Content available at: https://www.ipinnovative.com/open-access-journals

IP International Journal of Medical Microbiology and Tropical Diseases

Journal homepage: https://www.ijmmtd.org/

Original Research Article

Microbiological aspects of catheter associated urinary tract (CAUTI) infections in tertiary care hospital: A prospective cross-sectional study

Rachana Patel[1], **Amit Pravin Chauhan**[2]*, **Himani Pandya**[1], **Rezil Christie**[3], **Sucheta Lakhani**[1]

[1]*Dept. of Microbiology, SBKS MI and RC, Sumandeep Vidyapeeth Deemed to be University, Vadodara, Gujarat, India*
[2]*Dept. of Anaesthesiology and Critical Care Medicine, SBKS MI and RC, Sumandeep Vidyapeeth Deemed to be University, Vadodara, Gujarat, India*
[3]*SBKS MI and RC, Sumandeep Vidyapeeth Deemed to be University, Vadodara, Gujarat, India*

ARTICLE INFO

Article history:
Received 07-04-2024
Accepted 16-05-2024
Available online 22-06-2024

Keywords:
CAUTI
Tertiary care hospital
Antibiotics
AST

ABSTRACT

Background : Urinary Tract Infections (UTIs) rank among the most common bacterial infections, affecting all demographics in community and hospital settings. Catheterized patients in critical areas are at increased risk of Catheter-associated UTIs (CAUTIs) due to bacterial or candidial infections. This study assesses CAUTI incidence, causative agents, and antibiotic susceptibility, vital for treatment and infection control.
Aim & Objectives: 1. This study is aimed to find prevalence of catheter associated urinary tract infection rate among study population; 2. To find out mostly affected age group and gender; 3. The present study was taken to identify candida and bacterial uro-pathogens causing CAUTI -most common organism and their types and level of antimicrobial drug susceptibility attending a tertiary care hospital.
Materials and Methods: A three-month Prospective Cross-sectional study was conducted at Dhiraj Hospital. Following approval from the ethical committee, data collection commenced. Patients with over two days of catheterization and clinical signs of UTI were enrolled. Bacterial identification and antibiotic sensitivity were analyzed using standard protocols, alongside calculation of the CAUTI rate.
Result : Out of 80 catheterized urine sample, 51 cases found to as CAUTI. With standard formula applied it was counted that CAUTI rate came to be 15.67%. In our study 55% men and 45% female were affected. In 45 Cases, Most common Gram Negative organisms were *E.coli* (37.2%), *Klebsiella spp* (19.6%), Pseudomonas spp (9.8%) and in 6 cases *Candida spp* isolated. Most resistant drugs were Fluoroquinolones and Cephalosporin group. Amikacin, Fosfomycin, Meropenem and Imipenem sensitivity were 28.5%, 30%, 22.8% and 28.5% respectively. Most of candida urine infection were sensitive to azole group of antifungal.
Conclusion : According to micro-organism and AST pattern found in CAUTI need to formulate Antibiotic policy and strictly follow CAUTI bundle care and infection control practices which may help in line of treatment and management of patient in respective area.

1. Introduction

UTI have been demonstrated to be one of the most prevalent bacterial infections in humans,[1,2] and involves all the age groups and gender in both the community and hospital setups.[3,4] Most of all females will encounter minimum one episode of UTI during their lifetime.[5]

Urinary tract infections (UTIs) are frequent occurrences in both adult men and women, with women experiencing a higher incidence. This is often attributed to the anatomical differences in the female urogenital system, characterized by a shorter urethra and closer proximity of the urethral

* *Corresponding author*.
E-mail address: dramitchauhan85@gmail.com (A. P. Chauhan).

https://doi.org/10.18231/j.ijmmtd.2024.026

meatus to the anus.[6,7] High prevalence is seen in pregnant female and who are very sexually active.[8]

Asymptomatic bacteriuria denotes significant bacteriuria without symptoms of urinary tract infections (frequency, urgency, dysuria or fever) or other abnormal findings. UTI is an infection which affects any part of the urinary tract that is urethral meatus to the renal cortex of kidney. It is not categorized as a sexually transmitted disease[9] though sexual activity is a known risk factor in females.[10] Frequent and/or painful urination, a urge to urinate despite having an empty bladder, fever and flank pain are the symptoms of UTI. At times, pyuria and/or haematuria may be seen.[11] Virtually all healthcare-associated UTIs can be caused by instrumentation of the urinary tract.

CAUTI, the most common healthcare-associated infection, arises from urinary catheterization. Risk factors include age, female gender, diabetes, and prolonged catheterization. Proper aseptic technique, catheter care, and hand hygiene are crucial in prevention. Bacteria can enter through the catheter's external surface or ascend through its lumen, leading to infection.[12–17]

The study assessed CAUTI incidence, uro-pathogens, and antibiotic sensitivity in a tertiary care hospital. It aids in prescribing suitable antibiotics, reducing complications, hospital stay, and implementing effective care bundles by the infection control team, ultimately diminishing morbidity and mortality. CAUTI complications include patient discomfort, prolonged hospitalization, increased costs, and mortality.

2. Aims and Objectives

This study aims to investigate the prevalence of catheter-associated urinary tract infection (CAUTI) among the study population, identify the most affected age group and gender, and characterize the bacterial and candidial uro-pathogens responsible for CAUTI, including the common organisms and their levels of antimicrobial drug susceptibility, within a tertiary care hospital setting.

3. Materials and Methods

The study will be conducted at Dhiraj Hospital, utilizing data sourced from the Microbiology Laboratory and hospital rounds spanning 3 months from January 16, 2023, to April 15, 2023. This prospective cross-sectional study aims to assess any age group presenting with signs and symptoms indicative of urinary tract infection as the study population.

The study will include urine samples collected over a 3-month period from individuals showing signs and symptoms indicative of catheter-associated urinary tract infection. CAUTI according to NHSN criteria is UTI where an indwelling urinary catheter was in place for more than two consecutive days in an inpatient location 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 two consecutive days in an inpatient location and then removed, the date of event for the UTI must be the day of device discontinuation or the next day for the UTI to be catheter-associated. These individuals will have either indwelling urethral, indwelling suprapubic, or intermittent catheterization. Catheter-associated urinary tract infection (UTI) will be defined as the presence of symptoms or signs consistent with UTI, with no other identifiable source of infection, along with the presence of at least 10^3 colony-forming units (cfu) per milliliter of at least one bacterial species in a single catheter urine specimen or in a midstream voided urine specimen from a patient whose urethral, suprapubic, or condom catheter has been removed within the previous 48 hours.

3.1. Inclusion criteria

Urine Sample of adult Patient having minimum two days of urinary catheter after admisson to the tertiary care hospital, come with sign and symptom for urinary tract infection.

3.2. Exclusion criteria

Patients who had a positive urine culture prior to catheterization and had been catheterized for less than two calendar days were not included in the study.

Excluded organisms-Mixed flora in urine, mould, Dimorphic fungi, parasites.

Demographic data, including age, gender, clinical diagnosis, reasons for hospitalization and ICU admission sources, as well as history of systemic antibiotic treatment, were documented.After obtaining the permission from institutional ethical committee data was collected.

3.2.1. Clinical sample collection and inoculation

Physicians at Dhiraj Hospital applied sterile urethral indwelling catheters to patients following hospital guidelines to minimize microbial introduction. They aspirated 10 ml of urine from the catheter under aseptic precautions. Trained nurses or physicians labeled collected urine specimens in sterile containers. Samples were promptly sent to the microbiology laboratory for further processing. Using calibrated loops, part of the sample was inoculated onto MacConkey agar and sheep blood agar, while the rest was inoculated onto HiChrome Agar and Nutrient Agar.

3.3. Incubation

All plates containing inoculated samples were placed in an aerobic incubator at 37°C for a period ranging from 18 to 48 hours. They were then examined for the presence of bacterial and/or yeast growth. Colony counts resulting in bacterial or yeast growth equal to or greater than 10^4 and 10^5

per milliliter for single uropathogens and two uropathogens, respectively, were considered indicative of bacteriuria or candiduria. Urine samples containing three or more species were excluded from further analysis.

3.4. Bacterial and candida identification

The next day, bacterial and candida isolates were identified through culture, gram staining, and biochemical characteristics. Colony morphology and Gram stain were used for preliminary characterization, followed by standard biochemical tests and the Vitek automation method for species-level identification.

3.5. Antimicrobial susceptibility testing

Antibiotic susceptibility testing of pure cultures was performed on Muller Hinton agar using the Kirby Bauer disk diffusion method. Inoculum suspensions, adjusted to 0.5 McFarland turbidity, were lawn-cultured on plates and allowed to dry. Antibiotic disks including Ampicillin-Sulbactam, Cephalexin, Norfloxacin, and others were placed aseptically on the agar, followed by incubation at 37°C for 24 hours. Zones of inhibition were measured and recorded in millimeters. Internal quality controls were ensured using ATCC strains. Additionally, the Vitek automated system was utilized for identification and antibiotic sensitivity reporting, enhancing efficiency and accuracy in the analysis process. Susceptibility and resistance were assessed using the guidelines by the Clinical and Laboratory Standards Institute (CLSI).[18–25]

Uro-pathogens were isolated and identified then subjected to antibiotic sensitivity test by manual or automated method. CAUTI rate according to NHSN criteria was calculated and results were noted.

CAUTI RATE = Number of CAUTI cases * 1000 / Number of catheter days

3.6. Statistical methods

The collected data was organized in Microsoft Office Excel 2007 format and subsequently analyzed using Epi Info statistical software. Descriptive and analytical statistical methods were employed to prepare the results. In analytical analyses, the chi-square test was utilized to determine significance levels. The findings will be presented both in tabulated form and through graphical representations for comprehensive understanding.

4. Results

Total 227 urine samples received during 3 month study suspecting asymptomatic/ symptomatic, catheterized/Non catheterized Urinary tract Infection. However, days of catheter insertion and duration of stay in intensive care unit and hospital was significantly linked with bacteriuria/ Candiduria.

Out of 227 samples 92 samples yielded growth of single organisms; Out of 80 patient who were catheterized, 51 (22.4%) patients developed CAUTI. The overall prevalence of bacteriuria/ Candiduria was 22.4% among which 19.8% and 2.6% were bacteriuria and Candiduria respectively (Table 1).

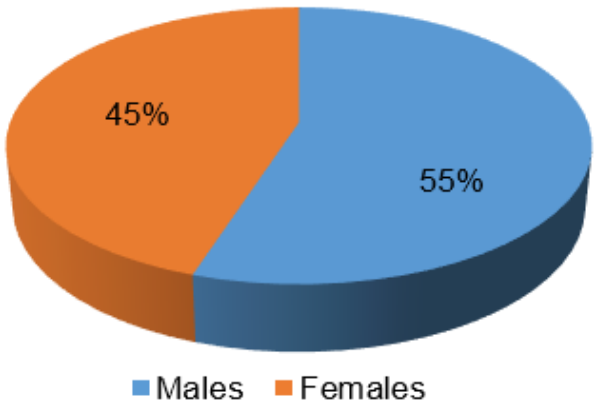

Figure 1: CAUTI gender distribution (%)

Patient who had developed CAUTI, 55% were males and 45% were females and most affecting CAUTI age group highest among 36 – 55 age group (45%).

Spectrum of causative agents includes *E. coli* (37.2%), *Klebsiella species* (19.6%), *Pseudomonas species* (9.8%), *Acinetobacter species* (4%) and *Enterococcus species* (12%) were the dominant bacterial isolates; followed by Proteus (1.9%), Providentia (1.9%) and Morganella morganii (1.9%) species were also isolated. Candida albicans (3.9%), Candida krusei (3.9%) and Candida tropicalis (3.9%) were the commonest yeasts. (Figure 2)

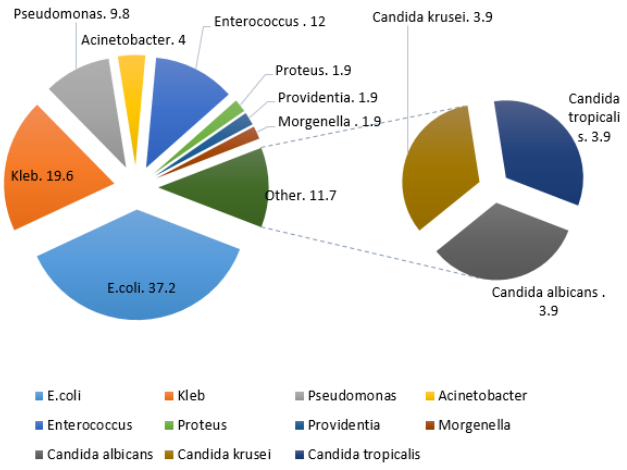

Figure 2: Isolated Organisms in CAUTI

Table 1: Total number of sample and its culture positivity.

S.No.	Sample	Total No Sample	Positive culture Number	Culture Positivity
1	Urine	227	92	40.52%
2	Urine (Catheterized Sample)	80	51 (CAUTI)	22.4%
3	CAUTI Urine sample	51	45 (Bacterial)	88.23%
4	CAUTI Urine Sample	51	6 (Candida)	11.76%

Enterobacteriaceae exhibited a notable resistance to commonly prescribed antimicrobials. like Amoxyclav (86.2%), Ceftriaxone (74.1%), Ceftazidime (81.5%), Ciprofloxacin (94.5%), Norfloxacin (100%), Nitrofurantoin (78.3%), Piperacillin tazobactam (86.4%), and were sensitive to Amikacin (28.5%), Fosfomycin (30%), Colistin (19.5%), Meropenem(22.8%),Imipenem (28.5%)., Both *Pseudomonas* and *Acinetobacter* were multidrug resistant in our study. They were resistant to commonly used antibiotics like Ciprofloxacin (100%), Imipenem (71.4%), Meropenem (71.4%), Ceftazidime (100%), Cefoperazone-sulbactam (100%) and Piperacillin-Tazobactam (100%).(Figure 3)

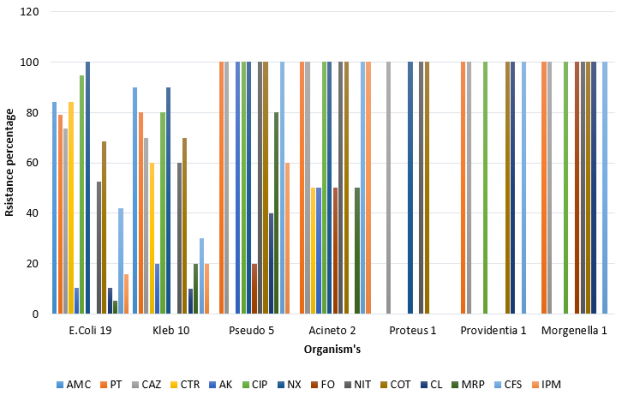

Figure 3: Resistance pattern in GNB

*Enterococcus sp*p. were mostly sensitive to Vancomycin and Linezolid.

For catheterized patient 51 patients were set in the criteria of CAUTI as discussed in method. For 51 patients total catheter days are 3256. Out of 51 CAUTI patients, 15.67% had developed CAUTI(CAUTI RATE). Patient who has developed CAUTI, most commonly they are of after 7 days of catheterization. The duration of stay in the critical care unit was significantly linked with bacteriuria /candiduria.

5. Discussion

The present study observed an overall rate of prevalence for catheter-associated bacteriuria/candiduria is 22.4%, Our result was comparable with Poddar et al., Bagchi et al. and Vishwajith et al 25.33%, 29.09% and 14%.[26–28] The CAUTI ranged from 5% to 73% among catheterized patients.[29] In our study rate of CAUTI was lower due to high compliance towards strict infection control practices including hand hygiene, incorporation of catheter care bundle and it could also be due to short study period.[30]

In the present study, CAUTI was seen among middle age group (35-55) which is contradict with Arunagiri Ramesh et al.[31] shows older age group (>80 years). In critical care unit patients, gender was not a significant risk factor for catheter-associated bacteriuria/candiduria, as observed by a non-significant difference in male-to-female ratios between affected and unaffected patients.[32] Male patients may exhibit higher rates of CAUTI due to factors like prosthetic surgery and UTIs from stones. General hospital studies show device-associated UTIs more common in women, possibly due to anatomical and hormonal factors.[33–35] No age disparity in hospital-acquired UTI occurrence found, consistent with Laupland et al.'s findings.[36]

In line with findings from numerous studies worldwide, this study similarly showed that Gram-negative bacteria were the primary involved in bacteriuria. 38 of 51 isolates (74.5%) were Gram-negative bacteria and *E. coli* was the predominant, followed by *Klebsiella species*, *Pseudomonas species*, and *Acinetobacter* spp, proteus, Providentia & Morganella species in their descending order. This finding was similar to the studies by Bagachi et al., Kazi et al.,[37] and Jayashri et al.[38] *E. coli* is the primary organism in UTIs, with *Enterococcus species* found in 11.7% of CAUTIs. Staphylococci and *Enterococcus* are commonly reported in urine cultures in similar studies.[39]

Several studies have demonstrated that within hospital settings, approximately 10%–15% of hospital-acquired urinary tract infections (UTIs) are attributed to Candida species, with candiduria being particularly prevalent in ICU.[40,41] In present study, candiduria represented 2.6% of CAUTI. The finding was contradict with Bizuayehu et al, .and Arunagiri Ramesh et al, 44.6% & 25% respectively.[32]

Patients followed up to 11 days post catheterization, and was found that 51 (22.4%) patients developed CAUTI after 5 days of catheterization, which was similar to earlier studies by Kulkarni et al[42] and Bagachi et al. Duration of catheterization is strongly related to CAUTI, hence proper maintenance and care of catheter is needed to decrease the incidence of CAUTI.

Enterobacteriaceae exhibited resistance to fluroquinolones, which is one of the common drug used in urinary tract infection. The level of antimicrobial

resistance observed against both Gram-positive and Gram-negative bacteria in this study was notably significant. The highest resistance against gram-negative bacteria was found with Piperacillin-Tazobactam 32 (86.4%), Amoxyclav 25 (86.2%), ceftriaxone 23 (74.1%), ceftazidime 31 (81.5%), Nitrofurantoin 18 (78.3%) Norfloxacin 36 (100%) and Ciprofloxacin 35 (94.5%). Gram-negative bacteria exhibited a considerable percentage of antibiotic resistance across nearly all tested antibiotic categories, although there was a comparatively low prevalence of resistance observed against Amikacin 10 (28.5%), Colistin 7 (19.4%), Meropenem 8 (22.8%), Imipenem 10 (28.5%) and Fosfomycin 3 (30%). Antimicrobial resistance towards Gram-positive bacteria was comparatively low in degree. *Enterococcus sp*p. were sensitive to Vancomycin and Linezolid. The indiscriminate utilization of broad-spectrum antibiotics empirically, coupled with the absence of an antibiotic stewardship program, likely relates the elevated rates of antibiotic resistance observed in this study. *Enterococcus spp*. were sensitive to Vancomycin (83.3%) and Linezolid (100%). These findings are similar to the Bizuayehu et al. Most of cadidial urinary tract infection was susceptible to amphotericin.

This suggests that implementing meticulous interventions such as stringent hand hygiene practices, appropriate catheter maintenance protocols, a well-defined antibiotic policy, and effectively guided infection control programs can help mitigate the prevalence of multidrug-resistant pathogens not only among CAUTI patients but also throughout the hospital environment overall.

6. Conclusion

Our study and others underscore CAUTI's global threat, necessitating robust infection control programs for surveillance. Implementing infection control practices is crucial for CAUTI prevention. Delaying antimicrobial use in suspected CAUTI cases until microbiology reports are available can curb resistant strain emergence. Educating paramedical staff, strict infection control, and an antibiotic policy are vital. Catheterization exceeding seven days heightens CAUTI risk. Multidimensional approaches are crucial, especially given high candiduria prevalence and non-albicans Candida's resistance to common antifungals. Addressing MDR bacteria like *E. coli* and *Klebsiella spp.* requires strict CAUTI bundle care and antibiotic stewardship.

7. Abbreviations

AST- Antibiotic Sensitivity Testing; CAUTI-Catheter associated Urinary Tract Infection; UTI- Urinary Tract Infections; *E.coli- Escherichia coli*; Spp- species; CDC-Center for disease center; NHSN-National Healthcare Safety Network; WHO- World health organization.

8. Source of Funding

None.

9. Conflict of Interest

None.

References

1. Demilie T, Beyene G, Melaku S, Tsegaye W. Urinary bacterial profile and antibiotic susceptibility pattern among pregnant women in north west ethiopia. *Ethiop J Health Sci*. 2012;22(2):121–8.
2. Parveen SS, Reddy SV, Rao MR, Rao J. Uropathogens and their drug susceptibility patterns among pregnant women in a teaching hospital. *Ann Biol Res*. 2011;2(5):516–21.
3. Ahmed E, Shahid H, Ikhlaque S, Ejaz M. Urinary tract bacterial pathogens and their sensitivity pattern. *J Rawalpindi Med Coll (JRMC)*. 2014;18(2):263–6.
4. Omigie O, Okoror L, Umolu P, Ikuuh G. Increasing resistance to quinolones: A four-year prospective study of urinary tract infection pathogens. *Int J Gen Med*. 2009;2:171–5. doi:10.2147/ijgm.s2641.
5. Al-Badr A, Al-Shaikh G. Recurrent urinary tract infections management in women: A review. *Sultan Qaboos Univ Med J*. 2013;13(3):359–67.
6. Rowe TA, Juthani-Mehta M. Urinary tract infection in older adults. *Aging Health*. 2013;9(5). doi:10.2217/ahe.13.38.
7. Vasudevan R. Emergence of UTI Causing Staphylococcus aureus as a Superbug: has the Pathogen Reduced the Options of Antimicrobial Agents for Treatment? *EC Microbiol*. 2015;1:88–112.
8. Verstraelen H, Verhelst R, Vaneechoutte M, Temmerman M. The epidemiology of bacterial vaginosis in relation to sexual behaviour. *BMC Infect Dis*. 2010;10:81. doi:10.1186/1471-2334-10-81.
9. Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. *Nat Rev Microbiol*. 2015;13(5):269–84.
10. Copstead-Kirkhorn CLE, Banasik JL. Study Guide for Pathophysiology. 5th Edn. Elsevier Health Sciences; 2013. p. 272.
11. Foxman B. Epidemiology of urinary tract infections: incidence, morbidity, and economic costs. *Am J Med*. 2002;113(Suppl 1A):5–13.
12. Sedor J, Mulholland SG. Hospital-acquired urinary tract infections associated with the indwelling catheter. *Urol Clin North Am*. 1999;26(4):821–8.
13. Abubakar E. Antimicrobial Susceptibility pattern of pathogenic bacteria causing urinary tract infection at specialist hospital Yola Adamawa state Nigeria. *J Clin Med Res*. 2009;1(1):1–8.
14. Wilson JM, Fenoff R. The health and economic effects of counterfeit pharmaceuticals in africa. anti-counterfeiting and product protection program backgrounder series. global edge business review; 2011. Available from: http://royfenoff.com/Global_Edge_Business_Review_Article.pdf.
15. Vasudevan R. Urinary tract infection: an overview of the infection and the associated risk factors. *J Microbiol Exp*. 2014;1(2):42–54.
16. Foxman B. The epidemiology of urinary tract infection. *Nat Rev Urol*. 2010;7(12):653–60.
17. Fatima N, Ishrat S. Frequency and risk factors of asymptomatic bacteriuria during pregnancy. *J Coll Physicians Surg Pak*. 2006;16(4):273–5.
18. Letica-Kriegel AS, Salmasian H, Vawdrey DK, Youngerman BE, Green RA, Furuya EY, et al. Identifying the risk factors for catheter-associated urinary tract infections: a large cross-sectional study of six hospitals. *BMJ Open*. 2019;9(2):e022137. doi:10.1136/bmjopen-2018-022137.
19. Nandini M, Madhusudan K. Bacteriological Profile of Catheter Associated Urinary Tract Infection and its Antimicrobial

Susceptibility Pattern in a Tertiary Care Hospital. *J Pharm Sci Res*. 2016;6(4):204–7.
20. Tambyah PA, Halvorson K, Maki DG. A prospective study of the pathogenesis of catheter-associated urinary tract infection. *Mayo Clin Proc*. 1999;74(2):131–6.
21. Maki DG, Tambyah PA. Engineering out the risk for infection with urinary catheters. *Emerg Infect Dis*. 2001;7(2):342–7.
22. Mnatzaganian G, Galai N, Sprung CL, Zitser-Gurevich Y, Mandel M, Ben-Hur D, et al. Increased risk of bloodstream and urinary infections in intensive care unit (ICU) patients compared with patients fitting ICU admission criteria treated in regular wards. *J Hosp Infect*. 2005;59(4):331–42.
23. Costel EE, Mitchell S, Kaiser AB. Abbreviated surveillance of nosocomial urinary tract infections: a new approach. *Infect Control*. 1985;6(1):11–3.
24. Horan TC, Andrus M, Dudeck MA. CDC/NHSN surveillance definition of health care-associated infection and criteria for specific types of infections in the acute care setting. *Am J Infect Control*. 2008;36(5):309–32.
25. 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(5):678–82.
26. Poddar N, Panigrahi K, Pathi B, Pattnaik D, Praharaj A, Jena J, et al. Microbiological profile of catheter associated urinary tract infection in ICUs of a tertiary care hospital Bhubaneswar, Odisha, India. *IP Int J Med Microbiol Trop Dis*. 2020;6(2):107–12.
27. Bagchi I, Jaitly NK, Thombare VR. Microbiological Evaluation of Catheter Associated UrinaryTract Infection in aTertiary Care Hospital. *People's J Scientific Res*. 2015;8(2):23–9.
28. Vishwajith, Sahkare R, Archana R, Sangeetha S. A study on catheter associated urinary tract infections (CAUTI) and antibiotic sensitivity pattern of uropathogens causing CAUTI from a tertiary care hospital. *Indian J Microbiol Res*. 2021;8(3):196–9.
29. Danchaivijitr S, Dhiraputra C, Cherdrungsi R, Jintanothaitavorn D, Srihapol N. Catheter- associated urinary tract infection. *J Med Assoc Thai*. 2007;88(10):26–30.
30. Davoodian P, Nematee M, Sheikhvatan M. Inappropriate use of urinary catheters and its common complications in different hospital wards. *Saudi J Kidney Dis Transpl*. 2012;23(1):63–7.
31. Ramesh A, Janagond AB, Raja S, Gobinathan SP, Charl J. Microbiological profile, comorbidity, incidence and rate analysis of catheter associated urinary tract infections in adult intensive care unit. *Indian J Microbiol Res*. 2018;5(1):38–43.
32. Bizuayehu H, Bitew A, Abdeta A, Ebrahim S. Catheter-associated urinary tract infections in adult intensive care units at a selected tertiary hospital, Addis Ababa, Ethiopia. *PLoS ONE*. 2022;17(3):265102. doi:10.1371/journal.pone.0265102.
33. Merle V, Germain JM, Bugel H, Nouvellon M, Lemeland JF, Czernichow P, et al. Nosocomial urinary tract infections in urologic patients: assessment of a prospective surveillance program including 10,000 patients. *Eur Urol*. 2002;41(5):483–9.
34. Tissot E, Limat S, Cornette C, Capellier G. Risk factors for catheter-associated bacteriuria in a medical intensive care unit. *Eur J Clin Microbiol Infect Dis*. 2001;20(4):260–2.
35. Rosser CJ, Bare RL, Meredith JW. Urinary tract infections in the critically ill patient with a urinary catheter. *Am J Surg* . 1999;177(4):287–90.
36. Laupland KB, Bagshaw SM, Gregson DB, Kirkpatrick AW, Ross T, Church DL, et al. Intensive care unit-acquired urinary tract infections in a regional critical care system. *Crit Care*. 2005;9(2):R60–5.
37. Kazi MM, Harshe A, Sale H, Mane D, Yande M. 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):193. doi:: 10.4172/2327-5073.1000193.
38. Dund JV, Ninama R, Sinha M. Antibiotic Sensitivity Pattern of Bacteria Isolated from Catheter Associated Urinary Tract Infections in Tertiary Care Hospital, Jamangar. *Sch J App Med Sci*. 2015;3(5C):1985–8.
39. Duszyńska W, Rosenthal VD, Szczęsny A, Woźnica E, Ulfik K, Ostrowska E, et al. Urinary tract infections in intensive care unit patients-a single-center, 3-year observational study according to the INICC project. *Anaesthesiol Intensive Ther*. 2016;48(1):1–6.
40. Alvarez-Lerma F, Nolla-Salas J, Leon C, Palomar M, Jorda R, Carrasco N, et al. Candiduria in critically ill patients admitted to intensive care medical units. *Intensive Care Med*. 2003;29(7):1069–76.
41. Kauffman CA, Vasquez JA, Sobel JD, Jack D, Sobel D. Prospective multicenter surveillance study of funguria in hospitalized patients. The National Institute for Allergy and Infectious Diseases Mycoses Study Group. *Clin Infect Dis*. 2000;30(1):14–8.
42. Kulkarni SG, Talib SH, Naik M, Kale A. Profile of Urinary Tract Infection in Indwelling Catheterized Patients. *IOSR J Dent Med Sci*. 2014;13(4):132–8.

Author biography

Rachana Patel, Associate Professor https://orcid.org/0000-0002-2514-6634

Amit Pravin Chauhan, Professor and Chief Intensivist https://orcid.org/0000-0002-3466-4599

Himani Pandya, Associate Professor https://orcid.org/0000-0001-9444-9279

Rezil Christie, Infection Conrol Nurse

Sucheta Lakhani, Professor https://orcid.org/0000-0001-6684-0908

Cite this article: Patel R, Chauhan AP, Pandya H, Christie R, Lakhani S. Microbiological aspects of catheter associated urinary tract (CAUTI) infections in tertiary care hospital: A prospective cross-sectional study. *IP Int J Med Microbiol Trop Dis* 2024;10(2):145-150.