JIDC | THE JOURNAL OF INFECTION IN DEVELOPING COUNTRIES

Brief Original Article

Asymptomatic bacteriuria persisting after catheter removal: are we missing the true catheter associated urinary tract infection burden?

Simran[1], Ujjwala Gaikwad[2], Sabah Siddhiqui[1]

[1] Department of General Medicine, All India Institute of Medical Sciences, Tatibandh, Raipur, Chhattisgarh, India
[2] Department of Microbiology, All India Institute of Medical Sciences, Tatibandh, Raipur, Chhattisgarh, India

Abstract

Introduction: Catheter Associated Asymptomatic Bacteriuria persisting beyond 48 hours after catheter removal predisposes to the development of catheter associated urinary tract infections, necessitating treatment. Current surveillance strategies do not screen for infection detection after catheter removal, missing most of the clinically significant catheter associated urinary tract infection cases.

Methodology: The study reports findings of a pilot, short-term, cross-sectional study conducted on patients who underwent indwelling urinary catheterization for any of the recognized indications. Surveillance for catheter associated urinary tract infections was done as per Centre for Disease Control and Prevention, National health and safety network protocols starting from two days onwards until the entire period of catheterization. Patients who remained asymptomatic during the period of catheterization were further screened for catheter associated asymptomatic bacteriuria at 48 hours after catheter removal and followed up for development of signs and symptoms suggestive of urinary tract infections. Catheter associated urinary tract infection rates were calculated with and without inclusion of catheter associated asymptomatic bacteriuria and compared.

Results: Screening for catheter associated asymptomatic bacteriuria at 48 hours of catheter removal significantly (p = 0.00021) improved the catheter associated urinary tract infection rates from 2.67 to 8.01 per 1,000 catheter days. Approximately 75% of patients with catheter associated asymptomatic bacteriuria after catheter removal became symptomatic for UTIs on follow-up.

Conclusions: Diagnosing catheter associated asymptomatic bacteriuria at 48 hours after catheter removal can improve the surveillance process and identify impending urinary tract infections early in the course of the disease.

Key words: Asymptomatic bacteriuria; catheter-associated infections; urinary tract infection; surveillance.

J Infect Dev Ctries 2022; 16(5):897-901. doi:10.3855/jidc.14603

(Received 31 December 2020 – Accepted 06 July 2021)

Introduction

Catheter-associated urinary tract infection (CAUTI) is one of the most commonly reported health-care-associated infections, particularly in intensive care units (ICUs) [1]. A urinary catheter is placed in up to 25% of patients at some point during their hospital stay [2]. CAUTI occurs at a rate of 3%-10% per day of catheterization [3,4]. In 2-4 percent of cases, the infection is followed by bacteremia, and in a few cases, septic shock and death [5].

Traditionally CAUTI is diagnosed based on the presence of both clinical parameters pertaining to infection and microbiological evidence. For example, CAUTI is diagnosed when patients with signs and symptoms compatible with urinary tract infection (UTI) without any other identified source, show bacteriuria of $\geq 10^3$ CFU/mL by ≤ 2 bacterial species, in a catheter urine specimen or in a midstream voided urine specimen from a patient whose catheter has been removed within the previous 48 hours [6].

Catheter-associated asymptomatic bacteriuria (CA-ASB), defined as the presence of less than or equal to two bacterial species in 10^5 CFU/ml counts from a catheterized patient urine specimen without any sign or symptom suggestive of UTI, does not necessitate treatment. CA-ASB is nearly 100 percent prevalent in long-term catheterized patients and is frequently caused by antibiotic-resistant hospital bacterial strains [7]. Screening and treatment for CA-ASB during catheterization is not recommended, except in pregnant women and patients undergoing urological surgery [8]. However, evidence suggests that if CA-ASB persists for more than 48 hours after catheter removal, it may be a sign of impending CAUTI and should be treated [6]. Most hospital settings do not screen for CA-ASB after catheter removal, resulting in underreporting of UTIs. This causes complications and raises the patient's treatment costs. It also makes CAUTI surveillance more difficult because exact figures are lost.

Considering the above - mentioned complication and the scarcity of available literature on this topic, the purpose of this study is to determine the occurrence of clinically significant CA-ASB in previously catheterized patients at 48 hours after catheter removal, as well as its role in determining the actual CAUTI burden, in order to improve diagnostic and surveillance protocols.

Methodology

The study reports the findings of a pilot, short-term, cross-sectional two-month study of conducted on patients admitted to intensive care unit and Medical wards at All India Institute of Medical Sciences, Raipur, Chhattisgarh, India, which is a tertiary care level hospital. Approval of Institutional Ethics Committee was taken prior to the study. The hospital has a functional hospital infection control programme, and the infection control team uses Centre for Disease Control and Prevention (CDC) National Health and Safety Network (NHSN) protocols to conduct regular surveillance of major health care associated infections (HAIs), including CAUTI [9]. The study was taken up as a small extension of the routine surveillance activity aimed at improving CAUTI detection rate for diagnostic and surveillance purposes.

The study included patients over the age of 14 who received short-term or long-term indwelling urinary catheterization for any of the recognized indications, with a minimum catheterization duration of 2 days. They were monitored for the duration of the catheterization and even after the catheter was removed for 48 hours. Those who expired during the study or were discharged orreferred to another hospital, as well as patients wholeft against medical advice with a catheter in place or soon after catheter removal were not included. The patients were screened for the presence of symptomatic bacteriuria, which was not secondary to or related to any other infective condition, from two days onward until the entire period of catheterization. Urine samples collected aseptically from the catheter of symptomatic patients [1] were cultured to identify catheter-associated significant bacteriuria (growth of ≤ 2 types of organisms with count of ≥ 10^3 CFU/mL; henceforth referred as CA-SB). Asymptomatic catheterized patients were also analyzed for microbiological evidence of asymptomatic bacteremic CAUTI (ABUTI) from the available laboratory reports. Patients in whom catheter was removed while they were still hospitalized were further observed for development of symptoms like dysuria, urgency or frequency of urination. Clean, voided, mid-stream urine samples were collected from such patients, irrespective of the presence or absence of symptoms at 48 hours after catheter removal and sent for bacterial culture to determine CA-ASB (growth of ≤ 2 types of organisms with count of ≥ 10^5 CFU/mL). The organisms were identified and tested for antibiotic susceptibility testing according to standard protocols. To describe briefly, the urine samples were cultured semi quantitatively on cysteine lactose electrolyte deficient (CLED) medium with a standard loop technique [10]. The plates were incubated at 37 °C overnight and read on the next day. The colonies grown were counted for determination of significant count and processed further for bacterial/yeast identification using standard biochemical tests. The colonies of one or two types of organisms with count of ≥ 10^5 CFU/mL in a voided urine sample and count of ≥ 10^3 CFU/mL in the catheterized sample was considered as a significant count. The identified organisms were tested for antibiotic susceptibility testing according to CLSI guidelines [11]. After the sample was cultured, microscopic examination of wet films of uncentrifuged urine was performed to detect pyuria. Presence of ≥ 5 Pus cells/High power field was considered as significant pyuria.

Number of patients identified as having CA-SB and CA-ASB (as mentioned above) from four different patient locations were calculated along with the data on 'Patient days' and 'Catheter days' from each location. The CAUTI rates with and without the inclusion of CA-ASB were calculated as described below and compared. The statistical significance was analyzed using chi square test with p value of < 0.05.

$$CAUTI\ rate\ without\ inclusion\ of\ CA-ASB = \frac{Total\ number\ of\ CAUTI(CA-ASB)}{Total\ number\ of\ Catheter\ days \times 1{,}000} \quad (1)$$

$$CAUTI\ rate\ after\ inclusion\ of\ CA-ASB = \frac{Total\ number\ of\ CAUTI(No.of CA-SB+clinically\ significant\ CA-ASB)}{Total\ number\ of\ Catheter\ days \times 1{,}000} \quad (2)$$

The patients with CA-ASB were further followed up until 15 days of catheter removal for the development of symptoms suggestive of UTI. The patients who were discharged from the hospital were contacted telephonically and in follow-up visits for history suggestive of UTI.

Results

A total of 92 patients underwent indwelling urinary catheterization during the study period, of which only 21 patients were followed up for the entire duration of catheterization till 48 hours after catheter removal. Most of the catheterized patients (38.04%) were elderly (> 60 years), however, the median age of patients

undergoing catheterization was 48 years (SD ± 17.75). The number of male patients undergoing catheterization was higher (55.43%) than females (44.57%) (p = 0.477). The average duration of catheterization in all patients was 9.65 days (SD ± 4.71). Among the cohort of 21 patients who could be followed up, three patients developed symptoms (fever and hypotension, without any other identifiable cause) while catheter was *in situ*, and two out of which were confirmed as CA-SB. Remaining 18 patients who continued to be asymptomatic during the entire duration of catheterization till 48 hours after catheter removal revealed significant bacteriuria (CA-ASB) associated with pyuria in four patients. These patients showed pathogens like *Escherichia coli* (n = 2), *Enterococcus faecalis* (n = 1) and *Acinetobacter baumannii* along with *E. coli* (n = 1) in significant counts in urine culture. The isolates of *Escherichia coli* (sensitive only to carbapenems) and *Enterococcus faecalis* (sensitive only to vancomycin and linezolid) were multidrug resistant, while Acinetobacter was sensitive to most of the antibiotics tested.

On comparison of CAUTI rates in four patient locations (Table 1), maximum CAUTI incidences were reported from general medicine wards (ward 2 and 1) where device utilization ratio (DUR) was at the least. Interestingly, all the four cases of CAUTI diagnosed from these locations were cases of CA-ASB persisting beyond 48 hours. While locations where more critical patients, with higher device utilization were hospitalized (i.e. Medicine ICU and Trauma Emergency ward) had incidences of CA-SB only (n = 2).

Considering the standard method of CAUTI rate calculation (including only CA-SB), the overall CAUTI rates can be derived as 2.67 per 1,000 catheter days. However, after including CA-ASB cases in the surveillance data, the overall rate was increased to 8.01 per 1,000 catheter days. The difference obtained in the rates was statistically significant (p = 0.00021).

Discussion

Screening for CA-ASB that persists at any time after 48 hours from catheter removal is recommended but not widely practised, and is not well documented in the literature. The present study clearly demonstrated an increase in the CAUTI rate if CA-ASB persisting after catheter removal is included in the surveillance. The CAUTI rate of 2.67 per 1,000 days, reported in our study, owing to CA-SB only is equivalent or slightly higher than the CAUTI rates reported by other Indian studies[12,13] as well as that of the CDC/NHSN benchmark rate of 2.09 per 1,000 catheter days, and much lower than the INICC (International Nosocomial Infection Control Consortium) rate of 6.5 per 1,000 days [12]. However, the rate of 8.01 per 1,000 catheter days obtained after including CA-ASB in the current study was significantly (p = 0.05) higher than the rates obtained and reported by all the preceding studies. This finding was not surprising given that none of the surveillance methods used in other countries screen for CA-ASB after catheter removal. In the ICUs of seven INICC-member hospitals in seven Indian cities [14], the overall infection rate for CAUTI was 1.41 per 1,000 catheter days, which is significantly lower than our study. Patients diagnosed with CA-ASB in our study were located in general wards, had an average duration of catheterization of 9.5 days (SD ± 4.8), and did not have serious illness. In contrast, both CA-SB patients were located in acute care and emergency settings and were moribund, with an average catheterization duration of 15 days (SD ± 1.41). The occurrence of significant bacteriuria in asymptomatic patients in the absence of significant risk factors such as increased catheterization duration, preexisting serious co-morbid conditions, and ICU stay raises the question of whether they should be labelled as having true infection. During

Table 1. Distribution of CAUTI cases and calculated rates.

Location	Month	Catheter days	DUR	CA-SB cases	CA-ASB cases	Total CAUTI cases	*CAUTI Rate without CA-ASB	*CAUTI Rate with CA-ASB
Medicine ICU	July	117	0.92	0	0	0	0	0
	August	93	0.70	1	0	1	10.75	10.75
Trauma and Emergency ward	July	175	0.47	0	0	0	0	0
	August	137	0.34	1	0	1	7.29	7.29
Medicine ward 1	July	47	0.09	0	1	1	0	21.27
	August	83	0.11	0	0	0	0	0
Medicine ward 2	July	45	0.08	0	1	1	0	22.22
	August	52	0.08	0	2	2	0	38.46
TOTAL		749	0.21	2	4	6	2.67	8.01

* CAUTI Rates were expressed per 1000 catheter days. DUR = Device utilization ratio.

their follow-up, however, three patients out of four (75%) who had significant bacteriuria developed clinically significant UTI, necessitating medical attention. They were successfully treated with the antimicrobials. Harding *et al*. (1991) [15], in a prospective, randomized, placebo-controlled trial of antimicrobial treatment for CA-ASB persisting at 48 hours after short-term catheter removal in hospitalized women, concluded that asymptomatic bacteriuria after short-term catheter use frequently becomes symptomatic and should be treated. The study reported significantly improved microbiologic and clinical outcomes at 14 days in treated women. Based on this observation, in our study we followed up the CA-ASB patients for 14 days after catheter removal. However, more studies with larger cohort of male as well as female patients are needed to prove or disprove the association of CA-ASB with the development of clinical signs and symptoms on follow-up.

Another factor that may have led to such patients being labelled as "asymptomatic" during and after catheter removal despite having significant bacteriuria is the nonspecific nature of common UTI symptoms, such as fever, which can be easily attributed to other infective causes. Failure to associate this important symptom with a possible UTI may have resulted in health care providers being hesitant to order urine cultures in such patients at the appropriate time. Based on the aforementioned observation, the question of whether we should screen for CA-ASB during catheter removal remains unanswered. The IDSA guidelines [6] recommend (Level of recommendation - C-I) treating asymptomatic bacteriuria at catheter removal (CA-ASB that persists after 48 hours of short-term indwelling catheter removal) in "women" because such patients are at risk of subsequent CAUTI. However, there is insufficient evidence to recommend screening for CA-ASB in all women at catheter removal. Similarly, there are few studies that support screening for and treatment of CA-ASB during catheter removal in "men." In our study, we attempted to screen for CA-ASB in both men and women at catheter removal in order to generate evidence to support the preceding statement. Expectedly, our study found CA-ASB in four (19.04 percent) of 21 patients at catheter removal, three of whom were females and one of whom was male. However, the study experienced a significant drop in the number of study participants for a variety of reasons, limiting the cohort for analysis and limiting our ability to draw significant conclusions. Other limitations included the short duration of the study and the non - inclusion of patients from other indoor settings with surgical patients.

Conclusions

Screening for CA-ASB, 48 hours after catheter removal not only improved CAUTI detection rates significantly, but also aided in the early detection of impending UTI. The study provides an insight to undertake future studies on larger cohort of patients which can help in devising improved diagnostic and surveillance strategies to include asymptomatic but clinically significant catheter-associated bacteriuria.

Acknowledgements

The authors acknowledge the Indian Council of Medical Research (ICMR), New Delhi, India, for considering the project for approval under the ICMR short-term studentship project for the year 2018-19.

The authors acknowledge the help extended by Mr. Nithin Varghese (Infection Control Nurse) in data collection and technical staff of the department of Microbiology for their assistance in laboratory processing of samples.

References

1. World Health Organization (WHO) (2002) Prevention of hospital-acquired infections: a practical guide 2nd Edition. Available: https://apps.who.int/iris/handle/10665/67350. Accessed 15 September 2019.
2. Jarvis WR, Bennett JV (2014) Bennett Et Brachman's Hospital Infections, 6th edition. Philadelphia (USA): Lipincott William Et Wilkins, Wolters Kluwer.
3. Warren JW (2001) Catheter-associated urinary tract infection. Int J Antimicrob Agents 17: 299-303.
4. Maki DG, Tambyah PA (2001) Engineering out the risk for infection with urinary catheters. Emerg Infect Dis 7: 342-347.
5. Stamm WE (1991) Catheter-associated UTI: epidemiology, pathogenesis and prevention. Am J Med 91: 65S-71S.
6. Hootan TM, Bradley SF, Cardenas DD, Colgan R, Geerlings SE, Rice JC, Saint S, Schaeffer AJ, Tambyah PA, Tenke P, Nicolle LE (2010) 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 Infect Dis 50: 625-663.
7. Nicolle LE (2016) The paradigm shift to non-treatment of asymptomatic bacteriuria. Pathogens 5: 38.
8. Nicolle LE, Bradley S, Colgan R, Rice JC, Schaeffer A, Hooton TM, Infectious Diseases Society of America; American Society of Nephrology; American Geriatric Society (2005). Infectious Diseases Society of America guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults. Clin Infect Dis 40: 643-654. Erratum in: Clin Infect Dis 40: 1556.
9. Centers for Disease Control and Prevention (CDC) (2018). Urinary tract infection (Catheter-associated urinary tract infection [CAUTI] and non-catheter- associated- urinary tract infection [UTI] events. Available:

www.cdc.gov/nhsn/pdfs/pscmanual/7psccauticurrent.pdf. Accessed on 24 August 2019.
10. Collee J G, Mackie TJ McCartney JE (1996) in Gerald CJ, editor, Mackie and McCartney practical medical microbiology, 14th edition. New York: Churchill Livingstone.
11. Clinical and Laboratory standard institute (CLSI) (2017). Performance standards for antimicrobial susceptibility testing 27th informationalsupplement. CLSI document M100-S27.
12. Singh S, Chakravarthy MR, Sengupta S, Munshi N, Jose T, Chaya V (2014) Analysis of a multi-centric pooled healthcare associated infection data from India: New insights. J Natl Accredit Board Hosp Healthc Provid 1: 39-43.
13. Mehta Y, Jaggi N, Rosenthal VD, Kavathekar M, Sakle A, Munshi N,Chakravarthy M, Todi SK, Saini N, Rodrigues C, Varma K, Dubey R, Kazi MM, Udwadia FE, Myatra SN, Shah S, Dwivedy A, Karlekar A, Singh S, Sen N, Joshi KL, Ramachandran B, Sahu S, Pandya N, Mathur P, Sahu S, Singh SP, Bilolikar AK, Kumar S, Mehta P, Padbidri V, Gita N, Patnaik SK, Francis T, Warrier AR, Muralidharan S, Nair PK, Subhedar, Ramachadran Gopinath VR, Azim A, Sood S (2016) Device-associated infection rates in 20 cities of India, data summary for 2004-2013: findings of international nosocomial infection consortium. Infect Control Hosp Epidemiol 37: 172-181.
14. Mehta A, Rosenthal VD, Mehta Y, Chakravarthy M, Todi SK, Sen N, Sahu S, Gopinath R, Rodrigues C, Kapoor P, Jawali V, Chakraborty P, Raj JP, Bindhani D, Ravindra N, Hegde A , Pawar M, Venkatachalam N, Chatterjee S, Trehan N, Singhal T, Damani N (2007) 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 67: 168-174.
15. Harding GKM, Nicolle LE, Ronald AR, Preiksaitis JK, Forward KR, Low DE, Cheang M (1991) How long should catheter-acquired urinary tract infection in women be treated?: A randomized controlled study. Ann Intern Med 114: 713–719.

Corresponding author
Dr. Ujjwala Gaikwad, MD (Microbiology)
Additional Professor, Department of Microbiology, All India Institute of Medical Sciences, GE Road, Tatibandh, Raipur, Chhattisgarh – 492099, India
Phone: +91 8518881724
Email: ujugaikwad@gmail.com, ujugaikwad@aiimsraipur.edu.in

Conflict of interests: No conflict of interests is declared.