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Bacteriological Profile of Clinical Isolates from Urinary Samples and Prevalence of CAUTI at a Tertiary Care Hospital

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Abstract **Original Research Article**

Background: Urinary tract infections (UTIs) attributed to the use of an indwelling catheter is one of the most common infections acquired by patients in health-care facilities. This infection is associated with varied microbiological etiology. Catheter-associated urinary tract infection (CAUTI) is an important cause of morbidity and mortality in India. The objective of this study was to find the prevalence of CAUTI infection and to determine their antibiotic profile. ***Aims and Objectives:*** The aim of the study was to provide a baseline information in the context of culture positivity rate of urinary isolates and prevalence of catheter-associated urinary tract infections (CAUTI), to identify the associated microbial, and to determine their susceptibility pattern to commonly used antimicrobial agents for prophylactic and empiric therapy. ***Materials and Methods:*** This prospective study was done on nonrepetitive urine samples from all age group patients of both inpatient and outpatient department. Semi-quantitative bacterial culture was performed, and isolates were identified and antimicrobial sensitivity tests were carried out by Vitek-2 compact automated method. ***Results:*** Significant bacteriuria was observed among 257/1543 (16.65%) urine samples. Among bacterial isolates, Gram-negative bacilli predominate. Escherichia coli 7/17 (44%) being the most common isolate followed by Klebsiella (35%). The incidence of CAUTI/1000 catheter days observed in our study was 2.77. Total 3 CAUTI were identified from July 2021 to June 2022, out of which 2 were Klebsiella pneumoniae and 1 isolate was Enterococcus faecium. ***Conclusions:*** Uropathogens from CAUTI patients exhibit significantly higher resistance to most antibiotics than non- CAUTI isolates. This is an important factor to take into consideration when choosing correct treatment options for patients with urinary tract infection. Klebsiella pneumoniae is one of the important notable pathogens causing nosocomial infections. The present study helped us to generate institutional data regarding CAUTI prevalence among all catheterized patients and multi drug resistant organisms isolated.

Keywords: CAUTI, UTI, bacteriology, urinary isolates, urinary catheter, antibiotic profile.

INTRODUCTION

Catheter-associated urinary tract infection (CAUTI) is an important cause of morbidity and mortality in Indian subjects, affecting all age groups [1]. 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]. CAUTI can lead to such complications as prostatitis, epididymitis, and orchitis in males, and cystitis, pyelonephritis, gram-negative bacteremia, endocarditis, vertebral osteomyelitis, septic arthritis, endophthalmitis, and meningitis in patients. Complications associated with CAUTI cause discomfort to the patient, prolonged hospital stay, and increased cost and mortality [4]. It has been estimated that each year, more than 13,000 deaths are associated with UTIs [5].

Catheter-associated urinary tract infection (CAUTI) is a common device-associated infection in the United States and one of the most common healthcare associated infections worldwide [9]. As per Center for disease prevention (CDC) and control, CAUTI is where an indwelling urinary catheter (IUC) was in place for >2

calendar days on the date of the event, with a day of device placement being Day 1 and an IUC was in place on the date of the event or the day before. If an IUC was in place for >2 calendar days and then removed, the date of event for UTI must be the day of discontinuation or the next day for the UTI to be catheter-associated [11].

The aim of the study was to identify the microbial pathogens associated with UTI in all urine cultures and to provide baseline information in the context of prevalence of CAUTI in tertiary care hospital wards and intensive care units (ICUs) and to determine their susceptibility pattern to commonly used antimicrobial agents for prophylactic and empiric therapy.

MATERIALS AND METHODS

This study was conducted in all urinary specimens of patients admitted in wards and attending outpatient department in Premier Hospital between July 2021 and June 2022. The age, gender, provisional diagnosis, foleys catheter insertion date, duration of ICU stay of selected patients were recorded properly. For outpatients, early morning mid- stream clean catch urine sample was collected for culture sensitivity. In patients with Foleys catheters were used, careful attention was given to the drainage system. The urethral catheters were inserted after wearing sterile gloves and using sterile drapes to avoid risk of infection. Urine was collected directly from catheter after 2 days of catheterization with a sterile syringe in a sterile container. The urine was taken to microbiology laboratory for isolation and identification of bacteria.

Inclusion Criteria

- Adult patients who are on continuous catheterization admitted in Intensive care units and all wards regardless of associated signs and symptoms.
- Duration of catheterization should be minimum 2 days.
- All OPD urine culture samples.

Exclusion Criteria

- Patients who already have sub-acute/chronic Urinary tract infections prior to admission.
- Duration of catheterization less than 2 days.

The samples were processed by the routine standard laboratory procedure. This included microscopy, culture identification, and antibiotic susceptibility testing. Urine microscopy was performed on centrifuged catheter urine specimen. The culture was set up on Blood Agar, Urichrome agar and MacConkey Agar for isolating all kind of urinary pathogens. Semiquantitative method of urine culture was followed. A sterile calibrated wire loop was used to deliver a loopful (0.01 ml) of urine onto each culture media. All the culture plates were incubated at 37°C aerobically for 18–24 h and the culture-positive isolates were identified by their colony morphology, Gram-staining, and characterized biochemically for species identification [13]. Vitek-2 compact automated system was used for identification of organism and MIC values obtained in it. Isolate suggestive of the yeast were subcultured on Sabouraud dextrose agar with further identification by the demonstration of germ tube; sporulation on cornmeal agar, sugar fermentation and assimilation and Chrome agar.

First line antibiotics such as Ampicillin, Amikacin, Cotrimoxazole, Nitrofurantoin, ciprofloxacin/norfloxacin and Cefotaxime, cefepime and second line of Antibiotics such as Imipenem, Amoxiclav, Piperacillin, Tazobactam and Cefoperazone sulbactam are the panel of antibiotics subjected in this method.

CAUTI was diagnosed as per CDC criteria with the presence of at least two of the following features with no other recognized cause: fever, urgency of micturition, dysuria or suprapubic tenderness, and pyuria or positive urine culture. To monitor the occurrence of CAUTIs, the following formula was calculated once a month: Incidence rate = dividing the number of new CAUTI case(s) by the number of catheter days and multiplying the result by 1000.[12]

RESULTS

The present study was carried out from July 2021 to June 2022 in Department of Microbiology in Premier hospital, Hyderabad, India. A total of 1543 patient's urine culture samples were included in our study. The distribution of patients is shown in Table 1. Out of the total samples, 66% urine cultures were from admitted patients and 34% were from outpatient department. 1543 urine samples were collected and processed, out of which 257 (16.65%) showed growth and 83.35% showed no growth after 48 hours of incubation.

Most common age group for urine cultures sent was 21 to 30 years with 26% of total patients followed by 51 to 60 years with 18% as shown in table 2. However, the greatest number of specimens were received from females aged 21 to 30. In part, this increased testing rate is likely accounted for by screening for asymptomatic bacteriuria in pregnancy. Figure 1 shows culture positive data with distribution of gram-negative bacilli and gram-positive cocci from total positive cultures. Table 3 shows the overall percentage of growth obtained from culture with *E-coli* being highest followed by *Klebsiella*. Organisms were identified as Escherichia coli 44%, Klebsiella sps 35%, Enterobacter 1.2%, Staphylococcus aureus 6.6% which includes MRSA 4%, Pseudomonas aeruginosa 3.5%, Proteus 1.5%, Enterococcus 2.7%, Candida species 3.1%

Out of 486 males included in the study, 39% were positive for growth, while out of 1057 females,

61% were positive for growth. This shows females are affected more as shown in above Figure 2. In females, no. of organisms involved are higher including MRSA which reported in 2 cases and Escherichia coli being commonest among both sexes as shown in Table 2. Out of total culture positive, 34% were from OPD and 66% culture positives from IPD as shown in figure 3.

In outpatient department, 525 urine samples were collected, of which 60 were positive for organism (11.4%) while in Inpatient out of 1018 samples, 197 were positive for organism (19.3%). This correlates with the culture positivity rate of our hospital (16.65%). Further, MRSA isolates are obtained from 2 samples collected from ICU ward out of 17 Staphylococcus aureus isolates.

A total of 1543 patients were included in the survey, of which 156 had an indwelling urinary catheter. This gave a point prevalence of 10.8% (95% confidence interval [CI] = 10.53–11.07), which varied between organizations, ranging from 2.36% (95% CI = 2.05–2.73) to 22.02% (95% CI = 20.12–24.05).

CAUTI data from July 21 to June 2022 is shown in Table 4 with 3 cases of CAUTI, one each in August 2021, November 2021 and June 2022. CAUTI rate is shown in figure 4 as 2.7 per 1000 catheter days. Table 5 shows antibiotic sensitivity pattern of CAUTI isolates. Klebsiella pneumonia was isolated in 2 urine samples (female patients) and Enterococcus faecium from one urine sample (male patient) out of the total 3 CAUTI cases throughout the year. The 3 isolates were multi drug resistant organisms isolated from patients admitted in critical care unit.

Table 1: Distribution of patients

Ward	**PERCENTAGE**
Inpatient	66%
Out Patient	34%
Duration of catheter	
3-9 days	70%
10 and above	30%
Sex	
Male	31.5%
Female	68.5%
TOTAL CULTURES	
Positive	17%
Negative	83%

Table 2: Age wise distribution

Age Wise Distribution	**Percentage**
0-10	2.2%
11-20	4.5%
21-30	26%
31-40	11%
41-50	08%
51-60	18%
61-70	10%
71-80	10%
81-90	09%
91-100	1.1%

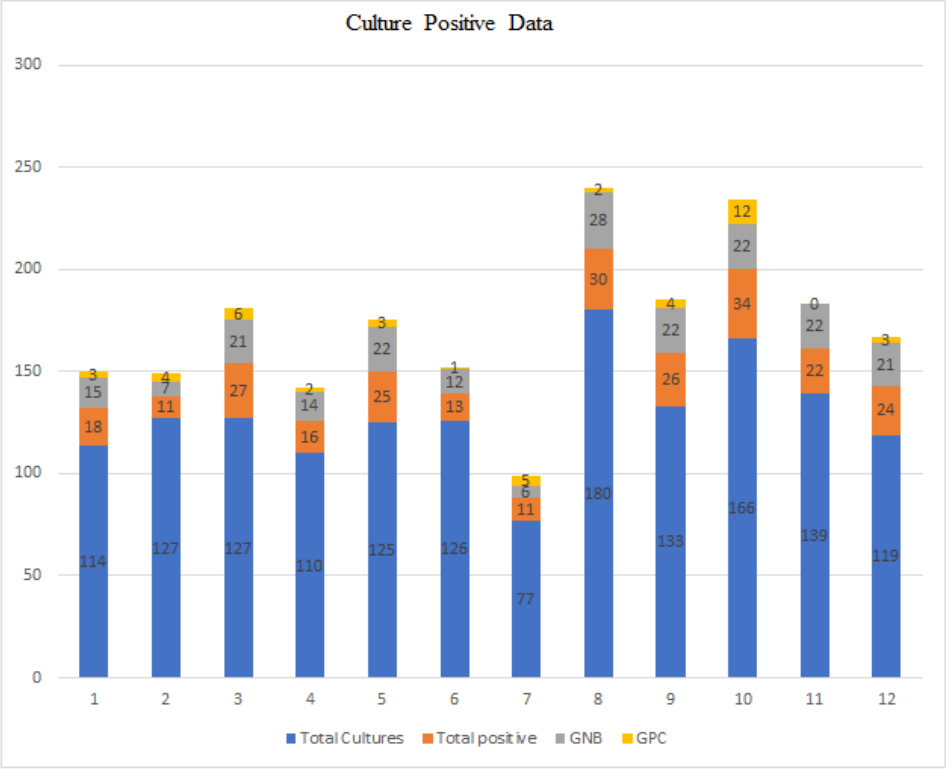

Figure 1: Culture positive data

Table 3: The overall percentage of growth obtained from urine cultures

S.NO	ORGANISM	TOTAL	percentage
1	E. coli	102	43.67
2	K. pneumoniae	89	34.63
3	Pseudomonas aeruginosa	9	3.5%
4	P. mirabilis	4	1.5%
5	Acinetobacter baumannii	3	1.16%
6	Enterobacter	3	1.16%
7	Burkholderia	1	0.4%
8	Serratia	1	0.4%
9	Citrobacter	5	1.94%
10	Staph aureus	17	6.6
11	Enterococcus	7	2.7
12	Staph. hemolyticus	2	0.7
13	Streptococcus	1	0.4
14	Candida	8	3.11

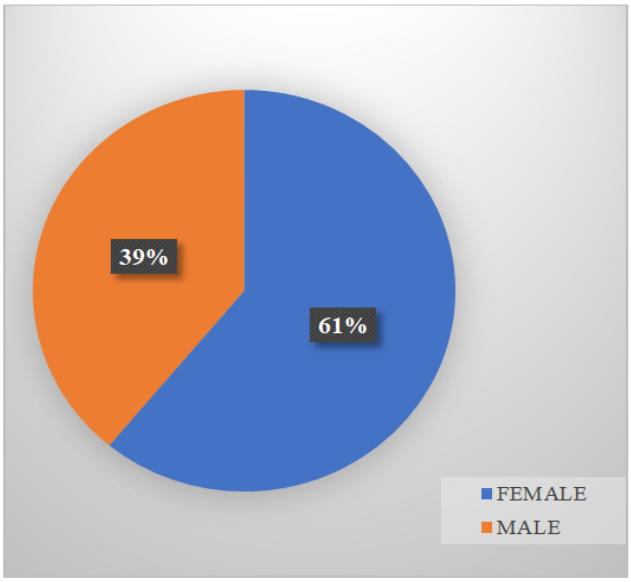

Figure 2: Gender Wise Distribution of Culture Positive

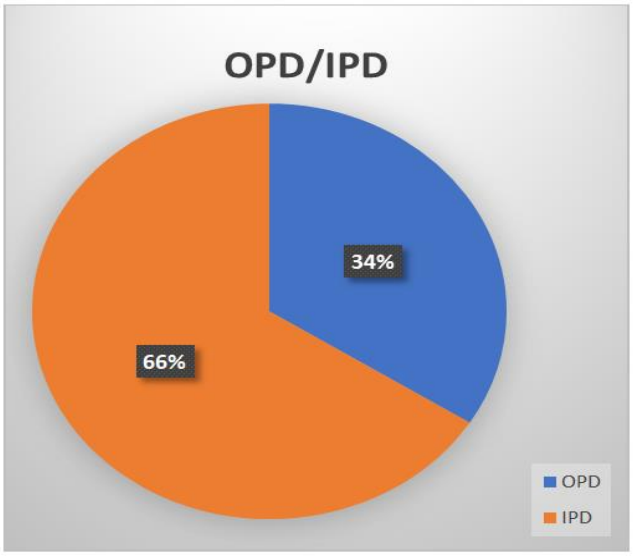

Figure 3: OP/IP Distribution of Culture Positive

Table 4: CAUTI DATA

MONTH& YEAR	FOLEYS CATHETER DAYS	No.of CAUTI	CAUTI rate/1000
JULY 21	381	0	0
AUG 21	444	1	2.25
SEP 21	407	0	0
OCT 21	371	1	2.69
NOV 21	297	0	0
DEC 21	383	0	0
JAN 22	479	0	0
FEB 22	450	0	0
MAR 22	337	0	0
APR 22	271	0	0
MAY 22	415	0	0
JUNE 22	361	1	2.77

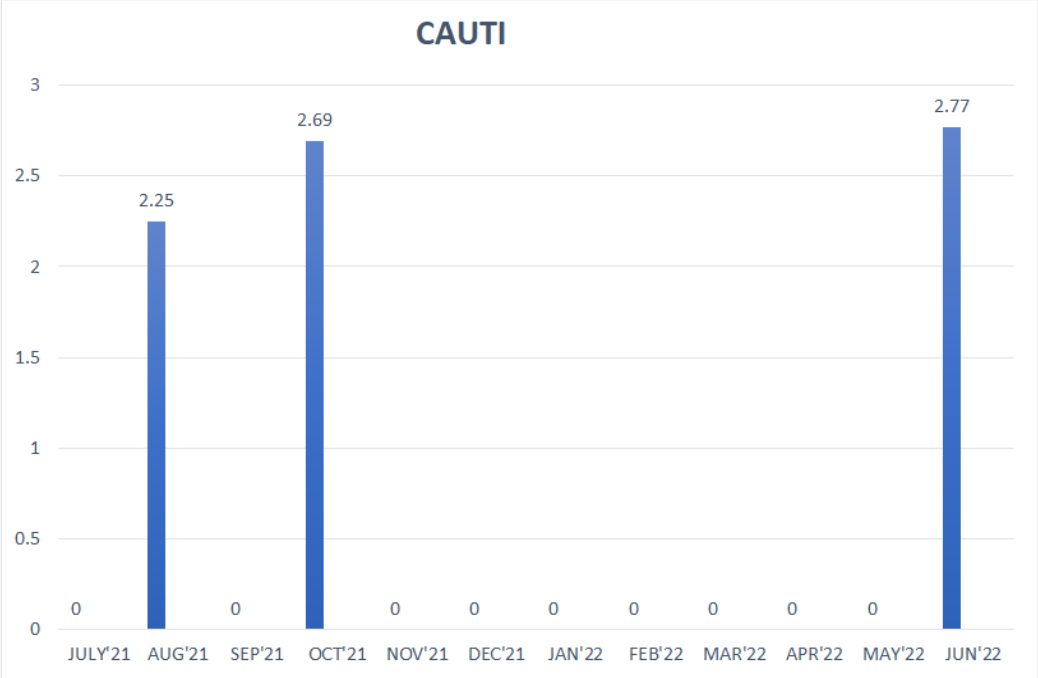

Figure 4: CAUTI data graph

Table 5: Antibiotic sensitivity pattern of CAUTI isolates

Antibiotic	Klebsiella 1	Klebsiella 2		Enterococcus
Amikacin	I	S	Vancomycin	R
Gentamicin	I	S	Linezolid	S
Ciprofloxacin	R	I	Erythromycin	R
Nitrofurantoin	R	R	Cefoxitin	R
Cotrimoxazole	S	S	Benzylpenicillin	R
Cefipime	R	S	Gentamicin High level	R
Cefuroxime	R	R	Ciprofloxacin	R
Cefotaxime	R	R	Levofloxacin	R
Cefoperazome-Sulbactum	R	S	Nitrofurantoin	R
Amoxicillin - clavulanic acid	R	I	Teicoplanin	S
Imipenam	R	R		
Meropenam	R	R		
Fosfomicin	S	S		
Colistin	I	R		
Piperacillin-Tazobactum	R	S		

DISCUSSION

The culture positivity rate of urinary tract infections in our hospital is about 16.65%. The common pathogens found in this study are Escherichia coli (44%), Klebsiella (35%), Enterobacter (1.2%), Staph. aureus (6.6%) which include MRSA (4%), Pseudomonas (3.5%), Enterococcus (2.7%), Candida sps (3.1%) and Proteus (1.5%). This findingis similar to the study conducted by NHSN which also shown the Escherichia coli (21%) to be the common pathogen [13]. This data strongly proves that CAUTI is one of the important nosocomial infections.

No. of patients positive for culture in the inpatient ward is higher (66%) compared to those in outpatient department (34%). Elderly patients 50 years and above are affected higher by CAUTI and symptomatic bacteriuria compared to young which indicates increasing age is a risk factor similar studies done by Vinoth M *et al.,* [1]. Further 60% of patients with catheter 2 to 9 days, while 83.3% of patients with catheter above 10 days had organisms in their urine which clearly shows risk of developing CAUTI and asymptomatic bacterial colonization increases with days of catheterization. So that unnecessary catheterization should be avoided wherever possible short-term catheterizations must be done [1].

The urinary catheter prevalence (10.8%) found in our hospital was similar to reports of urinary catheter prevalence in other countries, such as Japan (13%) [15], the U.S. (18.7–20.1%) [16, 18], Canada (22.4%) [17], Netherlands (18.3%–21.2%) [19, 20], Australia (20.7%) [21], and Korea (14.9%) [22]. The CAUTI Rate (CAUTI per 1000 catheter-days) in our hospital was 2.7 which was also similar to reports from India (4.41) [7], the US (1.54–2.28) [16, 18], Korea (1.6) [22], and Netherlands (4.0 infections per 1000 catheter-days) [19, 20].

Rise in increasing of CAUTI in critical care units is mainly because of not adopting meticulous aseptic precaution during catheter insertion, infrequent change of catheter and improper catheter care.[14] Females are affected more (61%) than males (39%) in our study. Kakaria *et al.,* observed a higher incidence of CAUTI in females (56.46%) as compared to males (43.54%). This increased risk in women is likely to be due to easier access of the perineal flora to the bladder along the outside of the catheter as it traverses the shorter female urethra. In addition, a woman's urethra is closer to anus. This makes it easier for bacteria to spread into her urethra and cause an infection [23].

Klebsiella pneumonia was isolated in 2 urine samples (female patients) and Enterococcus faecium from one urine sample (male patient) out of the total 3 CAUTI cases throughout the year. The 3 isolates were multi drug resistant organisms isolated from patients admitted in critical care unit with foleys catheter in place for more than 6 days. Both isolates of K. pneumoniae were resistant to imipenem, meropenem, amoxicillin/ clavulanic acid, nitrofurantoin, piperacillin, cefotaxime and cefuroxime indicates the injudicious use of this antibiotic in the past in this setup. While with resistance to cefepime, colistin, cefoperazone-sulbactam & ciprofloxacin were observed in 1 isolate, these antibiotics are soon going to be 100% resistant. Similar findings were noted by other workers also. (24,25) Similar resistant pattern of Klebsiella isolates in CAUTI patients was observed in a study by Tomar *et al.,* except all isolates were imipenem sensitive in their study [24]. Different hospital setup, use of antibiotics and infection control policies among different institutes may be the reasons for varied results. 1 Vancomycin resistant enterococcus (VRE) was isolated from CAUTI which was sensitive only to linezolid and teicoplanin. VRE isolates from CAUTI were reported in other studies [27].

CONCLUSION

UTI has low prevalence of 16.65% in our hospital with common pathogen being Escherichia coli (44%) followed by Klebsiella (35%). Klebsiella pneumoniae is one of the important notable pathogens causing nosocomial infection among admitted patients. Catheterized urinary tract provides ideal conditions for bacterial adherence inducing complications in patients' care. Second, treating physicians should carefully evaluate the indications for usage of urinary catheter and avoid unnecessary catheterization to their patients.

The patients present mainly as asymptomatic bacterial colonization and risk of CAUTI increases with longer duration of catheterizations. All patients those who had catheter for more than 2 days, aged 60 and above, should be checked for UTI symptoms. And their urine should be cultured regularly in order to diagnose and prevent CAUTI and its complications which are very dangerous and difficult to treat due to multi drug resistant organisms being isolated.

The present study helped us to generate institutional data regarding CAUTI prevalence among all catheterized patients and multi drug resistant organisms isolated. The development of universal resistance among uropathogens to antibacterial agents is clinically important and has to be considered when instigating antibiotic therapy for symptomatic infections. Replacing the old catheters before antibiotic treatment is a sensible option. The treatment should be based on the susceptibility of organisms that are isolated from urine aspirated from the new catheter, as samples collected from the old catheter can contain different species and greater numbers of organisms.

UTIs are the most common infections in both hospitalized and community patients at all ages. The increasing reports on UTI in ICU patients have become a major concern in the public health area given that the lack of effective treatment options for these infections. By this study we can understand the prevalence of

bacteria associated with urinary tract infection that will help in identification and early treatment CAUTI.

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CONFLICT OF INTEREST

None declared.

ETHICAL APPROVAL

Not required.

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