# Catheter associated urinary tract infection(CAUTI)– Incidence and microbiological profile in a tertiary care hospital in Andhra Pradesh

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## Abstract

**Background**: The etiological agents of Catheter associated urinary tract infection (CAUTI) are sundry and often multidrug resistant. An early, appropriate antimicrobial therapy based on culture sensitivity report and implementation of infection control practices together play a key role in management of CAUTI.

**Objectives:**

1. To find the incidence of CAUTI in intensive care unit (ICU) patients.
2. To identify etiological agents responsible for CAUTI.
3. To determine antimicrobial susceptibility pattern for bacterial agents obtained.

**Methods**: Urine samples from clinically suspected cases of CAUTI were obtained from patients with urinary catheters admitted in ICUs. Urine samples were subjected to wet mount, culture and sensitivity testing. Responsible pathogens and their antimicrobial susceptibility pattern were obtained based on CSLI standards.

**Results**: A total of 640 patients were having indwelling urinary catheter with an aggregate of 5199 catheter days over a period of 6 months. 19 were culture positive out of 45 clinically suspected cases of CAUTI. The CAUTI rate was 3.65 cases per 1000 catheter days. Most predominant etiological agents responsible for CAUTI were *Citrobacter* species (26.3%) followed by *P.aeruginosa* (21.1%) and *E. coli* (21.1%). 2(18.2%) ESBL producing Gram negative bacteriawere obtained among Enterobacteriaciae. The most effective antibiotics were ceftazidime/clavulinic acid, colistin and meropenam for Enterobacteriaciae; piperacillin/tazobactam for *P.aeruginosa*; linezolid and vancomycin for *Enterococcus* species.

## Introduction

Nosocomial infections, or hospital-acquired infections (HAI), are important cause of morbidity and mortality in healthcare settings especially among patients admitted in intensive care units(ICUs).[1,2] Urinary tract infections (UTIs) account for 20-50% of all hospital-acquired infections occurring in the intensive care unit (ICU).[3] Urinary catheterization in itself is a risk factor for Catheter associated urinary tract infection (CAUTI).

CAUTI as defined by CDC is an UTI where an indwelling urinary catheter was in place for more than 2 calendar days on the date of event, with day of device placement being Day 1, and an indwelling urinary catheter was in place on the date of event or the day before. If an indwelling urinary catheter was in place for more than 2 calendar days and then removed, the date of event for the UTI must be the day of discontinuation or the next day for the UTI to be catheter-associated. Culture positivity is the said event. Several bacterial species are known to form biofilm on urinary catheters as a survival benefit.[4] The most common pathogens of CAUTI include *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterococcus* species and *Candida albicans*. Both the microbiological profile and antimicrobial sensitivity pattern vary considerably from time to time and region to region.[5] CAUTI is coupled with prolonged hospital stay among patients and considerable financial burden to both patients and hospitals.[6] Pooled mean CAUTI rate was 0 to 4 per 1000 catheter days as given by National Healthcare Safety Network (NHSN) report[7] of U.S.A. Inappropriate and recurrent use of antibiotics to treat CAUTI, can promote antimicrobial resistance.[8] Therefore evidence based diagnosis of CAUTI and initiation of appropriate antimicrobial therapy based on microbiological test results is necessary in ICU settings.

## Materials and Methods

The present study was carried out in a tertiary care hospital at Visakhapatnam, Andhra Pradesh for a period of 6 months (January 2016 to June 2016). It is a prospective study approved by institutional ethical committee. A total of 640 patients admitted in ICUs were catheterized with indwelling urinary catheter (Foley's catheter) during the study period. Urinary catheter care bundle was implemented among all catheterized patients as per Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines.[9] Follow up of catheterized patients was done meticulously on daily basis and observed for local and systemic signs of UTI. On clinical suspicion of UTI in catheterized patients, urine sample was sent to microbiology laboratory along with prompt documentation. Culture positivity obtained in less than 2 calendar days of urinary catheterization was not considered as CAUTI.

**Sample collection**: Fresh urine samples were collected in a sterile, leak-proof universal container from patients under aseptic technique from sampling port of sterile closed urinary drainage system which was transported to the microbiology laboratory for immediate processing.[10]

**Processing of specimens in laboratory:** The urine samples were subjected to direct wet mount and culture using semi-quantitative standard loop technique.[11] Inoculation was done on Cystine Lactose Electrolyte Deficient medium (CLED) and blood agar. Significant count was considered. Discrete bacterial isolates thus obtained were subjected to Gram staining, hanging drop preparation, other necessary tests including biochemical tests for further identification. The species identification of bacterial and fungal isolates was done based on standard laboratory procedures.[12-14] Kirby-Bauer disc diffusion method was adopted for antimicrobial susceptibility testing using appropriate antimicrobial discs as per CLSI guidelines.[15]

## Results

Indwelling urinary catheter was used in 640 patients admitted in ICUs with catheter days ranging from 5-10 catheter days on an average for each patient. A sum total of 5199 catheter days were obtained in the study period. 45(7.03%) patients developed clinical signs or symptoms of UTI after 2 calendar days from the time of insertion of indwelling urinary catheter. Of 45 urine samples cultured, 19(42.2%) were culture positive and 26(57.8%) showed no evidence of growth. Incidence of CAUTI was 3.65 per 1000 catheter days over a 6 month period. Single significant pathogen with colony count of more than 100000 colony forming units was obtained from each culture positive sample.

**Table 1: Spectrum of isolates obtained in CAUTI**

| Sl no. | Organism | No. of isolates |
|---|---|---|
| 1 | *Citrobacter* species | 5 |
| 2 | *Pseudomonas aeroginosa* | 4 |
| 3 | *E. coli* | 4 |
| 4 | *K.pneumoniae* | 1 |
| 5 | *Enterobacter* species | 1 |
| 6 | *Enterococcus* species | 2 |
| 7 | *Candida albicans* | 2 |
| Total | | 19 |

Spectrum of causative agents of CAUTI is depicted in Table 1. Our study revealed a total of 19 isolates which included 17(89.5%) bacterial and 2(10.5%) fungal agents as causative agents of CAUTI. Among bacteria, 15 were Gram negative and 2 Gram positive bacteria. Gram negative bacteria included 11 isolates belonging to Enterobacteriaciae and 4 isolates of *P. aeroginosa. Enterococcus* species was the only Gram positive bacteria found in our study. Overall predominant etiological agent was *Citrobacter* species(26.3%), followed by *P.aeroginosa* (21.1%), *E.coli* (21.1%), *Enterococcus* species (10.5%), *K.pneumonia* (5.25%) and *Enterobacter* species (5.25%). Fungal isolates obtained were *Candida albicans* (10.5%).

**Antimicrobial susceptibility pattern of Enterobacteriaciae**

**Table 2: Antimicrobial susceptibility pattern of Enterobacteriaciae**

| Antimicrobial drug | Sensitive | Intermediately sensitive | Resistant |
|---|---|---|---|
| Ampicillin | 7 | - | 4 |
| Amikacin | 9 | - | 2 |
| Amoxicillin/ Clavulinic acid | 7 | 4 | - |
| Ampicillin/ Sulbactam | 10 | - | 1 |
| Azreonam | 5 | 3 | 1 |
| Cefepime | 9 | 1 | 1 |
| Cefoperazone | 5 | 2 | 4 |
| Cefotaxime | 7 | 1 | 3 |
| Ceftazidime | 5 | 4 | 2 |
| Ceftazidime/ Clavulinic acid | 11 | - | - |
| Ceftriaxone | 5 | 2 | 4 |
| Ciprofloxacin | 3 | 3 | 5 |
| Colistin | 11 | - | - |
| Cotrimoxazole | 8 | - | 3 |
| Doripenam | 6 | 4 | 1 |
| Gentamicin | 10 | | 1 |
| Imipenam | 9 | 2 | - |
| Levofloxacin | 7 | 2 | 2 |
| Meropenam | 11 | - | - |
| Nitrofurointoin | 9 | - | 2 |
| Piperacillin/ Tazobactam | 9 | 2 | - |
| Ticarcillin/ Clavulinic acid | 5 | 3 | 3 |

Antimicrobial susceptibility pattern of Enterobacteriaciae is depicted in Table 2. Among 11 Enterobacteriaciae family of isolates, namely *Citrobacter* species, *E. coli*, *Enterobacter* species and *K. pneumoniae*, 2(18%) were Extended spectrum β lactamase (ESBL) producing strains both of which were *E.coli*. All isolates were sensitive to ceftazidime/ clavulinic acid, colistin, meropenam, 10(90.9%) were sensitive to ampicillin/ sulbactam and gentamicin. Colistin was preserved as reserve drug. 5(45.5%) isolates were resistant to ciprofloxacin, 4(36.4%) were resistant to ampicillin, cefoperazone and ceftriaxone.

**Antimicrobial susceptibility pattern of non-fermenting bacteria**

Antimicrobial susceptibility pattern of non-fermenting Gram negative bacteria that is *P. aeruginosa* is shown in Table 3. The most effective antibiotic was piperacillin/tazobactam (75% sensitive, 25% intermediately sensitive) and least effective antibiotic agents were ciprofloxacin, doripenam and amikacin(25% each).

**Table 3: Antimicrobial susceptibility pattern of non-fermenting bacteria**

| Antimicrobial drug | Sensitive | Intermediately sensitive | Resistant |
|---|---|---|---|
| Amikacin | 1 | - | 3 |
| Aztreonam | 1 | 1 | 2 |
| Cefepime | 2 | - | 2 |
| Ceftazidime | 2 | - | 2 |
| Ciprofloxacin | 1 | - | 3 |
| Doripenam | 1 | - | 3 |
| Gentamicin | - | 2 | 2 |
| Imipenam | 2 | 1 | 1 |
| Levofloxacin | 2 | - | 2 |
| Meropenam | - | 2 | 2 |
| Piperacillin/ Tazobactam | 3 | 1 | - |
| Ticarcillin/ Clavulinic acid | 1 | 1 | 2 |

Antimicrobial pattern of non-fermenting Gram negative bacteria that is *P. aeruginosa* is shown in Table 3. The most effective antibiotic was piperacillin/tazobactam (75% sensitive, 25% intermediately sensitive) and least effective antibiotic agents were ciprofloxacin, doripenam and amikacin (25% each).

**Antimicrobial susceptibility pattern of *Enterococcus* species**

**Table 4: Antimicrobial susceptibility pattern of *Enterococcus* species**

| Antimicrobial drug | Sensitive | Intermediately sensitive | Resistant |
|---|---|---|---|
| Ampicillin | - | 1 | 1 |
| Ciprofloxacin | - | 1 | 1 |
| Gentamicin | 1 | - | - |
| Teicoplanin | 1 | 1 | - |
| Levofloxacin | 1 | 1 | - |
| Nitrofurointoin | 1 | - | - |
| Tigecyclin | 2 | - | - |
| Linezolid | 2 | - | - |
| Vancomycin | 2 | - | - |

Antimicrobial susceptibility pattern of *Enterococcus* species is shown in Table 4. Both the isolates were sensitive to linezolid and vancomycin. One isolate was resistant to both ampicillin and ciprofloxacin. Vancomycin was preserved as a reserve drug.

## Discussion

CAUTI is the common HAI among ICU patients. Risk factors associated with the development of CAUTI include prolonged duration of urinary catheterization, lengthy hospital stay, female gender, prior systemic antimicrobial therapy and co-morbid conditions in critical care patients.[5] The impact of CAUTI varies among patients based on their age, immune status and socio-economic status. Common signs and symptoms include fever, dysuria, rigors, lower back pain, suprapubic pain/tenderness and new or worsening confusion.

In our study the incidence of CAUTI was 3.65 per 1000 catheter days which correlates with pooled mean CAUTI rate of 0 to 4 per 1000 catheter days of NHSN report.[7] Duszyńska*et al*[16] reported a CAUTI rate of 6.44, 6.84, 7.16 per 1000 catheter days for the years 2012, 2013 and 2014, respectively from Poland. Incidence density of 9.6 per 1000 ICU days was found at Calgary by Laupland and colleagues.[17] In this study lower rate of CAUTI was due to compliance towards adherence of infection control practices, hand hygiene, implementation of catheter care bundle and it also could be due to exclusion of asymptomatic bacteriuria from catheterized patients. Our study revealed most frequent pathogen responsible for CAUTI as *Citrobacter* species (26.03%) followed by *P. aeroginosa* (21.05%), *E. coli* (21.05%), *Enterococcus* species(10.5%), *K.pneumoniae* (5.25%), *Enterobacter* species (5.25%) and *Candida albicans* (10.5%). Laupland *et al*[17] obtained *E. coli* (23%), *Candida albicans* (20%) and *Enterococcus* species (15%) at Calgary which is similar to our study. The most common microorganisms isolated were C*andida* species (34%) at Singapore as evaluated by Tay*et al*.[18] *Enterococcus* species (22%), *Acinetobacter baumannii* (20%), *K.pneumoniae* (18%), *P.aeruginosa* (13%) and *Candida* species (13%) were the main pathogens of CAUTI as demonstrated by Duszyńska*et al*.[16] Among Enterobacteriaciae obtained in our study 2(15.4%) were ESBL producers as compared to 18% of ESBL strains of *E. coli* obtained by Spadafina JT, Cohen B and Larson E[19] at New York. They also demonstrated increasing trend of EBSL isolates over the years.

## Conclusion

Implementation of infection control practices is necessary for prevention and control of CAUTI. Usage of antimicrobial agents in suspected cases of CAUTI may be withheld in ICUs till microbiology reports are made available unless absolute need for empirical therapy is required in order to avoid emergence of resistant strains.

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