Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/hej9td31

PREVALENCE AND ANTIMICROBIAL SUSCEPTIBILITY PATTERN OF GRAM NEGATIVE BACTERIA ISOLATES IN CATHETER ASSOCIATED URINARY TRACT INFECTION IN TERTIARY CARE HOSPITAL

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ABSTRACT

Introduction: Urinary tract infections (UTIs) are a leading healthcare-associated infection, often linked to urinary catheter use, with a daily 3%-7% increased risk of catheter-associated UTIs (CAUTIs). CAUTIs cause significant complications; prolonged hospital stays, and increased mortality, with 13,000 deaths annually. This study examines the bacteriological profile and antimicrobial resistance patterns of CAUTIs in a tertiary care hospital.

Material and Methods: A cross-sectional study done at a tertiary hospital included 200 catheterized patients over six month. Urine samples were collected aseptically following CDC guidelines, excluding patients with prior UTIs, suprapubic catheters, or pre-admission catheterization. Demographic and clinical data were recorded. Suspected CAUTI samples were cultured, with significant growth defined as $\geq 10^5$ CFU/ml. Isolates were identified, and antimicrobial susceptibility tested using CLSI-guided Kirby-Bauer disc diffusion.

Results: Among 200 catheterized patients, 25 (12.5%) developed CAUTI, with females (68%) affected more than males (32%). The highest infection rate occurred in the 41–60 years age group (39.5%), followed by 21–40 years (33%). A total of 25 gram-negative bacteria were isolated, predominantly *Escherichia coli* (48%), followed by *Klebsiella* spp. (36%) and *Pseudomonas aeruginosa* (16%).

Conclusion: The study highlights that catheter-associated urinary tract infections (CAUTIs) are more prevalent in females and middle-aged individuals, with *Escherichia coli* being the most common causative organism. The findings emphasize the importance of monitoring antimicrobial susceptibility to guide effective treatment strategies and reduce the burden of CAUTIs in hospitalized patients.

Keywords: Catheter-associated urinary tract infection (CAUTI), Gram-negative bacteria, *Escherichia coli*, Antimicrobial susceptibility, Hospital-acquired infections, Catheterization, Tertiary care hospital.

INTRODUCTION

Urinary tract infections (UTIs) are the fifth most common type of healthcare-associated infection, with an estimated 62,700 UTIs in acute care hospitals in 2015. UTIs additionally account for more than 9.5% of infections reported by acute care hospitals (1). Virtually, all healthcare-associated UTIs are caused by instrumentation of the urinary tract. Approximately 12%-16% of adult hospital inpatients will have an indwelling urinary catheter (IUC) at some time during their hospitalization, and each day the indwelling urinary catheter remains, a patient has a 3%-7% increased risk of acquiring a catheter-associated urinary tract infection (CAUTI) (2-3). CAUTIs can lead to such complications as prostatitis, epididymitis, and orchitis, cystitis, pyelonephritis, gram-negative bacteremia, endocarditis, vertebral osteomyelitis, septic arthritis, endophthalmitis, and meningitis in patients. Complications associated with CAUTIs cause discomfort to the patient, prolonged hospital stays, and increased costs and mortality (4). It has been estimated that each year, more than 13,000 deaths are associated with UTIs (5). The present study was undertaken to find out the Bacteriological profile of catheter associated urinary tract infection and its antimicrobial susceptibility pattern in tertiary care hospital.

MATERIAL AND METHODS

A cross sectional observational study was conducted at tertiary care teaching hospital over a period of six month. Urine samples were collected from 200 patients who were catheterized, according to CDC guidelines using sterile needle from tubing of catheter under aseptic precautions. Single urine sample was taken from each patients.

Inclusion criteria: All patients who were catheterized for at least 48 hours were included in the study.
Exclusion criteria: 1. Patients with suprapubic catheters. 2. Patients having UTI before catheterization. 3. Patients catheterized prior to admission in hospital.
Data were collected from the patients using a preformed structured format. Demographic data such as name, age, sex, date of admission, and clinical data like presenting complaints, personal history, past medical history, high risk factors, immunocompromised status, physical examination findings and details of clinical diagnosis were collected. Indications for catheterization were noted.
Urine samples were collected from clinically suspected cases of CAUTI in a sterile wide mouthed universal container taking aseptic precautions with a sterile disposable syringe after cleaning and clamping the catheter tube. Collected urine specimens were transported immediately to Department of Microbiology. Urine specimens were processed in the laboratory within 2 h of collection.
Semi-quantitative culture was done on MacConkey Agar and Blood Agar and the plates were incubated aerobically at 37ºC for 18-24 hours. Next day colony count more than or equal to 10^5 colony forming unit (cfu) with no more than two species of microorganisms was taken as significant. Isolates were identified through standard conventional microbial and biochemical test. Antimicrobial susceptibility test was performed using a Kirby- Bauer disc diffusion method according to Clinical and Laboratory Standards Institute (CLSI) guidelines. The following antibiotics were used: Ampicillin (AMP; 10 µg), Amikacin (AK, 30 µg), Aztreonam (AT; 30 µg), Cefotaxime(CTX; 30 µg), Ceftazidime (CAZ; 30 µg) , Gentamicin (GEN; 10 µg), Nitrofurantoin (NIT; 300 µg), Co-trimozaxole (COT; 25/125 µg), Ciprofloxacin (CIP; 5 µg), Norfloxacin (Nx; 10 µg) Piperacillin+Tazobactum (PIT; 100/10 µg) , Ceftazidime+Clavulanic acid (CAC; 30/10 µg), Meropenem (MRP; 10 µg).
Statistical analysis: Data were edited, cleaned, entered and analyzed using statistical package for social science (SPSS) version 22. All characteristics were summarized descriptively. For categorical data, the number and percentage were used in the data summaries.

RESULTS

A total of 200 urine sample were collected from catheterized patients. Out of 200 catheterised patients, 25 (12.5) patients developed CAUTI. Out of 200 patients, 120 (60%) were female and 80 (40%) were male as shown in Table 1. In present study, females were affected more than males. Out of 25 patients,

17 (68%) were female and 8 (32%) were male. The highest infection rate was found in age group of 41-60 years (39.5%) followed by 21-40 years (33%)(Table 2).
In present study, a total of 25 gram negative bacteria were recovered. Most common isolate was found to be *Escherichia coli* (48%), followed by *Klebsiella spp.* (36%) and *Pseudomonas aeruginosa* (16%) (Table 3). Antibiotic susceptibility pattern of gram negative bacteria are shown in table 4.

Table 1: Gender Distribution

Sex	No. of patients	Percentage
Female	120	60%
Male	80	40%
Total	200	100%

Table 2: Age wise distribution of patients

Age in years	No. of patients	Percentage
1-20	42	21%
21-40	66	33%
41-60	79	39.5%
>61	13	6.5%
Total	200	100%

Table 3: Bacteriological profile and Gender wise distribution of isolated microorganisms

Name of the organism	Male	Female	Total	Percentage
Escherichia coli	4	8	12	48%
Klebsiella spp.	3	6	9	36%
Pseudomonas aeruginosa	1	3	4	16%
Total	8(32%)	17(68%)	25	100%

Table 4: Antibiotic susceptibility pattern of Gram-negative bacteria

Antibiotic drugs	*Escherichia coli* N (%)	*Klebsiella spp.* N (%)	*Pseudomonas aeruginosa* N(%)
Amikacin	7(58.33%)	6(66.66%)	2(50%)
Ampicillin	2(16.66%)	1(11.11%)	-
Aztreonam	2(16.66%)	2(22.22%)	-
Cefotaxime	2(16.66%)	3(33.33%)	-
Ceftazidime	5(41.66%)	3(33.33%)	1(25%)
Ciprofloxacin	3(25%)	4(44.44%)	1(25%)
Cotrimoxazole	7(58.3%)	2(22.22%)	-
Colistin			3(75%)
Gentamicin	5(41.66%)	5(55.55%)	2(50%)
Meropenem	8(66.66%)	6(66.66%)	3(75%)
Nitrofurantoin	5(41.66%)	4(44.44%)	-
Norfloxacin	5(41.66%)	2(22.22%)	-
Ceftazidime/clavulanic acid	3(25%)	3(33.33%)	2(50%)
Piperacillin / tazobactam	7(58.31%)	3(33.33%)	-

DISCUSSION

The present study highlighted the burden of CAUTI in a tertiary care hospital in Rajasthan. A Comparisons of overall prevalence of CAUTI with other studies are shown in Table 5. In present study, the incidence of CAUTI was 12.5% which was comparable to Rachna patel et al., Smriti parihar

et al., Reminder sandhu et al., and Mohaptra et al. studies by Sushitha et al., Smita bagali et al. and K patel et al. reported higher incidence of CAUTI. Lower incidence rate was reported by Ashok sharma et al.

Table 5: Comparison of overall prevalence of CAUTI with other studies.

S. no	Study	Year	Prevalence (positive isolates %)
1	Rachna patel et al. (6)	2024	15.67%
2	Smriti parihar et al. (7)	2023	14.67%
3	Reminder sandhu et al. (8)	2022	10.55%
4	Sushitha et al. (9)	2022	24%
5	Mohaptra et al. (10)	2022	10.1%
6	Smita bagali et al. (11)	2021	25%
7	K patel et al. (12)	2019	21%
8	Ashok sharma et al. (13)	2019	6.67%
9	Present study	2024	12.5%

Comparisons of gender wise distribution of CAUTI with other studies are shown in Table 2. Out of 25 patients, 17 (68%) were female and 8 (32%) were male in present study. In present study, females were affected more than males. All studies mentioned in the table 6 are comparable with present study for higher prevalence rate of CAUTI in female patient than male patient.

Table 6: Comparisons of gender wise prevalence of CAUTI with other studies.

S. no	Study	Year	(%) Isolates in female patient	(%) Isolates in male patient
1	Rachna patel et al. (6)	2024	45%	55%
2	Mohaptra et al. (10)	2022	72.5%	27.5%
3	K patel et al. (12)	2019	56.19%	43.81%
4	Neha garg et al. (14)	2017	64.2%	35.7%
5	Present study	2024	68%	32%

Comparisons of prevalence of CAUTI in the age group are shown in table 7. In the present study, the highest prevalence of CAUTI (37.6%) was found in the age group of 41-60 years. Similar results were observed in other studies like Rachna patel et al., Smita bagali et al. Study by Smriti parihar et. al, Sushitha et al and Panjwani et al reported highest prevalence in older age group. Study by K patel et al reported highest prevalence in younger age group.

Table 7: Comparison of age groups wise CAUTI Prevalence with other studies

S. No	Study	Year	Age group in years	% prevalence
1	Rachna patel et al. (6)	2024	36-55	45%
2	Smriti parihar et. al. (7)	2023	51-70	34%
3	Sushitha et al. (9)	2022	>60	66.7%
4	Smita bagali et al. (11)	2021	41-60	36%
5	Panjwani et al. (15)	2021	>55	58%
6	K patel et al. (12)	2019	21-40	33.33%
7	Present study	2024	41-60	39.5%

In present study, *Escherichia coli* were found most common bacteria among all isolates followed by *Klebsiella spp*. Comparisons of Results with the similar studies are shown in Table 8. All the studies

have reported that *Escherichia coli* were the predominant isolates followed by *Klebsiella spp.* except Smriti parihar et al. where *Enterococcus spp.* were second most common isolates**.**

Table 8: Comparison of gram negative bacteria isolates causing UTI with other studies

Study	Rachna patel et al. (6)	Smriti parihar et al. (7)	Reminder sandhu et al. (8)	Smita bagali et al. (11)	Panjwani et al. (15)	K patel et al. (12)	Ashok sharma et al. (13)	Present study
Year	2024	2023	2022	2021	2021	2019	2019	2024
Escherichia coli	37.2%	36%	41.18%	38%	38%	53.81%	40%	48%
Klebsiella spp.	19.6%	4%	5.88%	30%	24%	32.38%	40%	36%
Pseudomonas aeruginosa	9.8%	20%	-	10%	24%	5.71%	10%	16%
Acinetobacter spp.	4%	4%	-	4%	-	1.90%	10%	-
Proteus spp.	1.9%	-	-	4%	-	3.81%	-	-
Citrobacter spp.	-	-	5.88%	4%	-	-	-	-

The pathogens isolated from CAUTI cases were multidrug resistant. These findings were similar to various other studies where multidrug resistant pathogens were isolated. Increase in the antibiotic resistance amongst the pathogens indicates that they are hospital acquired and thus difficult to treat. The chances of transmission of these multi drug resistant are high if infection prevention practices are not followed during care of the catheterized patients. A number of combined practices such as improved hand hygiene, enhanced barrier protection and reduced catheter use can reduce CAUTI. Urinary catheters should be inserted using aseptic technique and sterile equipment, particularly in an acute care setting. Although catheter use should be minimized in all patients, particularly those at higher risk of CAUTI and mortality (e.g. the elderly or those with impaired immunity).

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