Catheter associated urinary tract infection in an acute care setting of a tertiary care centre in South India

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ABSTRACT

Background: Catheter associated UTI is a serious cause of morbidity and mortality in intensive care unit (ICU) patients. Hence, authors undertook the present study to know the prevalence of catheter associated urinary tract infections (CAUTI) in medical ICU patients of tertiary care centre and to know the antibiotic resistance pattern of the causative organisms.

Methods: A one-year prospective study was carried out from September 2015 to August 2016. Demographic data from the catheterized patients were collected daily and scrutinized for the signs and symptoms as per CDC criteria for confirmation as CAUTI. Relevant antimicrobial resistance data of etiologic agents were also collected to ascertain the prevalent resistance pattern.

Results: The overall incidence of CAUTI was 14.69 per 1000 catheterized days in the present study. Out of the 37 diagnosed CAUTI cases, 12 (32.4%) were males and 25 (67.6%) were females with maximum patients being between 40 to 60 years of age. The commonest uropathogens was Escherichia coli (n=26) followed by K. pneumoniae (n=5). Both Escherichia coli and Klebsiella pneumoniae isolates were found to be 100% resistant to cefotaxime, ceftazidime and cefuroxime. Pseudomonas aeruginosa and Acinetobacter species were least common etiological culprits and demonstrated complete resistance to all the tested antibiotics.

Conclusions: In the present study the prevalence of CAUTI is much higher which needs to be rectified by continuous monitoring and training of the staff in implementation of infection control practices in a proactive manner.

Keywords: Antimicrobial resistance, CAUTI, Escherichia coli

INTRODUCTION

Catheter associated urinary tract infections (CAUTI) are the most frequent nosocomial infections with the daily risk of developing CAUTI being 3-7% in the acute care settings.1 It constitutes for over 30% of all device-associated, healthcare-associated infections and 23% of hospital-acquired infections (HAI) in intensive care units (ICU).2 Apart from increasing hospital stay and cost, CAUTI is associated with increased morbidity and mortality.3,4 More importantly, these patients become reservoir of multidrug resistant organisms that can result in more serious HAI.5

To lower down the incidence of CAUTI, many scientific societies, like CDC, Centre for Disease Control and Prevention (CDCP), Society of Healthcare Epidemiology of America (SHEA), etc have outlined appropriate
preventive recommendations. All health care personals should abide by these policies to reduce the incidence of CAUTI, thus contributing to the improved safety of patients and lower the costs of treatment.

With this background, authors undertook this study to provide an insight regarding the prevalence of CAUTI and its etiologic agents in ICU patients in a tertiary care institute. This study will serve as a guide to the clinicians in the selection of appropriate antimicrobial agents for prophylaxis and empiric therapy of CAUTI. It will also provide a scope for determining any non-compliance with the preventive recommendations and also improvising the infection control policy of the hospital.

METHODS

A one-year (September 2015 to August 2016) prospective study was performed in the 16-bedded medical ICU of Maharaja institute of medical sciences, Nellimarla, Vizianagaram, Andhra Pradesh. All patients with indwelling urinary catheters hospitalised for longer than 48 hours were included in the study. Patients with symptoms of urinary tract infections prior to catheterization were excluded. Data was collected daily, as per a standard proforma, at the same time of each day. The diagnosis of CAUTI was done as per the CDC guidelines. Prior to catheter change or removal from each patient, 10 ml of urine was obtained from the distal edge of the catheter tube (after cleaning with an antiseptic) using a sterile needle and syringe. The sample was carefully dispensed into a sterile container and transported to the microbiology laboratory for analysis. Urine microscopy was performed on uncentrifuged catheter urine specimen to detect the presence of leukocytes, erythrocytes and other cells. The unspun urine was also subjected to Gram stain. With the calibrated loop, urine was cultured on blood agar media for quantitative analysis to assess the microbial counts. MacConkey agar media was also plated and incubated aerobically at 37°C for 24-48 hours.

A urine culture was considered positive with more than or equal to 10³ organisms/ml of urine, with no more than two species of micro-organisms. Bacteria were identified according to conventional biochemical techniques. Antibiotic sensitivity was done by the Kirby Bauer disc diffusion test as recommended by CLSI guidelines. All data were tabulated and analysed using Microsoft Excel 2010. Catheter utilization rate was calculated by dividing the total number of device days by the total number of patient days. Rate of CAUTI per 1000 device days were calculated by dividing the total number of CAUTIs by the total number of catheter days and multiplying the result by 1000. One-tailed Fischer’s Exact test was used for computing the p-value. A p-value <0.05 was considered as statistically significant.

RESULTS

During the study period of 1 year, a total of 337 patients were catheterized in the institute’s medical ICU for an aggregate of 3321 patient days. The catheter utilization rate was 0.75. Table 1 depicts month-wise data regarding patient days, urinary catheter days, number of CAUTI cases and prevalence of CAUTI per 1000 catheter days.

The overall CAUTI rate was 14.69%. Out of the 37 diagnosed CAUTI cases, 12 (32.4%) were males and 25 (67.6%) were females and this difference was statistically significant (p=0.0235). Maximum patients were between 40 to 60 years of age followed by more than 60 years age group. Least number of patients were between the age

| Month     | Patient days | Urinary catheter days | Number of cases of CAUTI | Prevalence of CAUTI per 1000 catheter days |
|-----------|--------------|-----------------------|--------------------------|-------------------------------------------|
| September | 248          | 202                   | 4                        | 19.8                                      |
| October   | 256          | 194                   | 3                        | 15.46                                     |
| November  | 291          | 212                   | 3                        | 14.15                                     |
| December  | 302          | 215                   | 4                        | 18.6                                      |
| January   | 270          | 208                   | 3                        | 14.42                                     |
| February  | 269          | 193                   | 2                        | 10.36                                     |
| March     | 305          | 218                   | 2                        | 9.17                                      |
| April     | 327          | 245                   | 4                        | 16.32                                     |
| May       | 235          | 192                   | 3                        | 15.62                                     |
| June      | 274          | 213                   | 3                        | 14.08                                     |
| July      | 307          | 221                   | 4                        | 18.1                                      |
| August    | 231          | 196                   | 2                        | 10.2                                      |
| Total     | 3321         | 2509                  | 37                       | 14.69                                     |
group of 18-39 years (Table 2). The uropathogens isolated in this study and their antibiotic resistance pattern is outlined in Table 3 and 4. The commonest causative uropathogens of CAUTI in the study was found to be *Escherichia coli* (n=26) and this association was found to be statistically significant (p = 0.010). The second commonest etiology was found to be *Klebsiella pneumoniae* (n=5) followed by *Enterococcus* species (n=4), *Klebsiella oxytoca* (n=3). Least common organism was found to be *Pseudomonas aeruginosa* and *Acinetobacter* species.

In the present study, *Escherichia coli* isolates were found to be 100% resistant to cefotaxime, ceftazidime, amoxycillin-clavulanic acid and cefuroxime followed by ofloxacin (92%), cotrimoxazole (61%), gentamicin (46%), nitrofurantoin and amikacin (38%), imipenem (38%) and meropenem (23%). *Klebsiella pneumoniae* isolates were found to be 100% resistant to cefotaxime, ceftazidime, cefuroxime and amoxyclav followed by cotrimoxazole and ofloxacin (80%), gentamicin (60%), amikacin (40%) and nitrofurantoin, amikacin and meropenem (20%). *Klebsiella oxytoca* isolates were found to be 100% resistant to cefotaxime, ofloxacin, amoxiclav. The isolates were found to be 100% sensitive to nitrofurantoin. *Pseudomonas aeruginosa* was found to be 100% resistant to cefotaxime, ceftazidime, piperacillin and aztreonam while the isolate was found to be sensitive to imipenem, meropenem, amikacin, ofloxacin, piperacillin tazobactam and ceceplime. *Enterococcus spp.* were found to be 100% resistant to tetracyclines and high-level gentamicin while found to be 100% sensitive to vancomycin and linezolid.

### Table 2: Gender distribution of CAUTI patients.

| Age (years) | Male | Female |
|-------------|------|--------|
| 18-40       | 2    | 5      |
| 40-60       | 5    | 12     |
| > 60        | 5    | 8      |
| Total       | 12   | 25     |

### Table 3: Uropathogens related to CAUTI.

| Uropathogen                  | Numbers |
|------------------------------|---------|
| *Escherichia coli*           | 26      |
| *Klebsiella pneumoniae*      | 5       |
| *Klebsiella oxytoca*         | 3       |
| *Pseudomonas aeruginosa*     | 1       |
| *Acinetobacter baumannii*    | 1       |
| *Enterococcus species*       | 4       |

### Table 4: Antibiotic resistance pattern of uropathogens related to CAUTI.

| Name of uropathogens | Resistance pattern (%) |
|----------------------|------------------------|
|                      | Nitrofurantoin | Imipenem | Meropenem | Amoxiclav | Ofloxacin | Cefotaxime | Ceftazidime | Cefuroxime | Gentamicin | High level gentamicin (120 µg) | Cotrimoxazole | Tetracycline | Vancomycin | Linezolid | Piperacillin | Tazobactam | Ceceplime | Aztreonam |
| E. coli              | 0            | 20        | 38        | 30        | 23        | 38        | 38         | 92        | 60        | 46         | 60           | NT          | NT          | NT         | NT       | NT         | NT          | NT        | NT        |
| K. pneumoniae        | 20           | 20        | 30        | 66        | 40        | 38        | 38         | 92        | 60        | 46         | 60           | NT          | NT          | NT         | NT       | NT         | NT          | NT        | NT        |
| K. oxytoca           | 66           | 33        | 33        | 100       | 100       | 100       | 100        | 100       | 100       | 100        | 100           | NT          | NT          | NT         | NT       | NT         | NT          | NT        | NT        |
| P. aeruginosa        | 0            | 0         | 0         | 33        | 100       | 0         | 100        | 100       | 100       | 100        | 100           | NT          | NT          | NT         | NT       | NT         | NT          | NT        | NT        |
| A. baumannii         | 100          | 100       | 100       | 100       | 100       | 100       | 100        | 100       | 100       | 100        | 100           | NT          | NT          | NT         | NT       | NT         | NT          | NT        | NT        |
| Enterococcus spp.    | NT           | NT        | NT        | NT        | NT        | NT        | NT         | NT        | NT        | NT         | NT           | NT          | NT          | NT         | NT       | NT         | NT          | NT        | NT        |

### DISCUSSION

In the present study, prevalence of CAUTI per 1000 device days was 14.69, which is quite higher than those
reported by National Healthcare Safety Network (NHSN) system. Another study from South India have also reported similar high CAUTI prevalence rate of 13.63%. International Nosocomial Infection Control Consortium (INICC) had reported CAUTI rate of 7.1 in 422 ICUs of 36 developing countries from January 2004 to December 2009. Rosenthal et al, and Leblebicioglu et al, have stated that the difference in rate of nosocomial infections may be observed in developed and developing countries, due to better hygiene practices among health personals.

One of the host factors that predisposes to catheter associated UTI is advanced age and this study validated the same. More than 80% of patients in this study were above the age of 40 years. Females were also predominantly affected in this study in accordance to the general dictum. Taiwo and Aderounmu reported males to be more affected. Few Indian authors have also observed male predominance in their study cohort.

The present study has shown Escherichia coli as the most frequently isolated uropathogen, similar to the findings of Sangamithra et al, Vinoth et al, and Kakaria et al. The NHSN data also shows Escherichia coli as the major culpable pathogen, accounting for 70% of the total isolates. Laupland et al, also demonstrated Escherichia coli as the most common etiological agent of CAUTI. Escherichia coli has the capacity to adapt and survive in urinary tract by producing several virulence factors and hence are the frequent culprits. Klebsiella species was the second most common pathogen in this study cohort. Vinoth et al, Karina et al, and Kazi et al, also noted a similar pattern. Enterococcus species (4/37, 10.8%) was the only Gram-positive uropathogens isolated from CAUTI cases in this study. Chawla et al, found Acinetobacter species as the most common causative organism of CAUTI in their patients. In this study, however, Acinetobacter baumanii was isolated from a single case only. Other authors have found Candida species as one of the most frequently isolated organisms from CAUTI cases but according to CDC NHSN definition of UTI, Candida and other yeasts are excluded.

Antimicrobial resistance amongst the uropathogens is an ever-increasing problem, especially in ICU setting. In the current study, multidrug resistance was observed in all isolates. This is in accordance to other studies wherein a high degree of resistance was noted in all the isolates. Authors found Escherichia coli isolates to be sensitive to meropenem followed by imipenem and nitrofurantoin. The two species of Klebsiella were found to have similar resistance pattern and were found to be more resistant than Escherichia coli isolates. Klebsiella pneumonia exhibited a high degree of resistance to all antimicrobials except imipenem, meropenem and nitrofurantoin to which most of it was susceptible. Enterococcus isolates were found to be highly sensitive to vancomycin and linezolid while were resistant to amoxycyll, tetracycline and ofloxacin. Pseudomonas aeruginosa and Acinetobacter baumanii isolate showed resistance to all the drugs tested.

CONCLUSION

Hospital acquired uropathogens have increased antibiotic resistance and thus are difficult to treat. The chances of transmission of these multidrug resistant organisms are high if health care workers do not follow preventive practices meticulously. In the present study the prevalence of CAUTI is much higher because of lack of continuous monitoring and training of the staff particularly in ICU setups where morbidity ill patients get admitted. Active Infection control team, an efficient institutional infection control surveillance policy for non-compliances, strict adherence to preventive bundle practices and constant monitoring will bring down the prevalence rate of CAUTI. The most common practices shall include hand hygiene, close drainage, aseptic insertion and catheter care along with daily need assessment. This study showed high resistance in all uropathogens which is a concern for all. Empiric treatment with antibiotics should be in accordance to prescribed national guidelines as far as possible so that there will be a decrease in emergence of multidrug resistant uropathogens particularly in hospital setups. This study provides a scope for similar studies to be undertaken in this institute taking larger sample size so that a clearer picture can be obtained regarding the true prevalence of CAUTI.

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REFERENCES

1. Lo E, Nicolle L, Classen D, Arias KM, Podgorny K, Anderson DJ, et al. Strategies to prevent catheter associated urinary tract infections in acute care hospitals. Infect Control Hosp Epidemiol. 2008;29(Suppl 1):S41-50.
2. Nicolle LE. Urinary catheter associated infections. Infect Dis Clin North Am. 2012;26(1):13-27.
3. Wald HL, Kramer AM. Nonpayment for harms resulting from medical care. JAMA. 2007;298(23):2782-4.
4. Klevens RM, Edwards JR, Richards Jr CL, Horan TC, Gaynes RP, Pollock DA, et al. Estimating health care-associated infections and deaths in US hospitals, 2002. Pub Health Rep. 2007;122(2):160-6.
5. Tambyah P, Kaminski MV, Maki D. The direct costs of nosocomial catheter associated urinary tract infections in the era of managed care. Infect Control Hosp Epidemiol. 2002 Jan;23(1):27-31.
6. 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. Infection Cont Hosp Epid. 2014 May;35(5):464-79.
7. Gould CV, Umscheid CA, Agarwal RK, Kuntz G, Pegues DA. Healthcare Infection Control Practices Advisory Committee. Guideline for prevention of catheter-associated urinary tract infections 2009. Infect Control Hosp Epidemiol. 2010;31(4):319-26.
8. Centres for Disease Control and Prevention. Protocol for reporting Catheter-associated urinary tract infections to the National Healthcare Safety Network. Available at: http://www.cdc.gov/hai/pdfs/INHSN/7pscAUTISAMPLE.pdf. Accessed on January 2014.
9. Kunin CM, McCormack RC. Prevention of catheter-induced urinary tract infection by sterile closed drainage. N Engl J Med. 1996;274(21):1155-62.
10. Mehta A, Rosenthal VD, Mehta Y, Chakravarthy M, Todi SK, Sen N, et al. Device-associated nosocomial infection rates in intensive care units of seven Indian cities: Findings of the International Nosocomial Infection Control Consortium (INICC). J Hosp Infect. 2007;67(2):168-74.
11. Meite S, Boni-Cissé C, Guéi MC, Houédanou C, Fayé-Keté H. Assessment of the infected risk in clinical laboratory: Example of Bacteriology-Virology Laboratory of the University Hospital of Yopougon. Revue Bioafrica; 2007. Available at: http://www.revuebioafrica.net/files/bioafrica%20n%20C2%20B04,%202007/http//www.revuebioafrica.net/files/bioafrica%20n%20C2%20B04.
12. Clinical and Laboratory Standards Institute Performance Standards for Antimicrobial Susceptibility Testing, 25th Informational Supplement. M100-S 25;2015.
13. Dudeck MA, Weiner LM, Allen-Brudison K, Malpiedi PJ, Peterson KD, Pollock DA. National Health Safety Network (NHSN) report. Data summary for 2012, Device-associated module. Am J Infect Control. 2013;41(12):1148-66.
14. Deepashree R, Raghavan R, Sastry AS. Implementation of active surveillance system to track hospital-acquired infections in a tertiary care hospital in India. J Curr Res Sci Med. 2017;3(1):21-8.
15. Rosenthal VD, Bijie H, Maki DG, Mehta Y, Apisarnthanarake A, Medeiros EA. International Nosocomial Infection Control Consortium (INICC) report, data summary of 36 countries, for 2004-2009. Am J Infect Control. 2012;40(5):396-407.
16. Leblebicigilou H, Rosenthal VD, Mehta Y, Arkian OA, Yalcin AN, Koksal I. Device-associated hospital acquired infection rates in a Turkish intensive care units. Findings of the International Nosocomial Infection Control Consortium (INICC). J Infect Hosp. 2007;65(3):251-7.
17. Taiwo SS, Aderounmu OA. Catheter associated urinary tract infection: aetiology agents and antimicrobial susceptibility pattern in Ladoke Akintola University Teaching Hospital, Osogbo, Nigeria. African J Biomed Res. 2006;9(3):141-8.
18. Sangamithra VS, Manonmoney PS. Incidence of catheter associated urinary tract infection in medical ICU in a tertiary care hospital. Int J Curr Microbiol App Sci. 2017;6(4):662-9.
19. Vinoth M, Prabagaravathanan R, Bhaskar M. Prevalence of microorganisms causing catheter associated urinary tract infections (CAUTI) among catheterised patients admitted in a tertiary care hospital. Int J Res Med Sci. 2017;5(6):2367-72.
20. Kakaria BA, K Ashish, Raghuvanshi T. Study of incidence and risk factors of urinary tract infection in catheterised patients admitted at tertiary care. Int J Res Med Sci. 2018;6(5):1730-3.
21. 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. J Critical Care. 2005;9(2):60-5.
22. Karina BD, Myra MT, Tessa TT. Catheter related Urinary tract infections: Incidence, risk factors and microbiologic profile. Phil J Microbiol Infect Dis. 1999;28:133-8.
23. Kazi MM, Harshe A, Sale H, Mane D, Yande M, Chabukswar S. 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):100193.
24. Chawla K, Madan A, Chawla RK, Chawla AK. Healthcare associated infections: A menace-role of management at a multi-super-specially hospital in North West Region of Delhi. J Nat Accred Board Hosp Healthcare Providers. 2014;1(2):44-51.
25. Tigen ET, Dogru A, Koltka EN, Unlu C, Gura M. Device-associated nosocomial infection rates and distribution of antimicrobial resistance in a medical-surgical intensive care unit in Turkey. Jpn J Infect Dis. 2014;67(1):5-8.
26. Inan A, Ozgultekin A, Akay SS, Engin DO, Turan G, Ceran N. Alternations in bacterial spectrum and increasing resistance rates in isolated microorganisms from device-associated infections in an intensive care unit of a teaching hospital in Istanbul (2004-2010). Jpn J Infect Dis. 2014;67(1):5-8.
27. Yadav S, Goel S, Yadav AK. Increase in catheter associated urinary tract infections in intensive care units at a tertiary care centre: A cause of concern. Int J Biomed Res. 2015;6(10):815-8.
28. Rosenthal VD, Bijie H, Maki DG, Mehta Y, Apisarnthanarake A, Medeiros EA. International Nosocomial Infection Control Consortium (INICC) report, data summary of 36 countries, for 2004-2009. Am J Infect Control. 2012;40(5):396-407.