Annals of Medicine and Medical Sciences (AMMS)
Volume 03, 2024, *Page No.: 96 to 99*
Available at: *http://ammspub.com*

Original Article

OPEN ACCESS

Catheter-Associated Urinary Tract Infections in Surgical Patients Undergoing Short-Term Catheterization at a Tertiary Care Hospital: A Retrospective Study

Jyotiranjan Mohapatra [1], Snigdharani Choudhury [2], Rakesh Ranjan Swain *[3], Sashibhusan Dash [4]

[1]Assistant Professor, Department of General Surgery, Shri Jagannath Medical College and Hospital, Puri, Odisha, India.
[2]Assistant Professor, Microbiology, A.H. Post-Graduate Institute of Cancer, Cuttack, Odisha, India.
[3]Associate Professor, Department of General Surgery, Bhima Bhoi Medical College and Hospital, Balangir , Odisha, India.
[4]Scientist C, MRU, PRM Medical College and Hospital, Baripada, Odisha, India.

*Corresponding Author: Dr. Rakesh Ranjan Swain; *drrakesh.swain19@gmail.com*

Abstract

Background: Urinary catheters pose a potential risk of introducing infections in the urinary system. We aim to assess the rate of catheter-associated urinary tract infection (CAUTI) in surgical patients, observe catheterization practices, identify risk factors, and explore preventive measures to improve patient outcomes and reduce the burden of CAUTI. ***Methods:*** This retrospective study analyzes patient records from a tertiary care institute, examining demographics, catheterization duration, underlying health conditions, and microbial profiles. ***Results:*** A total of 198 patients admitted to our surgical ward underwent catheterization, of which 121 met the inclusion criteria (54 males, 67 females). Twelve patients (8 female, 4 male) developed positive urine cultures on day 3 of catheterization, with 10 experiencing UTI symptoms. The most common organism isolated was E. coli (7/12), followed by Klebsiella sp. (2/19), Pseudomonas aeruginosa (1/19), Enterococcus sp. (1/12), and Staphylococcus aureus (1/19). ***Conclusion:*** CAUTI is a cause for significant patient morbidity during hospital stay, incurring heavy costs on the patients, hospitals and also placing unnecessary burden on government. insurance schemes. Proper preventive measures and personnel training is necessary to reduce the morbidity associated with urinary catheters and improve patient care.

Keywords: ***Urinary tract infection, Catheter, Tertiary care***

Introduction

Catheter-associated urinary tract infection (CAUTI) remains one of the most prevalent healthcare-associated infections [1,2]. The widespread use of indwelling urethral catheters in healthcare facilities contributes significantly to this issue. Approximately 75% of hospital-acquired Urinary tract infections (UTIs) are linked to urinary catheters, and between 15-25% of hospitalized patients receive urinary catheters during their hospital stay [3]. Prolonged catheter use is the primary risk factor for developing CAUTI, reinforcing the importance of using catheters only when necessary and removing them promptly. UTIs are characterized by a range of symptoms of varying intensity, collectively known as lower urinary tract symptoms (LUTS). Common symptoms include increased urinary frequency, dysuria (burning sensation during urination), urgency, and small urine volume. Urine may appear cloudy or have an unusual odor. Lower abdominal discomfort or pelvic pain is also common.

Additionally, some individuals may notice hematuria. Untreated UTIs can lead to systemic symptoms such as fever and fatigue. Severe UTIs are often characterized by high-grade fever with chills, and patients may present with acute kidney injury due to ascending infection. Catheter-associated infection refers to an infection occurring in an individual with a urinary catheter or within 48 hours of catheter removal [4]. UTI denotes significant bacteriuria in a symptomatic patient without an alternative source of infection. Asymptomatic Bacteriuria (ASB) signifies significant bacteriuria in an asymptomatic patient. Bacteriuria is a general term encompassing both UTI and ASB. In the context of urinary catheter literature, catheter-associated bacteriuria predominantly comprises catheter-associated asymptomatic bacteriuria. In the context of this study, CA-UTI, CA-ASB and CA-bacteriuria are all considered indicative

Received: October 27, 2024; **Revised:** December 03, 2024; **Accepted:** December 07, 2024

of urinary tract infection, as bacteria are not typically found in the urinary tract [4].

The pathogenesis of CAUTI can be explained by the biofilm phenomenon. Biofilm formation on the catheter surface is the primary cause of bacteriuria. Biofilm is a complex organic matrix composed of microorganisms embedded within an extracellular mucopolysaccharide substance. Urine components, including Tamm-Horsfall protein and magnesium and calcium ions, contribute to this matrix [5,6]. Biofilm formation begins shortly after catheter insertion and can be accelerated by poor aseptic technique. This process occurs on both internal and external catheter surfaces. Stagnant urine in the drainage bag is often the initial site of infection, with bacteria subsequently ascending along the catheter tubing. Only about 5% of CA-ASB cases result from the introduction of periurethral organisms during catheter insertion [7].

The urinary tract is a reservoir for resistant microorganisms, posing a risk of cross-infection. Common pathogens include Escherichia coli, Klebsiella spp., Proteus, Pseudomonas, Staphylococcus aureus, coagulase-negative staphylococci (CoNS), and Enterococcus spp. These infections can lead to genitourinary complications, sepsis, skeletal infections, and, over time, bladder cancer [8]. Proteus mirabilis is less common in patients with short-term catheterization [9]. However, the longer a catheter remains in place, the more likely it is to colonize. Proteus mirabilis produces more abundant biofilm than other bacteria, contributing to persistent infections [10].

The objective of this study was to observe the rates of CA-UTI in our surgical ward and its association with various demographic and patient-dependent factors.

Materials and Methods

This retrospectively study was done on patients who underwent catheterization in the Department of General Surgery at Shri Jagannath Medical College and Hospital, Puri, Odisha, India, over a one-year period. Demographic information, presenting symptoms, comorbidities, and relevant laboratory results were collected and recorded.

Inclusion criteria: All patients who were admitted in our unit who required catheterization were included in this study. Intraoperative urine output monitoring in patients undergoing major surgery, Output monitoring in acutely ill patients and Patients with complaints of incontinence, strangury or dysuria.

Exclusion criteria: Patients with pre-existing UTI (diagnosed by urine routine and cultures at admission), Ongoing sepsis or positive blood culture at admission, History of type II diabetes, renal stones, patients referred with a catheter insitu, h/o indwelling catheter in the last 15 days, patient age.

Data were collected and organized in Microsoft Excel. Descriptive statistics, including frequencies and percentages, were used to summarize categorical variables. Continuous variables were summarized using mean and standard deviation.

Results

A total 121 patients were included in this study including 54 (44%) male and 67 (55%) female and maximum number of patients were from the 46-60 years age group, the median age being 46.7 years (range 19-78) as indicated by (**Table 1**).

Table 1: Age and sex wise distribution of included cases.

Age sex distribution		**Total N=121**	
		n	**%**
Sex	Male	54	44.6
	Female	67	55.4
Age	<20	7	5.8
	21-40	27	22.3
	41-60	53	43.8
	>61	34	28.1

All patients were catheterized in an emergency scenario. The various reasons for catheterization, the most common of which was found to be prior to major surgical procedure, which accounted for 102 cases (84.2%, 45 male and 57 female) followed by patients with acute illness in 16 cases (13.2%, 6 male and 10 female) and for difficulty in micturition in 3 cases (2.4%, 3 male).

After 48 hours of catheterization, patient urine cultures were sent again by drawing fresh samples from the catheter with an aseptic syringe. Of the above 121 patients, 12 patients (9.9%) were found to have a positive urine culture report (>105 CFU/ml). Of these 12 patients, 10 were found to have symptoms of UTI (83.3%) along with a urine routine suggestive of pyuria, thus establishing a diagnosis of CAUTI (**Table 2**).

Table 2: Urine culture findings.

Urine Culture (n=121)	**N (%)**
Positive for bacteria	12 (9.9)
Negative for bacteria	109 (90)
Symptoms of UTI (in patients with positive urine culture) (n=12)	
Present (CAUTI)	10 (83.3)
Absent (CA-ASB)	2 (16.7)
Age sex distribution	
Male	4 (33.3)
Female	8 (66.7)
<20	1 (8.3)
20-40	2 (16.7)
41-60	5 (41.7)

>60	4 (33.3)
Causative Organism isolated	
E. coli	7 (58)
Klebsiella spp	2 (16.6)
Pseudomonas aeruginosa	1 (8.3)
Enterococcus sp.	1 (8.3)
Staphylococcus aureus	1(8.3)

Of all these, E. coli cultures, were sensitive to polymyxin B, colistin, and ertapenem, followed by amikacin, imipenem, gentamicin, meropenem, ampicillin, piperacillin / tazobactam, cefoperazone / sulbactam, co-amoxiclav, cefotaxime, ceftriaxone, cefuroxime and ciprofloxacin. All cultures were resistant to amoxicillin.

Klebsiella species were resistant to amikacin, ampicillin, co-amoxiclav, gentamicin, imipenem, cefoperazone/sulbactam, cefotaxime, ceftriaxone, cefuroxime, ciprofloxacin, and meropenem. Growth was only sensitive to colistin and polymyxin.

Pseudomonas was sensitive to amikacin, colistin, piperacillin/tazobactam, meropenem, and polymyxin B. The organisim was resistance to ciprofloxacin, gentamicin, imipenem, and cefoperazone/tazobactam.

Discussion

In this retrospective observational study involving 121 patients (54 males, 67 females), we found that 12 patients (9.9%) developed catheter-associated urinary tract infection (CAUTI), resulting in a CAUTI rate of 3 per 1000 catheter days.

Sullivan et al., [11] reported that the risk of bacteremia during initial catheter insertion is similar, regardless of pre-existing UTI. Among the 114 patients undergoing major surgeries, 15 (13.1%) developed CA-ASB, with a female-to-male ratio of 11:4. This rate is lower than that reported by Farsi et al.,[12] for colorectal procedures. Bregenzer et al.,[13] reported a 5.6% rate of positive blood cultures in geriatric patients with long-term catheters, with limited evidence of bloodstream infections originating from the catheter itself.

Escherichia coli was the most common causative organism, identified in 58% of the 12 CAUTI cases, aligning with Nicolle et al.,[6] finding of 69.3% E. coli-positive cultures. Among the 12 patients with CA-ASB, there was a female-to-male ratio of 2:1, consistent with the 1.9:1 ratio reported by Tambyah et al., for CAUTI [7,14]. The mean age of patients with CA-ASB was 47.6 years, with a range from under 20 to over 60 years. Older age may be a risk factor for UTIs due to decreased immunity. In symptomatic UTI cases, the most common symptoms were fever and dysuria, contrasting with the low incidence of febrile episodes reported by Warren et al. in patients with chronic bacteriuria.

The older age group may be more susceptible to UTIs due to factors like neglect and weakened immune systems. In patients with symptomatic UTIs, the most common symptoms were fever and burning micturition. Two patients also experienced chills, while one patient reported abdominal pain and another reported increased urinary frequency. These findings contrast with a study by Warren et al., [10] which reported a low incidence of febrile episodes in patients with chronic bacteriuria, suggesting potential differences in the presentation of acute and chronic UTIs.

Among the seven patients with urine cultures positive for E. coli, all isolates demonstrated sensitivity to polymyxin B, colistin, and ertapenem. Sensitivity to amikacin, imipenem, gentamicin, meropenem followed. Conversely, all isolates were resistant to amoxicillin. These findings are consistent with previous research [15] which reported high resistance to cephalosporins in E. coli, potentially attributed to inappropriate antibiotic use in the region. Another study identified imipenem as the most effective antibiotic for E. coli-related UTIs [16]. The incidence of UTIs in our center may be attributed to several factors, including inadequate aseptic practices during catheterization, poor patient hygiene, and the presence of underlying comorbidities. These factors can increase the risk of bacterial entry into the urinary tract and subsequent infection.

This study's limitations include a relatively small sample size, which may limit the ability to establish definitive associations. Early admissions during the incubation period could lead to false-positive results. Additionally, suboptimal hygiene practices at hospitals and among patients may contribute to misinterpretation of findings.

Conclusion

This study demonstrates that CAUTI significantly contributes to patient morbidity during hospitalization, resulting in substantial costs for both patients and healthcare institutions. Additionally, it places an undue burden on government insurance programs. Implementing effective preventive measures and providing adequate training to healthcare personnel are essential to reduce CAUTI-related morbidity and improve patient care.

Declarations

Ethical Approval and Consent to participate

Not applicable

Consent for publication

Not applicable

Availability of supporting data

On request

Competing interests

Nil

Funding Statement

Nil

Authors' contributions

J.M., S.C., and R.R.S. design the concept; J.M., involved in the recruitment of cases; S.C., were involved in the experiments; J.M., S.C., S.D and R.R.S. were involved in the data acquisition; S.D. and R.R.S. was involved in the data analysis; J.M., S.C., R.R.S., and S.D., were involved in the manuscript preparation. All the authors have reviewed the manuscript.

References

[1] Zarb P, Coignard B, Griskevicienne J, Muller A, Vankerckho ven WK, Goossens MM, et al. The European Centre for Disease Prevention and Control (ECDC) pilot point prevalence survey of healthcare associated infections and antimicrobial use. Euro Surveill.2012; 17(46):20316.

[2] Magill SS, Edwards JR, Bamberg W, Beldaus ZG, Dumyati G, Kainer MA, et al. Multistate point prevalence survey of health care-associated infections. N Engl J Med. 2014; 370:1198-208.

[3] UTI. Available at: https://www.cdc.gov/hai/ca_uti/uti.html: text. Accessed on 20 November 2023.

[4] Hooton TM, Bradley SF, Cardenas DD, Colgan R, Geerlings SE, Rice JC, et al. 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. 2010; 50:625- 63.

[5] Stark RP, Maki DG. Bacteriuria in the catheterized patient. What quantitative level of bacteriuria is relevant?. N Engl J Med. 1984; 311:560-4.

[6] Nicolle LE. Catheter associated urinary tract infections. Antimicrob Resist Infect Control. 2014; 3:23.

[7] Stickler DJ. Bacterial biofilms in patients with indwelling urinary catheters. Nat Clin Pract Urol. 2008; 5(11):598-608.

[8] Hooton TM, Bradley SF, Cardenas DD, Colgan R, Geerlings SE, Rice JC, et al. 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. 2010;50(5):625-63.

[9] Matsukawa M, Kunishima Y, Takahashi S, Takeyama K, Tsukamoto T: Bacterial colonization on intraluminal surface of urethral catheter. Urology. 2005;65:440-44.

[10] Warren JW, Tenney JH, Hoopes JM, Muncie HL, Anthony WC: A prospective microbiologic study of bacteriuria in patients with chronic indwelling urethral catheters. J Infect Dis. 1982;146:719-23.

[11] Sullivan NM, Sutter VL, Mims MM, Marsh VH, Finegold SM. Clinical aspects of bacteremia after manipulation of the genitourinary tract. J Infect Dis. 1973;127(1):49-55.

[12] Farsi AH. Risk Factors and Outcomes of Postoperative Catheter-Associated Urinary Tract Infection in Colorectal Surgery Patients: A Retrospective Cohort Study. Cureus. 2021;13(5):e15111.

[13] Bregenzer T, Frei R, Widmer AF. Low Risk of Bacteremia During Catheter replacement in patients with long-term urinary catheters. Arch Intern Med. 1997;157(5):521-5.

[14] Tambyah PA, Maki DG. Catheter-Associated Urinary Tract Infection Is Rarely Symptomatic: A Prospective Study of 1497 Catheterized Patients. Arch Intern Med. 2000;160(5):678-682.

[15] Bagree R, Srinivas V, Kumar R, Gupta A, Kumar N, Kumar N. Incidence of urinary tract infection in surgical patients after short term catheterization in a tertiary care institute. Int Surg J 2024;11:924-928.

[16] Mukhit KM. 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;4:193.