71(72%)	6(12%)	15(44%)	9(56%)	5(42%)	0	3(21%)	5(83%)	2(22%)	1(50%)
	R	27(28%)	44(88%)	19(56%)	7(44%)	7(58%)	3(100%)	11(79%)	1(17%)	7(78%)	1(50%)
NET	S	66(67%)	9(18%)	12(35%)	8(50%)	5(42%)	0	7(50%)	2(33%)	4(44%)	0
	R	32(33%)	41(82%)	22(65%)	8(50%)	7(58%)	3(100%)	7(50%)	4(67%)	5(54%)	2(100%)
NIT	S	76(77%)	15(30%)	14(41%)	8(50%)	2(17%)	0	3(21%)	1(17%)	1(11%)	0
	R	22(23%)	35(70%)	20(59%)	8(50%)	10(83%)	3(100%)	11(79%)	5(83%)	8(89%)	2(100%)
MRP	S	66(67%)	19(38%)	13(38%)	6(38%)	1(8%)	0	6(43%)	3(50%)	1(11%)	0
	R	22(33%)	31(62%)	21(62%)	10(62%)	11(92%)	3(100%)	8(47%)	3(50%)	8(89%)	2(100%)

A/S-Ampicillin/Sulbactam,CFS-Cefoperazone/Sulbactam,CXM-Cefuroxime,CFM-Cefixime,COT-Co-Trimoxazole,LE-Levofloxacin,OF-Ofloxacin,AK-Amikacin,NET-Netillin,NIT-Nitrofurantoin,MRP-Meropenem

Table-5.Association among common gram +ve Uropathogens and their Sensitivity and Resistance pattern in diabetic and non-diabetic Patients.

Antibiotics	Pattern	*Enterococcus spp.*		*Staphylococcus spp.*		*Steptococcus spp.*	
		D	ND	D	ND	D	ND
VA	S	7(54%)	0	12(92%)	3(50%)	5(100%)	1(100%)
	R	6(46%)	1(100%)	1(8%)	3(50%)	0	0
TEI	S	5(38%)	0	9(69%)	3(50%)	5(100%)	1(100%)
	R	8(62%)	1(100%)	4(31%)	3(50%)	0	0
LZ	S	8(62%)	0	11(85%)	3(50%)	5(100%)	1(100%)
	R	5(38%)	1(100%)	2(15%)	3(50%)	0	0
CXM	S	2(15%)	1(100%)	10(77%)	3(50%)	3(60%)	0
	R	11(85%)	0	3(23%)	3(50%)	2(40%)	1(100%)
CZ	S	4(31%)	0	10(77%)	3(50%)	2(40%)	0
	R	9(69%)	1(100%)	3(23%)	3(50%)	3(60%)	1(100%)
AMC	S	4(31%)	1(100%)	6(46%)	4(67%)	3(60%)	0

	R	9(69%)	0	7(44%)	2(33%)	2(40%)	1(100%)
CTR	S	2(15%)	1(100%)	9(69%)	3(50%)	4(80%)	1(100%)
	R	11(85%)	0	4(31%)	3(50%)	1(20%)	0
MI	S	5(38%)	1(100%)	13(100%)	3(50%)	4(80%)	1(100%)
	R	8(62%)	0	0	3(50%)	1(20%)	0
C	S	7(54%)	0	10(77%)	3(50%)	4(80%)	1(100%)
	R	6(46%)	1(100%)	3(23%)	3(50%)	1(20%)	0
DAP	S	3(23%)	1(100%)	12(92%)	3(50%)	3(60%)	0
	R	10(77%)	0	1(8%)	3(50%)	2(40%)	1(100%)
AZM	S	4(31%)	1(100%)	3(23%)	5(83%)	1(20%)	0
	R	9(69%)	0	10(77%)	1(17%	4(80%)	1(100%)
CPM	S	2(15%)	1(100%)	11(85%)	3(50%)	4(80%)	1(100%)

VA-Vancomycin,DAP-Daptomycin,TEI-Teicoplanin,C-Chloramphenicol,LZ-Linezolid,CZ-Cefazolin,AMC-Amoxyclav,CXM-Cefuroxime,AZM-Azithromycin,CTR-Cetfriaxone,MI-Minocycline,CPM-Cefepime.

In diabetic patients *E. coli* showed higher sensitivity to nitrofurantoin (77%), amikacin (72%), meropenem (67%) and netillin (67%) while it was resistant to co-Trimoxazole (75 %) , cefixime (71%) and cefuroxime (69%). Same as in non diabetic patients E.coli showed higher sensitivity to ciprofloxacin (80%), cefuroxime (78%) and cot (76%) while it was resistant to amikacin (88%), Netillin (82%) and nitrofurantoin (70%). *Klebsiella* spp. showed higher sensitivity to ciprofloxacin (59%) and levofloxacin (62%) while it was resistant to cefuroxime (79%), ofloxacin (65%) and netilin (65%).

Discussion

The prevalence of UTI in our study is higher compared to previous studies conducted in Ethiopia (16.7–22.6%).[9,10,11] and Nepal (50.7%).[12] The difference in prevalence might be explained by geographical variation, sociodemographic of the community, health awareness, and personal hygiene practices. In our study, we observed that *E. coli* was the most frequent uropathogens isolate, and this finding is consistent with studies conducted in Ethiopia (31.7%),[10] Tanzania (39%),[13] Iran (43.8%),[5] and India (58%).[6] This might be due to the infections are mostly by the fecal contamination and the structure of *E. coli*, which promotes strong adherence to the uroepithelial cells of individuals with diabetes.[14,15] The other common isolates in our study were *Klebsiella* and candida.

Furthermore, genitourinary damage due to diabetes may impair bladder emptying[8] and decrease bladder sensation[16] that can lead to conditions conducive to UTI.

Conclusion

The most common isolates include *E. coli*, *Klebsiella* spp. and candida. In view of our study findings, we recommend amikacin, gentamicin, and nitrofurantoin as drug of choice for the treatment of UTI in persons with diabetes based on its demonstrated high sensitivity. The present study has shown that females with diabetes are at more risk of developing UTI. It underscores the importance of identifying individuals with diabetes who are at high risk of getting UTI and developing strategies to prevent UTI in this vulnerable population.

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