Original Research Article

Microbiological profile of catheter associated urinary tract infection in ICUs of a tertiary care hospital Bhubaneswar, Odisha, India

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ABSTRACT

Introduction: Among nosocomial infections catheter associated urinary infection (CA-UTI) is one of the most common infection. Uro- pathogens isolated from CAUTI were more multi-drug resistant than from community acquired urinary tract infection (UTI).

Aim of the study: To isolate micro-organisms responsible for CA-UTI in ICUs, to find out antibiotic sensitivity pattern of the isolates and to know the Impact of CAUTI care bundle on reducing CAUTI rate.

Materials and Methods: A retrospective study was conducted from September 2017 to August 2018, urine samples were collected from 300 catheterised patients which were processed microbiologically and antimicrobial sensitivity test was performed.

Results: Out of 300 catheterised patients, 76 patients developed CAUTI. So the incidence rate of CAUTI is 21.7%. A sum total of 38,067 catheter days were obtained in the study period from the month of September 2017 to August 2018. CAUTI rate was found to be 1.9 per 1000 catheter days over a period of 1 year

Out of 76 total isolates 56 were Gram negative and 20 were Gram positive bacteria. Gram negative bacteria included *Escherichia coli* 19(25%), followed by *Klebsiella* 14(19%), *Proteus* 8 (11%) *Pseudomonas* 6(8%), *Acinetobacter* 4(8%). Among gram positive *Enterococcus* species is 17(22%) followed by *Staphylococcus* spp. 03 (4%). *Enterobacteriaceae* showed high resistant to commonly used antimicrobials like Gentamycin, Ceftriaxone, Ofloxacin, Ciprofloxacin but were highly sensitive to Amikacin, ceftazidime, piperacillin Tazobactam, Imipenem, Meropenem.

Enterococcus and *Staphylococcus* were sensitive to Tigecyclin, Vancomycin, Teicoplanin and linezolid.

Conclusion: The most common organism responsible for CAUTI is *Escherichia coli* followed by *Klebsiella* spp. and *Enterococcus* spp. Members of *Enterobacteriaceae* are highly sensitive to Amikacin, ceftazidime, piperacillin Tazobactam, Imipenem, Meropenem. *Enterococcus* and *Staphylococcus* are sensitive to Tigecyclin, Vancomycin, Teicoplanin and linezolid. Strict insertion and maintenance CAUTI care bundle reduces CAUTI rate. Prevention of infections attributable to these devices should be an important goal of health-care infection prevention

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1. Introduction

Nosocomial infections, or hospital-acquired infections (HAI), are important cause of morbidity and mortality, hospital cost and length of stay in healthcare settings especially among patients admitted in intensive care units (ICUs).^{1,2} 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. Urinary catheter acquired infection is usually manifested as asymptomatic bacteriuria (CA-ASB). The term catheter associated urinary tract infection (CA-UTI) is used to refer to individuals with symptomatic infection.³

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Urinary tract infection attributed to the use of an indwelling urinary catheter is one of the most common infection acquired by patients in health care facilities. CAUTI accounts for over 1 million cases annually,⁴ or over 40% of all nosocomial infections in hospitals and nursing homes,^{5–7} and constitute 80% of all nosocomial UTIs.⁸

2. Aims and Objective

1. To find out organisms causing catheter associated urinary tract infection.
2. To find out antimicrobial sensitivity pattern of the isolates.
3. To calculate CAUTI rate and its reduction by implementing CAUTI care bundle for every catheterized patient.

3. Materials and Methods

The present study was carried out in a tertiary care hospital, Bhubaneswar, Odisha for a period of 1 year from September 2017 to August 2018. It is a retrospective study. About 300 urine samples were collected from catheterized patients admitted to different ICUs of this hospital.

3.1. Inclusion criteria

All patients who were catheterized were included in this study, 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.

3.2. Exclusion criteria

Patients who were earlier treated with UTI, Patients already suffering from cystitis and prostatic enlargement, Patients on suprapubic catheter, nephrostomy tube and condom catheter.

3.3. 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.⁹

Samples were collected on first day of catheterization, and processed to rule out prior urinary tract infection. 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.

The samples were processed on CLED and Blood agar by using standard calibrated loop. Samples which had colony count $\geq 10^5$ CFU/ml were processed further for biochemical reactions and antimicrobial sensitivity test. Antimicrobial

sensitivity test was done on Muller Hinton agar according to CLSI guidelines and antimicrobial sensitivity pattern was recorded.¹⁰ Staphylococcal ATCC 25923, Escherichia coli ATCC 25922 and Pseudomonas aeruginosa 25873 were used as control strains. The isolated organisms were also confirmed in automated VITEC system.

Total no. of CAUTI was calculated by taking into account the different factors defining CAUTI.

The CAUTI rate was calculated as total no. of CAUTI in a given month/ total no of catheter days $\times 1000$.

To control the CAUTI rate in the hospital, the infection control team have implemented urinary catheter care bundle among all catheterized patients as per Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines.⁴ Prevention of catheter acquired urinary tract infection Guidelines:

Several evidence-based guidelines provide recommendations for the development and maintenance of prevention programs for CA-UTI.^{4,10,11} Approaches to prevention include avoidance of catheter use, policies for catheter insertion and maintenance, catheter selection, surveillance of CA-UTI and catheter use, and recommendations for quality indicators.

Catheter insertion and maintenance bundle were advised which includes.^{11–13}

Catheter insertion bundles like, Appropriate hand hygiene, Choice of catheter (lumen), use of Aseptic techniques/sterile equipment, Barrier precautions, Antiseptic meatal cleanings.

Catheter maintenance was done by Appropriate hand hygiene, Securing catheter Closed drainage system, Obtaining urine samples aseptically, Replacement of the system if any breaks in asepsis.

4. Result

Out of 300 catheterized patients, 76 patients developed CA-UTI. So the incidence rate of CA-UTI is 25.33%. A sum total of 38,067 catheter days were obtained in the study period. From the month of September 2017 to August 2018. Among the study subjects, 76 patients developed clinical signs or symptoms of UTI after 2 calendar days from the time of insertion of indwelling urinary catheter. CAUTI rate was 1.9 per 1000 catheter days over a period of 1 year. Single significant pathogen with colony count of $\geq 10^5$ colony forming units (CFU) was obtained from each culture positive sample. From the month of September 2017 to August 2018, CAUTI rate per 1000 catheter days varies from 1.38–4.04. But in the month of Jan. 18 CAUTI rate increased to 4.04. All the parameters of CAUTI care bundle were strictly followed after January and CAUTI rate was gradually decreased in successive months.

Spectrum of causative agents of CAUTI is depicted in Table 1. Out of 76 total isolates 56 were Gram negative bacilli and 20 were Gram positive bacteria. Gram negative

bacteria included *Escherichia coli* 19(25%), followed by *Klebsiella* spp. 14(19%), *Proteus* spp. 8(11%) *Pseudomonas* spp. 6(8%), *Acinetobacter* spp. 4(8%). Among gram positive bacteria, *Enterococcus* spp. is 17(22%) followed by *Staphylococcus* spp. 3(4%). Enterobacteriaceae showed high resistant to commonly used antimicrobials like Gentamycin, Ceftriaxone, Ofloxacin, ciprofloxacin and were sensitive to Amikacin, ceftazidime, piperacillin tazobactam, imipenem, Meropenem.

In our study, both the *Pseudomonas* as well as *Acinetobacter* were multidrug resistant. They were resistant to commonly used antibiotics like Ciprofloxacin, Imipenem, Meropenem, Ceftazidime, Cefepime-sulbactam and Piperacillin-Tazobactam. *Pseudomonas* is highly sensitive colistin (83%) followed by Amikacin whereas *Acinetobacter* is maximally sensitive to colistin followed by Tigecyclin (75%).

Enterococcus and *Staphylococcus* were sensitive to Tigecyclin, Vancomycin, Teicoplanin and Linezolid.

Out of 76 CAUTI patients, 40 (52%) had developed CAUTI after 7 days of catheterization.

Fig. 1: Isolation rate of different microorganisms causing CA-UTI

5. Discussion

CAUTI is the common Hospital acquired infection (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.¹² Common signs and symptoms include fever, dysuria, rigors, lower back pain, suprapubic pain/tenderness.

The present study was carried out in a tertiary care hospital, Bhubaneswar, Odisha for a period of 1 year from September 2017 to August 2018. About 300 urine samples were collected from catheterized patients admitted to different ICUs of the hospital.

The present study reported incidence rate of CA-UTI is 25.33%. Bagchi et al. reported incidence rate of CAUTI to be 29.09%.¹⁴ The incidence rate of CAUTI ranged from as low as 5% to as high as 73% among catheterized patients.^{15,16}

In present study the CAUTI rate was 1.9 per 1000 catheter days which correlates with pooled mean CAUTI rate of 0 to 4 per 1000 catheter days of NHSN report.¹⁷ Duszyńska et al.¹⁸ 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. CAUTI rate of 9.6 per 1000 ICU days was found at Calgary by Laupland and colleagues.¹⁹

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.¹⁷

Present study revealed most frequent pathogen responsible for CAUTI is *Escherichia coli* 19(25%), followed by *Klebsiella* 14(19%), *Proteus* 8(11%) *Pseudomonas* 6(8%), *Acinetobacter* 4(8%). Among gram positive *Enterococcus* species is 17(22%) followed by *Staphylococcus* spp. 3(4%)

Patients were followed upto 11 days post catheterisation, and was found that 40(52.63%) patient developed CAUTI after 7 days of catheter insertion, which correlated with earlier studies by Kulkarni et al.²⁰ Bagchi et al.¹⁵. Duration of catheterization is strongly associated with CAUTI, hence proper maintenance and care of catheter is required to reduce the incidence of CAUTI. Among the uropathogens isolated from CAUTI Gram negative bacilli were predominant than Gram positive cocci. *Escherichia coli* was the most common organism 18 (34.61%) followed by *Klebsiella* spp. 11(21.15%), *Pseudomonas* spp. 9 (17.30%), *Proteus* 4 (7.69%). This finding was comparable to the studies conducted by Bagchi et al.¹⁵, Kazi et al.²⁰, Jayashri et al.²¹. *Staphylococcus aureus* and *Enterococci* were Gram positive organism isolated from CAUTI.

Enterobacteriaceae showed multidrug resistant, earlier studies^{12,15,16} also showed similar results. Higher resistant were found for fluoroquinolones which is the commonly used drug for urinary tract infection. *Pseudomonas* and *Proteus* species showed 100% sensitivity for imipenem, meropenem, ceftazidime, and ceftazidime - clavulanic acid, and piperacillin - tazobactam combination.

6. Conclusion

The most common organism responsible for CAUTI is *Escherichia coli* followed by *Klebsiella* spp. and *Enterococcus* spp. Members of enterobacteriaceae are highly sensitive to Amikacin, ceftazidime, piperacillin Tazobactam, Imipenem, Meropenem. *Enterococcus* and *Staphylococcus* are sensitive to Tigecyclin, Vancomycin, Teicoplanin and linezolid. Strict insertion and maintenance CAUTI care bundle reduces CAUTI rate.

Table 1: Monthwise Distribution of CAUTI rate

Month	No. of cauti	Total Catheter Days (TCD)	Cauti rate = CAUTI/TCD x1000
Sept.-17	04	2891	1.38
Oct.-17	05	2961	1.68
Nov.-17	05	2920	1.7
Dec.-17	07	3185	2.19
Jan.-18	13	3213	4.04
Feb.-18	05	2929	1.7
March-18	07	3657	1.9
April-18	02	3102	0.64
May-18	09	3646	2.4
June-18	07	3127	2.2
July-18	08	3279	2.4
August-18	04	3157	1.26
Total	76	38,067	1.99

Table 2: Antimicrobial Sensitivity Pattern Of members of Enterobacteriaceae

Antibiotics	E.coli oli	klebsiella	Proteus spp
Amikacin	90%	83%	78%
Gentamicin	89%	72%	78%
Ofloxacin	30%	72%	56%
Ciprofloxacin	28%	73%	56%
Amoxyclav	24%	17%	78%
Norflox	29%	62%	45%
Nitrofurantoin	91%	23%	11%
Levofloxacin	31%	75%	56%
Ceftriaxone	34%	60%	67%
Cefpodoxime	7%	27%	67%
Cefepime	27%	55%	67%
Cefadroxil	23%	43%	45%
Cefuroxime	28%	47%	67%
cotrimoxazole	51%	62	45%
	117(38%)	11(14.66%)	2(23%)

Table 3: Antimicrobial Susceptibility Pattern Of Non- Fermenters

Antibiotics	Pseudomonas	Acinetobacter
Amikacin	58%	10%
Gentamycin	45%	32%
Ciprofloxacin	38%	36%
Imipenem	37%	25%
Meropenem	37%	25%
Ceftazidime	30%	7%
Colistin	83%	86%
Cefoperazone-sulbactam	42%	39%
Piperacillin-tazobactam	33%	18%
Tigecyclin	2%	75%

Table 4: Antibiotic Sensitivity Pattern Of Gram Positive Cocci

Antibiotics	Enterococcus spp	Staphylococcus spp
Ciprofloxacin	10%	17%
Nitrofurantoin	56%	94%
Gentamycin	35%	62%
Levofloxacin	11%	22%
Linezolid	76%	85%
Penicillin	45%	2%
Tetracyclin	25%	82%
Teicoplanin	84%	88%
Tigecyclin	100%	100%
Vancomycin	77%	89%

The old age, prolonged catheterization, are the significant risk factors for CAUTI. Indwelling urethral catheters should be avoided whenever possible and should never be resorted to unless with absolute indications. Insertion of catheter should be done in strict asepsis by trained personnel. Closed catheter drainage system should be employed in all cases. The entire system should be replaced in an event where a break is present. The catheter should be inspected frequently to ensure that no obstruction in flow of urine. Emphasis should always be placed on good catheter management rather than the use of prophylaxis to reduce the incidence of CAUTI. Infection control programs in health care facilities must implement and monitor strategies to limit catheter-acquired urinary infection, including surveillance of catheter use, appropriateness of catheter indications, and complications. Prevention of infections attributable to these devices should be an important goal of healthcare associated control programme.

7. Source of Funding

None.

8. Conflict of Interest

None.

References

- Vincent J, Bihari DJ, Suter PM. The prevalence of nosocomial infection in intensive care units in Europe: Results of the European prevalence of infection in intensive care (EPIC) study. *JAMA*. 1995;274(8):639–44.
- Ding JG, Sun QF, Li KC. Retrospective analysis of nosocomial infections in the intensive care unit of a tertiary hospital in China during. *BMC Infect Dis*. 2003;9:115.
- López MJ, Cortés JA. Urinary tract colonization and infection in critically ill patients. *Med Intensiva*. 2012;36(2):143–51.
- Hooton TM, Bradley SF, Cardenas DD, Colgan R, Geerlings SE, Rice JC, et al. Diagnosis, Prevention, and Treatment of Catheter-Associated Urinary Tract Infection in Adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. *Clin Inf Dis*. 2010;50(5):625–63.
- Tambyah PA, Maki DG. Catheter-associated urinary tract infection is rarely symptomatic: a prospective study of 1,497 catheterized patients. *Arch Intern Med*. 2000;160:678–82.
- Stamm WE. Catheter-associated urinary tract infections: Epidemiology, pathogenesis, and prevention. *Am J Med*. 1991;91(3):S65–S71.
- Desforges JF, Stamm WE, Hooton TM. Management of Urinary Tract Infections in Adults. *N Engl J Med*. 1993;329(18):1328–34.
- Warren JW. Catheter-associated urinary tract infections. *Infect Dis Clin N Am*. 1997;11:609–22.
- Hartstein AI, Garber SB, Ward TT, Jones SR, Morthland VH. Nosocomial Urinary Tract Infection: A Prospective Evaluation of 108 Catheterized Patients. *Infect Control*. 1981;2(5):380–6.
- Gould CV, Umscheid CA, Agarwal RK, Kuntz G, and DAP. Guideline for Prevention of Catheter-Associated Urinary Tract Infections 2009. *Infect Control Hosp Epidemiol*. 2010;31(4):319–26.
- Lo E, Nicolle LE, Coffin SE, Gould C, Maragakis LL, Meddings J, et al. Strategies to Prevent Catheter-Associated Urinary Tract Infections in Acute Care Hospitals: 2014 Update. *Infect Control Hosp Epidemiol*. 2014;35(5):464–79.
- Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA. Healthcare Infection Control Practices Advisory Committee (HICPAC): guideline for prevention of catheter-associated urinary tract infections; 2009. Available from: http://www.cdc.gov/hicpac/cauti/011_cauti.html.
- Sobel JD, Kaye D. Mandell, Douglas and Bennett's principles and practice of infectious diseases. vol. 1. Philadelphia, USA; 2010. p. 958–72. Available from: http://www.cdc.gov/hicpac/cauti/011_cauti.html.
- Bagshaw SM, Laupland KB. Epidemiology of intensive care unit-acquired urinary tract infections. *Curr Opin Infect Dis*. 2006;19(1):67–71.
- Bagchi I, Jaitly NK, Thombare VR. Microbiological Evaluation of Catheter Associated Urinary Tract Infection in a Tertiary Care Hospital. *PJSR*. 2015;8:23–9.
- Danchavijitr S, Dhiraputra C, Cherdungsri R, Srihapol JD, N. Catheter-associated urinary tract infection. *J Med Assoc Thai*. 2007;88(10):S26–30.
- Inappropriate use of urinary catheters and its common complications in different hospital wards. *Saudi J Kidney Dis Transpl*. 2012;23(1):63–67.
- Desforges JF, Stamm WE, Hooton TM. Management of Urinary Tract Infections in Adults. *N Eng J Med*. 1993;329(18):1328–34.
- Laupland KB, Bagshaw SM, Gregson DB, Kirkpatrick AW, Ross T, Church DL. Intensive care unit-acquired urinary tract infections in a regional critical care system. *Crit Care*. 2005;9(2):R60–65.
- Kulkarni DSG, Talib DSH, Naik DM, Kale DA. Profile of Urinary Tract Infection in Indwelling Catheterized Patients. *IOSR J Dent Med Sci*. 2014;13:132–8.
- Kazi AMM, Harshe H, Sale. Dileep Mane, Minal Yande and Supriya Chabukswar, Catheter Associated Urinary Tract Infections (CAUTI) and Antibiotic Sensitivity Pattern from Confirmed Cases of CAUTI in a Tertiary Care Hospital: A Prospective Study. *Clin Microbiol*. 2015;4(2).

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