

## Identification and susceptibility pattern of Gram negative bacterial isolates of Catheter Associated Urinary Tract Infections (CAUTI) in a tertiary care institute

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### Abstract

**Introduction:** Catheter associated urinary tract infection (CAUTI) is the most common health care associated infection worldwide. Multiple factors (type of catheter, insertion procedure, duration of catheter, handling of catheter and primary disease of the patient etc.) are responsible for the CAUTI.

**Materials and Method:** This prospective study was conducted in a tertiary care teaching hospital over a period of one and half year from January 2012 to June 2013. CDC's CAUTI case definitions were used to label a case as CAUTI. Only culture proven cases, out of clinically suspected was included in the study for evaluation.

**Results:** Overall rate of CAUTI was 7.53 per 1000 device days. Out of 136 cultures proven cases of CAUTI 129 showed growths of Gram negative bacteria, among them *E. coli* (62.01%) was the leading isolate followed by *Klebsiella pneumoniae* (12.40%) and *Pseudomonas aeruginosa* (11.62%). Among common Gram negative bacterial isolates *E. coli* exhibited (98.75%) resistance to ampicillin, (96.25%) to amoxicillin+clavulanic and (96%) to cefuroxime followed by (82.5%) to ciprofloxacin and (47.5% & 22.5%) to gentamicin and amikacin respectively. Three isolates were resistant to imipenem. *Klebsiella pneumoniae* exhibited (100%) resistance to ampicillin, amoxicillin+clavulanic, piperacillin, and cefuroxime, (93%.75) to ciprofloxacin followed by (81.25% & 68.75%) to gentamicin and amikacin respectively. None of the isolates of *Klebsiella pneumoniae* were resistant to imipenem.

**Conclusion:** Proper insertion, handling, lesser duration of Urinary Catheter and continuous display and analysis of microbiological data of the cases of CAUTI will help in curbing down the incidences of CAUTI.

**Keywords:** Catheter associated urinary tract infection, Urinary Catheter, *E. coli*, *Klebsiella pneumoniae*.

### Introduction

An infection is labeled as Healthcare Associated Infection (HAI) if it is not present at the time of diagnosis and develops 48 hours after admission. HAI is defined by the Centers for Disease Control and Prevention (CDC) as a "localized or system condition (1) that results from adverse reaction to the presence of an infectious agent(s) or its toxin(s); and (2) that was not present or incubating at the time of admission to the hospital".<sup>(1,2)</sup> Catheter Associated Urinary Tract Infections (CAUTI) contributes approximately 30 to 35% of all HAIs<sup>(3-5)</sup> presence of indwelling catheter is a prerequisite for CAUT and risk varies from 3 to 7% per day with urinary catheter in place.<sup>(6)</sup> Catheterization for more than two days is significant factor for CAUTI.<sup>(7)</sup> Elderly age group, diabetics, female, obesity etc are other risk factors.<sup>(8)</sup> CAUTI are usually caused by gram-negative bacteria, the most common being *E. coli*, *Enterococcus* species, *P. aeruginosa*, and *K. pneumoniae*.<sup>(3)</sup> Healthcare-associated urinary tract infections are classified by the CDC as symptomatic urinary tract infection, asymptomatic bacteriuria, or other infection of the urinary tract, and microbiological culture confirmation of the collected urinary are necessary for diagnosis.<sup>(1,2)</sup> Use of urinary catheters when required, insertion with full aseptic procedure, properly secured catheter, removal of catheter as soon as possible and maintenance of unrestricted urine flow

are important for the prevention of CAUTI.<sup>(6)</sup> Higher rates of infection often leads to increased rates of antimicrobial prescription which in turn contribute to increased antimicrobial resistance.<sup>(9)</sup> Treatment of multi-drug resistant pathogens is a costly affair.<sup>(10)</sup>

The present study was designed to study the "Identification and susceptibility pattern of Gram negative bacterial isolates of Catheter Associated Urinary Tract Infections (CAUTI) in a tertiary care institute".

### Materials and Method

This prospective study was conducted in a tertiary care teaching hospital over a period of one and half year from January 2012 to June 2013. The study was carried out in medical & surgical ICU, general medicine, general surgery, and obstetrics/ gynecology wards. Patients admitted in hospital and fitting in the definition of HAI were included in the study. CDC's CAUTI case definitions<sup>(1,2)</sup> were used to label a case as CAUTI. Only culture proven cases, out of clinically suspected was included in the study for evaluation. Samples were collected from suspected CAUTI patients. Both active and passive surveillance methods were used for sample collection. Active surveillance was done by visiting various study areas daily along with infection control nurse. Passive surveillance was done by following the positive culture results obtained in microbiology

laboratory to retrospective wards in the hospital. The labeled specimens were transported to microbiology laboratory within one hour of sample collection. In the microbiology laboratory initially the uncentrifuged urine was subjected Gram stain and wet mount examination. Specimen were inoculated on appropriate culture media including blood agar, MacConkey agar, chocolate agar and incubated for 16-18 hrs at 35-37°C by using standard laboratory techniques.<sup>(11,12)</sup> Identification of bacteria was based on the colony characteristics of the organism i.e. colony morphology, hemolysis on blood agar, changes in the physical appearance of the differential media and enzyme activities of the organisms, Gram staining and biochemical tests.<sup>(11,12)</sup> Antimicrobial sensitivity was performed on Muller Hinton agar plates by Kirby-Bauer disk diffusion method as per CLSI guidelines.<sup>(13)</sup> Antibiotic discs were procured from HiMedia laboratories, Mumbai, India. Isolates were labeled susceptible, resistant & intermediate on the basis of CLSI disc zone interpretative criterion.<sup>(7)</sup> All the media, reagents and antimicrobial discs were procured from Himedia, Mumbai, India.

## Results

A total 2139 catheterized patients were screened for CAUTI during study period. Out of which 285 were clinically suspected as a case CAUTI. Of which 136 were culture positive. Overall rate of CAUTI was 7.53 per 1000 device days. (Table 1 & 2) Rate was higher in males (4.15 per 1000 device days) than in females (3.38 per 1000 device days).

(Table 2) It was evident that the rates of CAUTI were increased when duration of catheterization increased. (Table 3) Out of 136 cultures proven cases of CAUTI all were monomicrobial infections and 129 showed growths of Gram negative bacteria predominantly of enterobacteriaceae family. Only gram negative isolates were included in the study for further evaluation. Among Gram negative bacterial isolates from CAUTI, *E. coli* (62.01%) was the leading isolate followed by *Klebsiella pneumoniae* (12.40%) and *Pseudomonas aeruginosa* (11.62%). (Table 4) Among common Gram negative bacterial isolates *E. coli* exhibited (98.75%) resistance to ampicillin, (96.25%) to amoxicillin+clavulanic and (96%) to cefuroxime followed by (88.75%) to cefazolin and norfloxacin, (86.25%) to cefotaxime, (82.5%) to ciprofloxacin and (47.5% & 22.5%) to gentamicin and amikacin respectively. Three isolates were resistant to imipenem. *Klebsiella pneumoniae* exhibited (100%) resistance to

ampicillin, amoxicillin+clavulanic, piperacillin, cefazolin, cefotaxime and cefuroxime, (93%.75) to cefepime, ceftazidime and ciprofloxacin followed by (81.25% & 68.75%) to gentamicin and amikacin respectively. None of the isolates of *Klebsiella pneumoniae* were resistant to imipenem. *Pseudomonas aeruginosa* exhibited (33.33%) resistance to gentamicin and ciprofloxacin, (26.66%) to cefepime followed by (13.33%) to amikacin respectively. None of the isolates of *Pseudomonas aeruginosa* were resistant to imipenem. (Table 5)

**Table 1: Device utilization ratio and incidence and of CAUTI**

Type of HAI	Type of device	Device-days number	Culture positive DAI number	Rate per 1000 device-days
CAUTI	UC*	18053	136	7.53

\* Urinary catheter

**Table 2: Gender wise distribution of CAUTI**

Catheterized	Clinically suspected CAUTI	Culture positive CAUTI	Rate per 1000 device-days
2139	285	136	7.53
M=729	M=148	M=75	M=4.15
F=1410	F=137	F=61	F=3.38

**Table 3: Rates of CAUTI in accordance with catheter days**

Urinary catheter days	Culture positive CAUTI	Rate per 1000 device-days
< 4 days	08	0.44
4-7 days	23	1.27
8-14 days	36	1.99
> 14 days	69	3.82

**Table 4: Gram negative bacterial isolates from CAUTI (n=129)**

Microorganisms	Number	(%)
<i>E. coli</i>	80	62.01
<i>Klebsiella pneumoniae</i>	16	12.40
<i>Pseudomonas aeruginosa</i>	15	11.62
<i>Citrobacter freundii</i>	05	3.87
<i>Citrobacter koseri</i>	04	3.10
<i>Enterobacter aerogenes</i>	03	2.32
<i>Proteus mirabilis</i>	03	2.32
<i>Proteus vulgaris</i>	02	1.55
<i>Klebsiella oxytoca</i>	01	0.77

**Table 5: Resistance pattern of common Gram negative bacterial isolates from CAUTI (% resistance)**

Antibiotics	<i>E. coli</i> (n=80)	<i>Klebsiella pneumoniae</i> (n=16)	<i>Pseudomonas aeruginosa</i> (n=15)
Ampicillin	79 (98.75)	16 (100)	NA*
Amoxicillin + Clavulanic Acid	77 (96.25)	16 (100)	NA
Piperacillin	61 (76.25)	16 (100)	03 (20)
Piperacillin + Tazobactam	38 (47.5)	08 (50)	01 (6.66)
Cefazolin	71 (88.75)	16 (100)	NA
Cefepime	54 (67.5)	15 (93.75)	04 (26.66)
Cefotaxime	69 (86.25)	16 (100)	NA
Cefoxitin	43 (53.75)	11 (68.75)	05 (33.33)
Ceftazidime	62 (77.5)	15 (93.75)	03 (20)
Cefoparazone	NA	NA	02 (13.33)
Cefuroxime	72 (96)	16 (100)	NA
Imipenem	03 (3.75)	00 (00)	00 (00)
Amikacin	18 (22.5)	11 (68.75)	02 (13.33)
Gentamicin	38 (47.5)	13 (81.25)	05 (33.33)
Ciprofloxacin	66 (82.5)	15 (93.75)	05 (33.33)
Trimethoprim/ Sulfamethoxazole	22 (27.5)	11 (68.75)	ND
Norfloxacin	71 (88.75)	14 (87.5)	04 (26.66)
Nitrofurantoin	09 (11.25)	07 (43.75)	NA

\*NA: Not Applied

## Discussion

Catheter associated urinary tract infection (CAUTI) is the most common nosocomial infection in worldwide. Catheters act as reservoir of resistant pathogens. Several factors (type, duration, procedural mistakes during insertion of catheter and associated diseases of the patients etc.) are responsible for the different rate of CAUTI in different healthcare setup.<sup>(14,15)</sup> In order to determine the rate of CAUTI a total of 2139 catheterized patients with 18053 catheter days were evaluated during the study period. Out of 285 clinically suspected CUTI case, 136 were confirmed microbiologically. The overall rate of CAUTI was 7.53 per 1000 device days; which was high in comparison to Indian study (0.23% or 0.60 per 1000 device days) and to that of US rates 3.3 per 1000 device days,<sup>(16)</sup> but it was lower than the overall INICC rate of 9.0 per 1000 device days.<sup>(17)</sup> The present study also showed that the rate of CAUTI is increased with duration of catheterization. This finding is in accordance to other studies.<sup>(18-20)</sup> Varied rate of CAUTI among different health care facilities indicates that quality of nursing care provided to the catheterized patients and infection control policies followed by the institute can alter the rate of CAUTI. The present study indicates that *E. coli* is the most common isolate from patients of CAUTI. This finding is consistent with the other studies from Iran and other countries.<sup>(14,15,21)</sup> The highest resistance rate of *E. coli* isolate which was obtained from urine samples was against ampicillin (98.75%) followed by amoxicillin/clavulanic acid (96.25%),

norfloxacin (88.75%), cefotaxime (86.25%) and ciprofloxacin (82.5%). These results were predictable because these antibiotics have been used as a long time in study setup. In this study, imipenem (3.75%), nitrofurantoin (11.25%), amikacin (22.5%) and trimethoprim/ sulfamethoxazole (27.5%) were the least resistant antibiotics to *E. coli* isolates, stating the wise use of these anti-biotics in infections. Hundred percent isolates of *K. pneumoniae* were resistant to ampicillin, amoxicillin/ clavulanic acid, piperacillin, cefotaxime and cefuroxime, indicates the injudicious use of these antibiotic in the past in this setup. While with resistance rate of (93.75%) to cefepime, ceftazidime & ciprofloxacin, these antibiotics are soon going to be 100% resistant. Similar findings were noted by other workers also.<sup>(14,15,21)</sup> Fortunately no resistance was noted to imipenem in *K. pneumoniae* isolates, stated that this drug need to be used judiciously in future. *Pseudomonas aeruginosa* were the third most common isolate from CAUTI in present study and least resistance to the most used antibiotics in our setup. These findings are not consistent with the results of other observers.<sup>(14,15,21)</sup> Different hospital setup, use of antibiotics and infection control policies among different institutes may be the reasons for varied results.

## Conclusion

Present study point out clearly towards the increasing prevalence of multi drug resistant pathogens in the hospital environment and thus in the cases of CAUTI. Proper insertion, handling, lesser duration of

Urinary Catheter and continuous display and analysis of microbiological data of the cases of CAUTI will help in curbing down the incidences and thus in turn the complications associated with these kinds of infections.

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