Section: Microbiology

Original Research Article

A STUDY ON CATHETER ASSOCIATED URINARY TRACT INFECTIONS (CAUTI) IN A TERTIARY CARE HOSPITAL OF BIHAR

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Received : *05/01/2023*
Received in revised form : *15/02/2023*
Accepted : *27/02/2023*

Keywords:
Catheter associated urinary tract infections (CAUTI).

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DOI: 10.47009/jamp.2023.5.3.15

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2023; 5(3); 68-71

Abstract

Background: With this background, the current study was designed to provide baseline information of such infections in the hospital and to identify the microbial pathogens associated with these infections. **Materials and Methods:** A cross-sectional study was carried by the Department of Microbiology, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar from August 2022 to January 2023. Approval was acquired from the Ethical Committee. Urine microscopy was performed on centrifuged catheter urine specimen. The culture was set up on Blood Agar and Mac-Conkey Agar for isolating all kind of urinary pathogens. Semi quantitative method of urine culture was followed. Culture-positive isolates were identified by their colony morphology, Gram-staining, and characterized biochemically for species identification. Antimicrobial susceptibility testing for aerobic bacterial isolates was done by Kirby-Bauer disk-diffusion method on Mueller-Hinton agar as per Clinical and Laboratory Standards Institute guidelines. **Result:** Out of 100 catheterized urine samples collected with proper aseptic precautions. Maximum number of samples were obtained from medicine department (38%) followed by surgical wards (32%) and orthopedics wards (18%). 10% samples were obtained from medical ICU and 2% from surgical ICU. Significant growth was observed among 15% patients. **Conclusion:** The device-associated healthcare-acquired infection known as CAUTI is significant. To reduce infections linked to the use of these devices, infection management programs must create, apply, and observe rules and procedures. Maintaining proper hygiene by the patient and their caretaker is also important. Choosing.

INTRODUCTION

Catheter-associated urinary tract infection (CAUTI) has been explained as the appearance of the remarkable presence of bacteria in the urine in a catheterized patient. CAUTI occurs when germs (usually bacteria) enter the urinary tract through the urinary catheter and cause infection. CAUTIs have been associated with increased morbidity, mortality, healthcare costs, and length of stay. It can be classified briefly into two: CAUTI with manifestations referable to the urinary tract and catheter-associated asymptomatic bacteriuria (CA-ASB), without expression or declaration referable to the urinary tract. One of the most typical healthcare-acquired illnesses is device-acquired urinary tract infection, accounting for up to 40% of hospital-acquired infections.[1]

To prevent administering unneeded antibiotic medication, doctors must differentiate between non-manifested bacteriuria and manifested urinary tract infection; otherwise, resistance will develop against the antimicrobial drug.[2] A sizable percentage of patients receive therapy that is not advised for CAUTI after receiving an incorrect diagnosis. This ineffective therapy has the potential to be damaging due to the growth of diseases that are resistant to it, supra-infections and needless expenses.[3] In general, indwelling urinary catheters are categorized as short-duration if they are used for fewer than 30 days and chronic or long-duration if they are used for more than 30 days.

The fundamental starting point of CAUTI is the development of a contagious or infective biofilm on the surface of the indwelling urinary catheter. The best materials for a urinary catheter are biocompatible, antibacterial, and antifouling.

Patients who can be handled with intermittent catheterization versus those who need continuous indwelling catheters may have distinct demands. Given the rising antibiotic resistance in hospital-acquired infections, prevention of these infections must also be given priority.[4] They could prioritize the care of the urinary catheters if they had comprehensive knowledge of all practical preventative actions.[5]

With this background, the current study was designed to provide baseline information of such infections in the hospital and to identify the microbial pathogens associated with these infections.

MATERIALS AND METHODS

A cross-sectional study was carried by the Department of Microbiology of Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar for 6 months' duration from August 2022 to January 2023. Both adult males and females were included in the study group. Approval was acquired from the Ethical Committee. Adult patients who were catheterized and admitted to various wards and ICUs were included. Patients admitted to Neonatal ICU, pediatrics, ophthalmology, and obstetrics/gynecology ward and those who remained unwilling for participation were excluded. A questionnaire was used to investigate about the demographic detail, provisional diagnosis; predisposing factors as well as risk factors, treatment details along with the date of catheter insertion and removal. CAUTI was diagnosed as per CDC criteria with the presence of at least two of the following features with no other recognized cause: fever, urgency of micturition, dysuria or suprapubic tenderness, and pyuria or positive urine culture.[6]

Before catheter change or removal from each patient, urine samples were collected aseptically using a sterile needle and syringe from the distal edge of catheter tube into the sterile universal container and transported to the microbiology laboratory for analysis with minimum delay. The samples were processed by the routine standard laboratory procedure. This included microscopy, culture identification, and antibiotic susceptibility testing.

Urine microscopy was performed on centrifuged catheter urine specimen. The culture was set up on Blood Agar and Mac-Conkey Agar for isolating all kind of urinary pathogens. Semi quantitative method of urine culture was followed. A sterile calibrated wire loop was used to deliver a loopful (0.01 ml) of urine onto each culture media. All the culture plates were incubated at 37°C aerobically for 18–24 h and the culture-positive isolates were identified by their colony morphology, Gram-staining, and characterized biochemically for species identification.[7] Isolate suggestive of the yeast were sub cultured on Sabouraud dextrose agar with further identification by the demonstration of germ tube; sporulation on cornmeal agar, sugar fermentation, and assimilation and CHROME agar.

Antimicrobial susceptibility testing for aerobic bacterial isolates was done by Kirby-Bauer disk-diffusion method on Mueller-Hinton agar as per Clinical and Laboratory Standards Institute guidelines.[8] The antimicrobial drugs tested were as follows: cotrimoxazole (1.25/23.75 µg), amoxyclav (20:10 µg), cefuroxime (30 µg), cefoxitin (30 µg), cefazolin (30 µg), cefotaxime (30 µg), ceftazidime (30 µg), gentamicin (10 µg), amikacin (30 µg), ciprofloxacin (5 µg), nitrofurantoin (300 µg), azithromycin (15 µg), vancomycin (30 µg), and linezolid (30 µg).

Descriptive statistics expressed as percentages were used to evaluate the incidence of CAUTI in tertiary care hospital wards and adult ICUs and to define the resistance pattern of isolated organisms.

RESULTS

The present study comprised of 100 catheterized urine samples collected with proper aseptic precautions. Mean age of the participating patients was 44.7 years with a standard deviation of 11.4 years. The age range was 18 years to 78 years. Male comprised 59%. The male to female ratio was calculated and approximated to 1.44:1. Maximum number of samples were obtained from medicine department (38%) followed by surgical wards (32%) and orthopedics wards (18%). 10% samples were obtained from medical ICU and 2% from surgical ICU. Significant growth was observed among 15% patients. Out of these 15 samples, 7 were from medical wards, 3 were from surgical wards and 1 positive sample was obtained from orthopedics ward. Out of 12 samples from ICU patients, 4 yielded positive growth. The distribution of identified organism has been shown in Figure 1.

Previous history of catheterization was given by 17 patients and 9 out of these 17 patients had positive culture growth. Recurrent history of UTI was reported by 12% patients and 8 out of these 12 had positive growth on culture. Obstructive uropathy and associated diabetes are known to predispose a person to infection but none of the patient in the current study with obstructive uropathy or diabetes had positive growth.

The antimicrobial sensitivity testing of isolated organisms is shown in [Table 2].

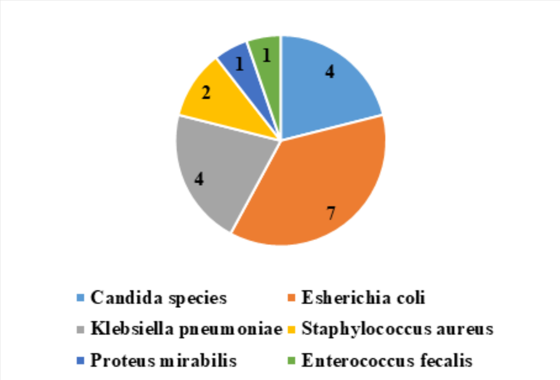

Figure 1: Pie distribution of organism from positive sample growth.

Table 1: Antimicrobial susceptibility profile of bacterial uropathogenic organisms (N = 15)

Antibiotic	Gram negative (N = 12)		Gram positive (N = 3)	
	Resistant	Susceptible	Resistant	Susceptible
Amikacin	9	3	0	3
Gentamycin	8	4	2	1
Ciprofloxacin	9	3	3	0
Nitrofurantoin	5	7	2	1
Cotrimoxazole	10	2	3	0
Cefazolin	0	12	-	-
Cefuroxime	0	12	-	-
Cefotaxime	1	11	-	-
Ceftazidime	1	11	-	-
Amox-clav	10	2	2	1
Vancomycin	-	-	0	3
Linezolid	-	-	0	3
Azithromycin	-	-	1	2
Cefoxitin	-	-	3	0

DISCUSSION

The current study encompasses 100 patients from various wards of the hospital. The age and gender distribution of the current study are in concordance with Verma et al,[9] where the majority of catheterized patients were male. However, this is contradictory to Kakaria et al., who observed a higher incidence of CAUTI in females as compared to males.[10] This increased risk in women is likely to be due to easier access of the perineal flora to the bladder along the outside of the catheter as it traverses the shorter female urethra. In addition, a woman's urethra is closer to anus. This makes it easier for bacteria to spread into her urethra and cause an infection. Many other authors have also failed to find female gender a risk factor for CAUTI. Moreover, less number of female patients in our study group could be a possible reason for this result. Maximum samples were from the medicine department, followed by orthopedics department and surgery. As most of the patients admitted to these wards had serious underlying disease or other invasive procedures done, and in most of them, IUCs were present.

Several risk factors have been cited to be associated with UTI. We included the previous history of catheterization/UTI, associated co morbid condition as diabetes and obstructive uropathy as potential risk factors in our study. These findings were similar to Kakaria et al,[10] who identified three risk factors associated with CAUTI: female gender, diabetes mellitus, and duration of catheterization. A nested case–control study in a multicenter cohort conducted by Clec'h et al., also found that diabetes is a risk factor for CAUTI.[12] The low infection rate among predisposed patients in our study can be explained by a limited number of the sample due to the short duration of the study. Among 716 patients treated in the ICU during 6698 person-days of hospitalization, UTIs were diagnosed in 17 patients.

Uropathogens isolated in the present study include Candida spp. 5/15, E. coli 7/15, K. pneumoniae 2/15 and S. aureus 1/15. Thus, Gram-negative bacteria (GNB) were most among bacterial isolates. Our findings were in accordance with Deorukhkar et al., who reported E. coli followed by K. pneumoniae among bacterial isolates and predominance of NAC over Candida albicans.[13] Similar to our finding, Santhose et al also reported E. coli as the predominant organism followed by Klebsiella spp.[14] E. coli is responsible for more than 80% of the UTIs, and it causes both symptomatic UTIs and Asymptomatic bacteriuria. Similarly to the bacterial spectrum of uncomplicated UTIs, E. coli is the most common pathogen in the presence of a catheter as well. The persistence of E. coli strains is related to the presence of Type 1 pili, an adhesin for uroepithelium as well as the Tamm–Horsfall protein. Colonising E. coli strains lack P fimbriae in most cases of catheter-associated infections.[15]

ISSN(O): 2687-5365; ISSN(P): 2753-6556

In the present study, bacterial isolates were tested against 10 antimicrobial agents, and their susceptibility pattern was observed. Most of the GNB isolates were sensitive to amikacin followed by cefazolin and ceftazidime but decreased sensitivity was observed to nitrofurantoin, cefuroxime, and cefotaxime. These findings are similar to Jafari et al., who also observed amikacin (91%) as the most effective drug against uropathogens.[16] In the present study, the prevalence of resistance was high to cotrimoxazole and ciprofloxacin. This is in accordance with Bhani et al., where CAUTIs due to GNB were significantly resistant to norfloxacin and levofloxacin but susceptible to nitrofurantoin.[17] Teshager et al. observed the intermediate level of resistance (48%–68%) to amoxicillin-clavulanic acid, gentamicin, cotrimoxazole, and low level of resistance (16%–24%) was observed to amikacin, ciprofloxacin, and nitrofurantoin.[18] In the present study, Gram-positive bacteria were all sensitive to vancomycin, linezolid and Amikacin. A similar pattern of susceptibility was observed in a study by Bhani et al., where all the Gram-positive isolates were susceptible to vancomycin and linezolid.[17]

Progress in the area of prevention of urinary catheter-associated infections is very limited, and the preventive procedures used nowadays rather only prolong the “abacterial window”. Effective strategies available are avoiding unnecessary catheterization, selecting alternative catheterization procedures, maintaining the closed drainage system, and eliminating bacterial colonization of the patient. The prolongation of the catheterization or even unnecessary catheterization is the first steps which can be changed in the course of prevention of the CAUTIs.[19] Other steps that may be considered are catheter insertion in the operating room or another clean environment, training for catheter insertion and early catheter removal. Antimicrobial indwelling urethral catheters mixed or coated with antibacterial agents, including silver hydro gel and nitrofural, are considered effective in preventing CAUTI because of suppression of bacterial growth on the catheter surface.[20]

CONCLUSION

The device-associated healthcare-acquired infection known as CAUTI is significant. The use of an indwelling urethral device is connected to inflated possibilities of the presence of bacteria in the blood and manifested urinary tract infections, as well as increased morbidity from non-infectious consequences. To reduce infections linked to the use of these devices, infection management programs must create, apply, and observe rules and procedures. Maintaining proper hygiene by the patient and their caretaker is also important. Choosing the right catheter also helps to reduce the chances of infection. The next best course of action is to detach the catheter shortly as it is no longer required. This action may be ordered by the computer end or finish orders that are automatically generated. In inclusion to these steps, strong adherence to infection control procedures, including making sure that urine drains according to gravity can help reduce CAUTI.

REFERENCES

1. Catheter associated urinary tract infections. Nicolle LE. Antimicrob Resist Infect Control. 2014;3:23.
2. Catheter-associated urinary tract infection and the Medicare rule changes. Saint S, Meddings JA, Calfee D, Kowalski CP, Krein SL. Ann Intern Med. 2009;150:877–884.
3. Risk factors for catheter-associated bacteriuria in a medical intensive care unit. Tissot E, Limat S, Cornette C, Capellier G. Eur J Clin Microbiol Infect Dis. 2001;20:260–262.
4. Pathogenesis of Proteus mirabilis infection. Armbruster CE, Mobley HL, Pearson MM. EcoSal Plus. 2018;8.
5. Complicated catheter-associated urinary tract infections due to Escherichia coli and Proteus mirabilis. Jacobsen SM, Stickler DJ, Mobley HL, Shirtliff ME. Clin Microbiol Rev. 2008;21:26–59.
6. Garner JS, Jarvis WR, Emori TG, Horan TC, Hughes JM. CDC definitions for nosocomial infections, 1988. Am J Infect Control 1988;16:128-40.
7. Collee JG, Miles RS, Watt B. Test for identification of bacteria. In: Collee JG, Fraser AG, Marmion BP, Simmons A, editors. Mackie and McCartney Practical Medical Microbiology. 14th ed. New York: Churchill Livingstone; 1996. p. 131-49.
8. Clinical and Laboratory Standards Institute. Performance Standards for Antimicrobial Susceptibility Testing; Twenty-Second Informational Supplement. CLSI document M100-S21. Wayne, PA: Clinical and Laboratory Standards Institute; 2012.
9. Verma S, Naik SA, Deepak TS. Etiology and risk factors of catheter associated urinary tract infections in ICU patients. Int J Med Microbiol Trop Dis 2017;3:65-70.
10. Kakaria BA, Ashish K, Raghuwanshi T. Study of incidence and risk factors of urinary tract infection in catheterized patients admitted at tertiary care. Int J Res Med Sci 2018;6:1730-33.
11. Apisarnthanarak A, Rutjanawech S, Wichansawakun S, Ratanabunjerdkul H, Patthranitima P, Thongphubeth K, et al. Initial inappropriate urinary catheters use in a tertiary-care center: Incidence, risk factors, and outcomes. Am J Infect Control 2007;35:594-9.
12. Clec'h C, Schwebel C, Français A, Toledano D, Fosse JP, Garrouste-Orgeas M, et al. Does catheter-associated urinary tract infection increase mortality in critically ill patients? Infect Control Hosp Epidemiol 2007;28:1367-73.
13. Deorukhkar SC, Saini S, Raytekar NA, Sebastian MD. Catheter associated urinary tract candida infections in Intensive Care Unit patients. J Clin Microbiol Biochem Technol 2016;2:15-7.
14. Bharathi Santhose N, Mythily N, Ashok Kumar C. Study on biofilm producing bacterial isolates in catheter associated urinary tract infection. IOSR J Dent Med Sci 2018;17:50-3.
15. Köves B, Magyar A, Tenke P. Spectrum and antibiotic resistance of catheter-associated urinary tract infections. GMS Infect Dis 2017;5:06.
16. Jafari HM, Saffar MJ, Nemate I, Saffar H, Khalilian AR. Increasing antibiotic resistance among uropathogens isolated during years 2006-2009: Impact on the empirical management. Int Braz J Urol 2019;38:25-32.
17. Bhani D, Bachhiwal R, Sharma R, Maheshwari RK. Microbial profile and antimicrobial susceptibility pattern of uropathogens isolated from catheter associated urinary tract infection (CAUTI). Int J Curr Microbiol Appl Sci 2020;6:2446-53.
18. Teshager L, Asrat D, Gebre-Selassie S, Tamiru S. Catheterized and non-catheterized urinary tract infections among patients attended at Jimma University teaching hospital, Southwest, Ethiopia. Ethiop Med J 2008;46:55-62.
19. Nicolle LE. Catheter associated urinary tract infections. Antimicrob Resist Infect Control 2021;3:23.
20. Muramatsu K, Fujino Y, Kubo T, Otani M, Fushimi K, Matsuda S, et al. Efficacy of antimicrobial catheters for prevention of catheter-associated urinary tract infection in acute cerebral infarction. J Epidemiol 2023;28:54-8.