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:

- $1. \quad \mbox{To find the incidence of CAUTI in intensive care unit (ICU) patients.}$
- 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) report⁷ 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
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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
Enterobacteriacia	9		

Table 2: Antimicrobial susceptibility pattern of Enterobacteriaciae

Enterobacteriaciae				
Antimicrobial drug	Sensitive	Intermediately sensitive	Resistant	
Ampicillin	7	-	4	
Amikacin	9	-	2	
Amoxicillin/	7	4	-	
Clavulinic acid				
Ampicillin/	10	-	1	
Sulbactam				
Azreonam	5	3	1	
Cefepime	9	1	1	
Cefoperazone	5	2	4	
Cefotaxime	7	1	3	
Ceftazidime	5	4	2	
Ceftazidime/	11	-	-	
Clavulinic acid				
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/	9	2	-	
Tazobactam				
Ticarcillin/	5	3	3	
Clavulinic acid				

Antimicrobial susceptibility pattern of Enterobacteriaciae is depicted in Table 2. Among 11 Enterobacteriaciae family of isolates, namelv 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 nonfermenting bacteria

Antimicrobial susceptibility pattern of nonfermenting 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).

Ter menting bacter la				
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/	3	1	-	
Tazobactam				
Ticarcillin/	1	1	2	
Clavulinic acid				

 Table 3: Antimicrobial susceptibility pattern of nonfermenting bacteria

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 practices, control 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 al¹⁷ 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 Candida species (34%) at Singapore as evaluated by Tayet 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 Duszyńskaet 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 E¹⁹ 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.

References

- Vincent J, Bihari DJ, Suter PM, et al. 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 Aug;274(8):639–44.
- Ding J-G, Sun Q-F, Li K-C, et al. Retrospective analysis of nosocomial infections in the intensive care unit of a tertiary hospital in China during 2003 and 2007. BMC Infect Dis. 2009 Jul 25;9:115.
- López MJ, Cortés JA. Urinary tract colonization and infection in critically ill patients. Med Intensiva. 2012 Mar;36(2):143–51.
- 4. Mittal S, Sharma M, Chaudhary U. Biofilm and multidrug resistance in uropathogenic *Escherichia coli*. Pathog Glob Health. 2015;109(1):26–29.
- Bagshaw SM, Laupland KB. Epidemiology of intensive care unit-acquired urinary tract infections. Curr Opin Infect Dis. 2006 Feb;19(1):67–71.

- Gould CV, Umscheid CA, Aggarwal RK, Kuntz G, Pegues DA. Healthcare Infection Control Practices Advisory Committee. Guideline for prevention of catheterassociated urinary tract Infections. 2009.
- Dudeck MA, Edwards JR, Allen-Bridson K, et al. National Healthcare Safety Network report, data summary for 2013, Device-associated Module. American Journal of Infection Control. 2015 Mar;43(3):206–21.
- Murni IK, Duke T, Kinney S, Daley AJ, Soenarto Y. Reducing hospital-acquired infections and improving the rational use of antibiotics in a developing country: an effectiveness study. Arch Dis Child. 2015 May;100(5):454–9.
- Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA. Guideline for Prevention of Catheter-Associated Urinary Tract Infections 2009. Infection Control & Hospital Epidemiology. 2010 Apr:31(04):319–26.
- Sobel JD, Kaye D. Urinary tract infections. In: Mandell GL, Bennett JE, Dolin R, editors. Mandell, Douglas and Bennett's principles and practice of infectious diseases. 7th ed. Vol. 1. Philadelphia, USA: Churchill Livingstone Elsevier publication; 2010. 958-72.
- Collee JG, Duguid JP, Fraser AG, Marmion BP, Simmons A. Laboratory strategy in the diagnosis of infective syndromes. In: Collee JG, Fraser AG, Marmion BP and Simmons A, editors. Mackey and McCartney Practical Medical Microbiology. 14thed. Churchill Livingstone, Elsevier;2006. 53-94.
- Vandepitte J, Engbaek K, Piot P, Heuck cc. Basic Laboratory Procedures for Clinical Bacteriology. Geneva, Switzerland: World Health Organization, Genevia;1991.
- Isenberg HD. Essential Procedures for Clinical Microbiology. Washington DC: American Society for Microbiology press; 1998.
- Forbes BA, Sahm DF, Weissfeld AS. Bailey and Scott's Diagnostic Microbiology. 12th ed. Philadelphia; Mosby Elsevier; 2007.
- Clinical and Laboratory Standards Institute (CLSI). Performance standards for antimicrobial susceptibility testing, 25th informational supplement M100-S25. Wayne, PA, USA: CLSI; 2015.
- Duszyńska W, Rosenthal VD, Szczęsny A, et al. Urinary tract infections in intensive care unit patients - a singlecentre, 3-year observational study according to the INICC project. Anaesthesiol Intensive Ther. 2016;48(1):1–6.
- 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):R60–5.
- Tay MKX, Lee JYC, Wee IYJ, Oh HML. Evaluation of intensive care unit-acquired urinary tract infections in Singapore. Ann Acad Med Singap. 2010 Jun;39(6):460–5.
- Spadafino JT, Cohen B, Liu J, Larson E. Temporal trends and risk factors for extended-spectrum beta-lactamaseproducing Escherichia coli in adults with catheterassociated urinary tract infections. Antimicrob Resist Infect Control. 2014;3(1):39.

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