



FREQUENCY OF MICROBIOLOGIC SPECTRUM AND ANTIBIOTIC SENSITIVITY OF CATHETER-INDUCED URINARY TRACT INFECTIONS IN PATIENTS WITH DIABETES MELLITUS

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ABSTRACT

Diabetes mellitus is one of the most common non-communicable diseases globally and has a substantial burden in term of morbidity, mortality and health care costs. Diabetes mellitus has emerged as a major health problem in Asia.

Objective of the study was to determine the frequency of microbiologic spectrum and in-vitro antibiotic sensitivity of catheter-induced urinary tract infections among patients with diabetes mellitus. Study area was Northwest General Hospital Peshawar and study design was cross sectional study of 6 Months in 2023 after approval of synopsis. A total of 120 patients were observed to determine the frequency of microbiologic spectrum and in-vitro antibiotic sensitivity of catheter-induced urinary tract infections among patients with diabetes mellitus. Sampling technique was Non probability convenient sampling.

Results: Age wise distribution among 120 patients was analyzed as n= 15- 30 Years was 12 (7.0%) 31-40 Years was 29(16.9%) 41-50 Years was 77(44.8%) 51-60 Years was 54 (31.4%) .Mean age was 41.56 years with standard deviation ± 1.357 . Gender wise distribution among 120 patients was analyzed as Male was 114(66.3%) and Female was 58(33.7%) Distribution of 2 Symptoms and signs of urinary tract infection among 120 patients were analyzed as Dysuria was 67(39.0%) and Urinary frequency was 71(41.3%) and Fever was 34(19.8%) Distribution among 120 patients were analyzed as Diabetic was 70(40.7%) and Non-Diabetic was 102(59.3%).

Conclusion: We observed the higher frequency of UTIs in female as compared to male participants due to poor hygiene. E.coli was the most frequent pathogen responsible for UTI in patients with diabetes

Keywords: Sensitivity patterns, uropathogens, compare the sensitivity pattern of uropathogens,

diabetic

INTRODUCTION

Diabetes mellitus (DM) has long been considered to be a predisposing factor for urinary tract infection (UTI). However, since the concept of significant bacteriuria was introduced the reported data on the prevalence of asymptomatic bacteriuria appear to be conflicting^{1,3}. Many UTIs are asymptomatic, especially in women. Unlike men with or without diabetes (among whom similar rates of UTI have been documented in most studies), several recent reports have noted a higher prevalence of asymptomatic bacteriuria among women with diabetes than among women without diabetes. However, other studies on asymptomatic outpatient diabetic women reported different results regarding the prevalence of bacteriuria^{4,7}.

The most common cause of UTI in men and women with and without DM is *E. coli*. Some reports have noted that a lower proportion of UTIs is caused by this organism in diabetic patients as compared with age-matched non diabetic patients^{8,9}. Antimicrobial resistance among uropathogens causing community and hospital acquired urinary tract infections is increasing. Few data are available on the role of DM itself as a risk factor for the development of antimicrobial resistance of the uropathogens.⁸⁻¹⁰ Catheter-related urinary tract infection occurs because urethral catheters inoculate organisms into the bladder and promote colonization by providing a surface for bacterial adhesion and causing mucosal irritation^{10,14}. The rates of uropathogens in diabetic and non-diabetics patients (males plus females) with indwelling bladder catheter were respectively: *E. coli* 30.8% *p* = NS; *Enterococcus* spp 21.8% *p* = NS; *Pseudomonas* spp 12.8% *Enterococcus* spp 9.4%, .

Pseudomonas spp 8.5%. *Staphylococcus aureus* (17%), *Proteus* (17%) and *Klebsiella* (11%). *Proteus* and *Pseudomonas* species are the organisms most commonly associated with biofilm formation. *E. coli* is the main organism in up to 40% of catheter-associated Urinary Tract Infections while it is associated with 61% prevalence of the community acquired UTIs. Ciprofloxacin 50% vs 55.4%, *p* = NS; ceftazidime 41.1% vs 14.1%, *p* = NS; imipenem 16.6% vs 11.1%, *p* = NS; amikacin 16.6% vs 14.6%, *p* = NS¹⁵ The leading risk factor for bacteriuria is the duration of catheterization: with each day of catheterization, the prevalence of bacteriuria increases 3% to 10%. These infections can be caused by exogenous microorganisms or endogenous fecal or urethral organisms. Catheter-associated UTIs warrant special attention because of their association with increased morbidity and possible mortality. It is one of the major factors contributing to high level of resistance to antibiotics. The rationale of this study was that it give spectrum of the microorganisms implicated in catheter-associated Urinary tract Infections and patterns of the antimicrobial resistance to the most commonly used antibiotics in diabetic patients, which could lead to a better clinical practice, improved patient care and provide us with fresh local descriptive statistics about microbiologic spectrum and in-vitro sensitivity of antibiotics in our local diabetic population¹⁵.

METHODOLOGY:

A Cross-sectional (Descriptive study) was conducted in the General medicine Department of Northwest General Hospital Peshawar for six months in year 2023(May – November). Sample size was 120 with Sampling technique was non-probability convenient sampling, using 8.5% proportional of *Pseudomonas* spp 15, 95% confidence level and 5% margin of error under WHO software for sample size determination.

Inclusion Criteria of current study was

1. Both gender s with diabetes mellitus (both type 1 and 2) with a minimum duration of 2 years and above 15 years of age, who are catheterized for 72 hours or more duration.
2. Diagnosis based on colony count >105 per ml of urine.
3. Culture positive.

Exclusion Criteria:

1. Patients with prior history of UTI before catheterization.
2. Patients with structural urological abnormalities e.g., Hydronephrosis, stones, Strictures, etc. (as

diagnosed by specific investigations or medical records).

All patients admitted in the medical departments meeting the inclusion criteria i.e. patients with diabetes mellitus (both type 1 and 2) with a minimum duration of 2 years and above 15 years of age, who are catheterized for 72 hours or more duration, were enrolled in the study. Written informed consent was obtained from all patients after explaining them the purpose and benefits of the study. From all the patients who were catheterized for 72 hours or more, urine was collected under strict aseptic technique and was sent to hospital laboratory for culture and sensitivity and examined by a pathologist. All specimens with bacteriuria of more than 10⁵ colony forming units per ml urine will be analyzed to determine their causative uropathogens and their susceptibility to the most commonly used antibiotics in hospital practice (i.e. ciprofloxacin, levofloxacin, ceftriaxone, cefixime, cefoperazone-salbactam, amikacin, gentamicin and tazobactam). Quantitative urine culture and sensitivity will be done on cysteine-lactose-electrolyte-deficient (CLED) medium, and incubated overnight at 37 °C. After incubation at 37 °C for 24 h, the organisms was identified by standard tests. In-vitro susceptibility tests to antibiotics was conducted using the disc diffusion method. All the data was recorded in a structured proforma. Confounding factors and bias will be controlled by strictly following exclusion criteria

Data entered into SPSS version 26.0 and descriptive statistics was used to analyze the data. Mean + standard deviation was calculated for quantitative variables like age and duration of diabetes while frequency / percentages was calculated for categorical variables like gender, common bacteria (E. coli, Enterococci, Pseudomonas, S. aureus, Proteus and Klebsiella) and their antibiotic sensitivity. Common bacteria was stratified among age, gender and duration of diabetes to see effect modification. All the results was presented as tables and graphs.

RESULTS:

Age wise distribution among 120 patients was analyzed as n= 15- 30 Years was 12(7.0%) 31-40 Years was 29(16.9%) 41-50 Years was 77(44.8%) 51-60 Years was 54(31.4%) .Mean age was 41.56 years with standard deviation ± 1.357 . Gender wise distribution among 120 patients was analyzed as Male was 114 (66.3%) and Female was 58(33.7%) .Distribution of Symptoms and signs of urinary tract infection among 120 patients were analyzed as Dysuria was 67(39.0%) and Urinary frequency was 71(41.3%) and Fever was 34(19.8%). Distribution among 120 patients were analyzed as Diabetic was 70(40.7%) and Non Diabetic was 102(59.3%).Common bacteria among 120 patients were observed as Escherichia Coli was 40(57.1%) ,Staphylococcus Aureus was 20(28.5%), Klebsiella Pneumoniae 10(14.2%) ,Antibiotic Sensitivity for Meropeneme (63%) was Sensitive and (7%) was resistant for E coli, 60% was sensitive and 10% was resistant for staphylococcus aureus, 56% was sensitive and 14% 96 was Resistant for klebsiella pneumoniae. Antibiotic Sensitivity for ciprofloxacin was 11% Sensitive and 59% was resistant for E coli, 24% was sensitive and 46% was resistant for staphylococcus aureus. 24% was sensitive and 46% was Resistant for klebsiella pneumonia .Antibiotic Sensitivity for ceftazidime 20 %was Sensitive and 50 % was resistant for E coli, 46% was sensitive and 24% was resistant for staphylococcus aureus, 42% was sensitive and 28% was Resistant klebsiella pneumonia.

Table: No 1: Age Wise Distributions (N=120)

	Age of the participants	Frequency	Percent
1	15- 25 Years	08	6.7
2	26-35 Years	37	30.8
3	36-45 Years	40	33.3
4	46-55 Years	10	8.3

5	56-65 Years	25	20.8
6	Total	120	100.0

Table No 2: Gender Wise Distribution (N= 120)

	Common bacteria	Males	females	Total	p-value
1	Escherichia coli	11	4	15	0.001
2	Enterococcus	15	6	21	
3	Pseudomonas	20	1	21	
4	Staphylococcus Aureus	15	6	21	
5	Proteus	1 2	8	20	
6	Klebsiella	1 9	3	22	
7	Total	92	28	120	

Table No 3: Distribution Of Duration Of Diabetes Mellitus (N=120)

	Duration of Diabetes Mellitus	Frequency	Percent
1	2-5 years	60	50.0
2	More than 5 Years	60	50.0
3	Total	120	100.0

Table No 4: Distribution Of Common Bacteria (N=120)

	Common bacteria	Frequency	Percent
1	Escherichia coli	15	12.5
2	Enterococcus	21	17.7
3	Pseudomonas	21	17.7
4	Staphylococcus aureus	21	17.7
5	Proteus	20	16.7
6	Klebsiella	22	18.3
7	Total	120	100.0

Table No 5: Stristification Of Common Bacteria With Respect To Age Distribution (N=120)

		Age of the participants					
	Common Bacteria	15 – 25 years	26-35 Years	36-45 Years	46 – 55 years	56-65 Years	Total
1	Escherichia coli	5	1	4	0	5	15
		33.3%	6.7%	26.7%	.0%	33.3%	100.0%
2	Enterococcus	3	4	7	0	7	21
		14.3%	19.0%	33.3%	.0%	33.3%	100.0%
3	Enterococcus	0	7	9	0	5	21
		.0%	33.3%	42.9%	.0%	23.8%	100.0%
4	Pseudomonas	0	7	10	4	0	21
		.0%	33.3%	47.6%	19.0%		100.0%
5	Proteus	0	7	7	6	0	20
		0%	33.3%	33.3%	30.0%	.0%	100.0%
6	Klebsiella	0	11	3	0	8	22
		0%	50.0%	13.6%	0%	36.4%	100.0%
7	Total	8	37	40	10	25	120
		6.7%	30.8%	33.3%	8.3%	20.8%	100.0%

Table No 6: Stritification Of Common Bacteria W.R.T Duration Of Diabetes Mellitus (N=120)

	Common Bacteria	Duration of Diabetes Mellitus		Total	p- value
		2- 5 years	More than 5 years		
1	Escherichia coli	5	10	15	
		33.3%	66.7%	100.0%	
2	Enterococcus	5	16	21	
		33.3%	76.2%	100.0%	
3	Pseudomonas	11	10	21	
		52.4%	47.6%	100.0%	
4	Staphylococcus aureus	14	7	21	
		66.7%	33.3%	100.0%	
5	Proteus	14	6	20	
		70.0	30.0	100.0	

		%	%	%	
6	Klebsiella	11	11	22	
		50.0%	50.0%	100.0%	
7	Total	60	60	120	
		50.0%	50.0%	100.0%	

Table No 7: Stritification Of Common Bacteria W.R. Tantibiotic Sensitivity (N=120)

	Common Bacteria	Ciprofloxacin		Total	p- value	Levofloxacin		Total	p- value
		Sensitive	Resistanc e			sensit ive	Resistan ce		
1	Escherichia coli	12	3	15	0.001	12	3	15	0.001
		80.0 %	20.0%	100.0%		80.0 %	20.0%	100.0%	
2	Enterococcus	12	9	21		12	9	21	
		57.1 %	42.9%	100.0%		57.1 %	42.9%	100.0%	
3	Pseudomonas	10	11	21		12	9	21	
		47.6 %	52.4%	100.0%		57.1 %	42.9%	100.0%	
4	Staphylococcus aureus	18	3	21		21	0	21	
		85.7 %	14.3%	100.0%		100.0 %	0.0%	100.0%	
5	Proteus	8	12	20		8	12	20	
		40.0 %	60.0%	100.0%		40.0 %	60.0%	100.0%	
6	Klebsiella	14	8	22		14	8	22	
		63.6 %	36.4%	100.0%		63.6 %	36.4%	100.0%	
7	Total	74	46	120		79	41	120	
		61.7 %	38.3%	100.0%		65.8 %	34.2%	100%	

Table No 8: Stritification Of Common Bacteria W.R. Tantibiotic Sensitivity (N=120)

	Common Bacteria	Ceftriaxone		Total	p- value	Cefixime		Total	p- value
		Sensitive	Resistance			sensiti ve	Resistance		
1	Escherichia coli	12	3	15	0.001	12	3	15	0.001
		80.0%	20.0%	100.0%		80.0%	20.0%	100.0 %	
2	Enterococcus	12	9	21		12	9	21	
		57.1%	42.9%	100.0%		57.1%	42.9%	100.0 %	
3	Pseudomonas	9	12	21		12	9	21	
		42.9%	57.1%	100.0%		57.1%	42.9%	100.0 %	
4	Staphylococcus aureus	14	7	21		21	0	21	
		66.6%	33.3%	100.0%		100.0 %	0.0%	100.0 %	

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5	Proteus	8	12	20		8	12	20	
		40.0%	60.0%	100.0%		40.0%	60.0%	100.0%	
6	Klebsiella	14	8	22		14	8	22	
		63.6%	36.4%	100.0%		63.6%	36.4%	100.0%	
7	Total	69	51	120		79	41	120	
		57.5%	42.5%	100.0%		65.8%	34.2%	100%	

Table No 9: Stritification Of Common Bacteria W.R. Tantibiotic Sensitivity (N=120)

	Common Bacteria	Gefoparazne-salbactum		Total	p-value	Amikicin		Total	p-value
		Sensitive	Resistance			sensitiv e	Resistance		
1	Escherichia coli	12	3	15	0.001	12	3	15	0.001
		80.0%	20.0%	100.0%		80.0%	20.0%	100.0%	
2	Enterococcus	12	9	21		12	9	21	
		57.1%	42.9%	100.0%		57.1%	42.9%	100.0%	
3	Pseudomonas	12	9	21		12	9	21	
		57.1%	42.9%	100.0%		57.1%	42.9%	100.0%	
4	Staphylococcus aureus	21	0	21		21	0	21	
		100.0%	0.0%	100.0%		100.0%	0.0%	100.0%	
5	Proteus	8	12	20		8	12	20	
		40.0%	60.0%	100.0%		40.0%	60.0%	100.0%	
6	Klebsiella	14	8	22		14	8	22	
		63.6%	36.4%	100.0%		63.6%	36.4%	100.0%	
7	Total	79	41	120		79	41	120	
		65.8%	34.2%	100.0%		65.8%	34.2%	100%	

Table No 10: Stritification Of Common Bacteria W.R. Tantibiotic Sensitivity (N=120)

	Common Bacteria	Gentamicin		Total	p-value	Tazobactum		Total	p-value
		Sensitive	Resistance			sensitive	Resistance		
1	Escherichia coli	12	3	15	0.001	12	3	15	0.001
		80.0%	20.0%	100.0%		80.0%	20.0%	100.0%	
2	Enterococcus	12	9	21		12	9	21	
		57.1%	42.9%	100.0%		57.1%	42.9%	100.0%	
3	Pseudomonas	12	9	21		12	9	21	
		57.1%	42.9%	100.0%		57.1%	42.9%	100.0%	
4	Staphylococcus aureus	21	0	21		21	0	21	
		100.0%	0.0%	100.0%		100.0%	0.0%	100.0%	

		%				%			
5	Proteus	8	12	20		8	12	20	
		40.0%	60.0%	100.0%		40.0%	60.0%	100.0%	
6	Klebsiella	14	8	22		14	8	22	
		63.6%	36.4%	100.0%		63.6%	36.4%	100.0%	
7	Total	79	41	120		79	41	120	
		65.8	34.2%	100.0%		65.8%	34.2%	100%	
		%							

DISCUSSION:

A urinary tract infection (UTI) is a bacterial infection that affects any part of the urinary tract and the presence of a pure growth of more than 10⁵ organisms per ml of urine is considered as diagnostic criterion for UTI¹. The risk of developing a UTI may be increased by a number of factors, including use of a bladder catheter, a recent procedure or surgery involving the urinary tract, an anatomic abnormality or blockage of the urinary tract, pregnancy or diabetes.

Incidence of infection is higher in diabetes and such infection results in complications. Diabetic patients tolerate infection poorly. Infections and diabetic control adversely affect each other. The diabetic has an altered response to infection as these patients' inherent susceptibility to infection as well as the potential to mount a normal inflammatory response.^{1,2}

There are differences in the bacteriologic patterns of UTI and in the antibiotic sensitivity patterns of the pathogens concerned with diabetic and non-diabetic patients. The study was carried-out on a large series of elderly adult diabetic and non-diabetic patients admitted to the medical wards. More than 70% of the patients were older than 65 yrs of age. The age and the gender were absolutely comparable in both study populations as well as the proportion of patients with indwelling bladder catheter. The rate of *E. coli* isolation we found in both diabetic and non-diabetic patients was much lower than that usually observed in community acquired UTI, thus suggesting that a significant part of our patients had nosocomial acquired UTI. Other studies have found that urinary *Klebsiella* is more frequent in patients with diabetes mellitus than in non-diabetic patients^{16,17,18}.

Some authors have defined UTI in patients with diabetes mellitus as complicated when the UTI is symptomatic^{19,20}. The spectrum of uropathogens we found in our patients and patterns of antimicrobial resistance in both diabetes mellitus and non-diabetes mellitus patients are similar to those observed in other studies dealing with complicated UTI's. This finding can be explained by the fact that 20% of our patients had an indwelling bladder catheter. In addition, many of our patients may have undergone previous antimicrobial treatment.

When the catheter was considered separately, the rate of the different uropathogens did not differ significantly in diabetic and non-diabetic groups. The spectrum of uropathogens and antimicrobial pattern resistance we found in our series of patients with catheter associated UTI may be different from those observed in other hospitals. This may depend on the different policy of antibiotics used in the various hospitals.

It is interesting to note that in a clinical setting different from ours, urinary isolates of symptomatic ambulatory postmenopausal women did not show a significant difference in the bacterial species when compared to a matched group of women without diabetes mellitus¹⁰⁰. It has been observed a higher isolation rate of *Pseudomonas* spp in non-diabetic than that in diabetic males; therefore we must underline that many of our male non diabetic patients had a history of a previous instrumentation of the urinary tract.²¹

Regarding the antimicrobial resistance profile of the uropathogens, we observed that the isolated *E. coli* strains were resistant at similar rates to ampicillin, cotrimoxazole, ciprofloxacin and nitrofurantoin in both diabetic and non-diabetic patients. The high rate of *E. coli* resistance to

ampicillin and cotrimoxazole we found in our series precludes, at least in our area, the choice of these or similar drugs in the empirical initial treatment of adult hospitalized patients with UTI. In a study performed in an emergency department, an association was found between the presence of cotrimoxazole resistance and diabetes, recent hospitalization and recent use of the same drug 101 but in an out-patients setting no correlation was found between *E. coli* resistance to cotrimoxazole 102,103 or to quinolones and diabetes mellitus. The proportion of *Pseudomonas* resistance to ciprofloxacin was very high as previously reported in our hospital but at a similar rate in patients with and without diabetes mellitus. In another study the rate of *E. coli* isolation in the diabetic males and females (57.5% and 63.8%) was lower than non-diabetic male and female (83.3% and 76.1%). Higher isolation rate of *Pseudomonas* spp in diabetic males (7.5%) and *Enterococcus* spp in diabetic females (16.5%) than non-diabetic groups. The percentage of *Klebsiella* spp causing UTI in diabetic patients (6.9%) was higher than non-diabetic (3.7%) which was similar to other studies done in different countries.^{22,23}

It has shown in several studies that women are at increased risk to develop UTI then men.¹⁰³ Majority of the culture positive patients in our study were also female (45.6%).

Catheter associated UTI is now a growing problem in hospitalized patients. In the present study, culture positivity rate in catheterized patients (60%) was found significantly higher ($p < 0.05$) than non- catheterized patients (39.9%).

Regarding the antimicrobial sensitivity profile of the uropathogenes, the observed that the isolated *E. coli* strains were sensitive at similar rate to ampicillin, cephalixin, imipenem, amikacin, nalidixic acid and cotrimoxazole in both diabetic and non-diabetic patients but sensitivity to ceftriaxone, ceftazidime, cefuroxime, netilmicin, gentamicin, ciprofloxacin and nitrofurantion were found significantly more ($p < 0.05$) in non-diabetic group compared to diabetic group. In one study was done in Iraq by Abdul Sahib and found ciprofloxacin resistant *E.coli* significantly higher in diabetic patients than control group ($p = < 0.05$).

Gram positive organisms were showing 100% sensitivity to both Vancomycin and linezolid, least sensitivity was shown to Norfloxacin. Gram negative organisms were showing 100% sensitivity to Polymyxin B, least sensitivity was shown to Norfloxacin. Antibiotic sensitivity pattern of organisms isolated showed that Nitrofurantoin and Amikacin were having highest cumulative antibiotic sensitivity, 73.4% and 66.3% respectively. Least sensitive antibiotic was found to be Cefotaxime. Aswani SM et al, found that the isolated *E. coli* strains showed an increased sensitivity to carbapenems in both diabetics (93.8%) and non-diabetics (95.1%) and decreased susceptibility to ampicillin (diabetics 16.7 per cent vs. non-diabetics 17 per cent).¹⁴ Manik C Shill and Naz H Huda et al, found that the most effective antibiotic overall was meropenem followed by amikacin.¹⁵

CONCLUSION

We observed the higher frequency of UTIs in female as compared to male participants due to poor hygiene. *E.coli* was the most frequent pathogen responsible for UTI in patients with diabetes.

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