Original Research Article

A Study On Prevalence Of Catheter Associated Urinary Tract Infections In A Tertiary Care Facility Of Bihar

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Abstract

Introduction: Urinary tract infection (UTI) is one of the most common infections in humans, accounting for more than 150 million cases worldwide. Beyond the initial urinary infection, catheter-associated UTIs (CAUTIs) can lead to complications including bacteremia, endocarditis, osteomyelitis, septic arthritis, and meningitis. 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. **Methodology:** A cross-sectional study was carried by the Department of Microbiology, Jan Nayak Karpuri Thakur Medical College and Hospital, Bihar, from January 2021 to July 2021. Both adult males and females were included in the study group. Before starting the study, the purpose of the study was explained to the subjects, and informed consent was obtained. Approval was acquired from the Ethical Committee. **Results:** The present study comprised of 150 catheterized urine samples collected with proper aseptic precautions. Mean age of the participating patients was 47.5 years with a standard deviation of 7.2 years. The age range was 17 years to 81 years. The male to female ratio was calculated and approximated to 1.5:1. The incidence rate of CAUTI calculated for this study for ICU and wards were 3.7 and 17.2 per 1000 catheter-days, respectively and catheter utilization ratio was 0.59 and 0.07 in ICU and ward, respectively. **Conclusion:** The study underscores the pressing need for the development of antimicrobial urinary catheters and their deployment when longer duration of catheter access is required.

Key Words: Prevalence, Catheter Associated Urinary Tract Infections

Introduction

Urinary tract infection (UTI) is one of the most common infections in humans, accounting for more than 150 million cases worldwide. In addition to being the most common bacterial infection, UTIs also account for 36% of all healthcare-associated infections. Of these 36% infections, 80% of them are estimated to be catheter associated. Beyond the initial urinary infection, catheter-associated UTIs (CAUTIs) can lead to complications including bacteremia, endocarditis, osteomyelitis, septic arthritis, and meningitis. These pathologies collectively result in prolonged hospital stays and increased morbidity and mortality[1]. As per Center for disease prevention (CDC) and control, CAUTI is where an indwelling urinary catheter (IUC) was in place for >2 calendar days on the date of the event, with a day of device placement being Day 1 and an IUC was in place on the date of the event or the day before. If an IUC was in place for >2 days and then removed, the date of event for UTI must be the day of discontinuation or the next day for the UTI to be catheter-associated[2].

The susceptibility of an individual to CAUTI is mediated by several risk factors, including older age, female gender, diabetes, and impaired immunity. However, the most important risk factor is the use of an indwelling catheter and the duration of catheterization. The CDC estimates that approximately 12%–16% of adult hospital inpatients will have an indwelling catheter at some point during their hospitalization and that the risk for developing a CAUTI increases by 3%–7% with each additional day of catheterization. This increased susceptibility in catheterized patients is due to the ability of the catheter to bypass several host defenses and thereby enable bacterial entry into the urinary tract. In intubated patients, bacteria can ascend from the urethral meatus into the bladder by migrating between the mucosal and catheter surfaces. Further, contamination of the drainage bag or disruption in the tubing junction may also result in bacterial migration via the drainage system. In addition, the presence of an indwelling device favors the persistence of the etiological agent in the urinary tract, thereby increasing the risk for CAUTI. UTIs, including CAUTIs, can be caused by several bacterial species. However, the most common causative agent for UTI and CAUTI is Uropathogenic Escherichia coli (UPEC). It is estimated that UPEC is responsible for approximately 80% of all UTIs[1].

Diagnosing CAUTI is often a diagnosis of exclusion. Fever without localizing findings is the usual presentation. Localizing signs or symptoms such as catheter obstruction, acute hematuria, recent trauma, suprapubic pain, or costovertebral angle pain or tenderness are helpful to identify a urinary source of fever but are present in only a minority of episodes of presumed symptomatic infection. If localizing genitourinary findings are not present, fever in bacteriuric patients should be attributed to urinary infection only when there are no other potential sources[3].

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.

Methodology

A cross-sectional study was carried by the Department of Microbiology, Jan Nayak Karpuri Thakur Medical College and Hospital, Bihar, from January 2021 to July 2021. Both adult males and females were included in the study group. Before starting the study, the purpose of the study was explained to the subjects, and informed consent was obtained. Approval was acquired from the Ethical Committee. Patients above 15 years of age who were

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catheterized and admitted to various wards and ICU s 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[4].

To monitor the occurrence of CAUTIs, the following were calculated: (1) Device Utilization Ratio (DUR): Determining the percentage of patients with urinary catheters urinary catheter utilization= dividing the number of indwelling catheter-days by number of patient-days × 100 (2) Incidence rate = dividing the number of new CAUTI case(s) by the number of catheter-days × 100[5].

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 MacConkey Agar for isolating all kind of urinary pathogens. Semiquantitative 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[6]. 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[7]. 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 150 catheterized urine samples collected with proper aseptic precautions. Mean age of the participating patients was 47.5 years with a standard deviation of 7.2 years. The age range was 17 years to 81 years. The male to female ratio was calculated and approximated to 1.5:1. Maximum number of samples was obtained from medicine department followed by orthopedics department and surgical wards. Significant growth was observed among 15/150 (10%) patients. [Figure 1 & 2]

Previous history of catheterization was given by 22 patients and 4 out of these 22 had positive culture growth while previous history of UTI was noted among 10 patients and 2 of these patients had positive growth. 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 incidence rate of CAUTI calculated for this study for ICU and wards were 3.7 and 17.2 per 1000 catheter-days, respectively and catheter utilization ratio was 0.59 and 0.07 in ICU and ward, respectively.

The antimicrobial sensitivity testing of isolated organisms is shown in table 2.

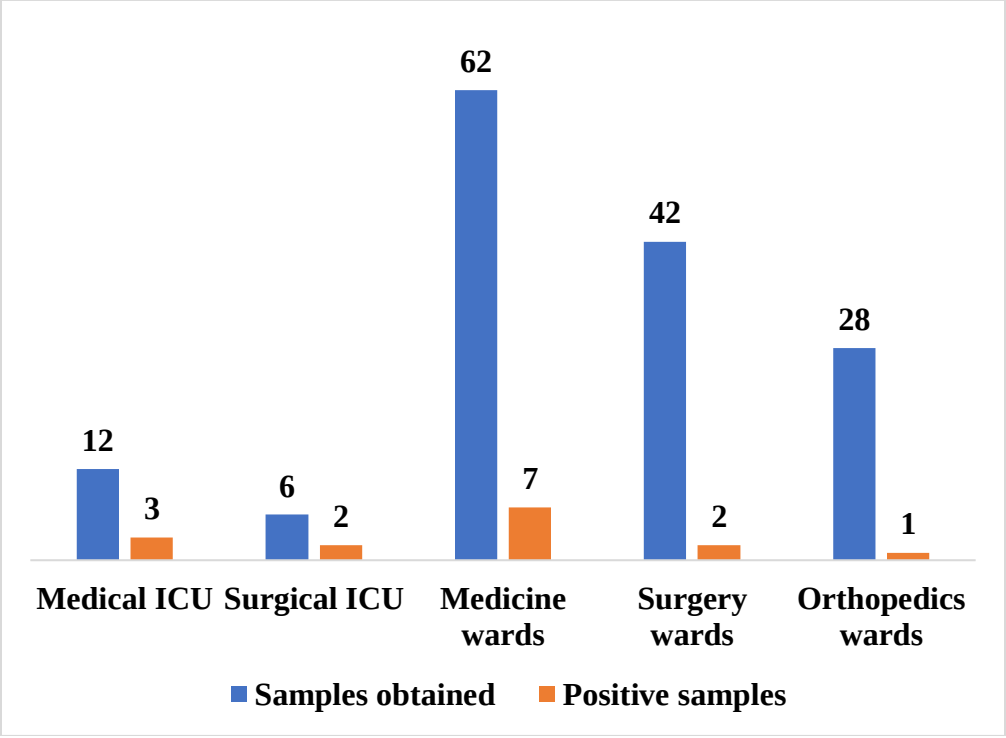

Figure 1: Column showing distribution of samples obtained from various wards and their results on culture

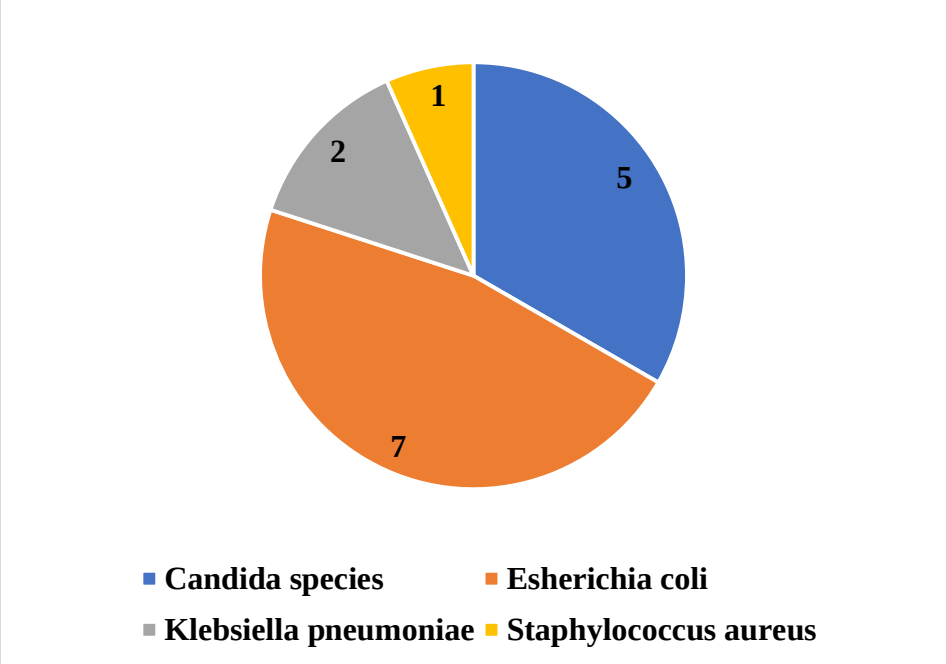

Figure 2: Pie distribution of organism from positive sample growth

Table 1: Antimicrobial susceptibility profile of bacterial uropathogenic organisms (N = 10)

Antibiotic	Gram negative (N = 9)		Gram positive (N = 1)	
	Resistant	Susceptible	Resistant	Susceptible
Amikacin	1	8	0	1
Gentamycin	5	4	1	0
Ciprofloxacin	6	3	1	0
Nitrofurantoin	5	4	1	0
Cotrimoxazole	7	2	1	0
Cefazolin	2	7	-	-
Cefuroxime	4	5	-	-
Cefotaxime	5	4	-	-
Ceftazidime	2	7	-	-
Amox-clav	8	1	1	0
Vancomycin	-	-	0	1
Linezolid	-	-	0	1
Azithromycin	-	-	0	1
Cefoxitin	-	-	1	0

Discussion

The presence of indwelling catheter creats an ideal environment for pathogenic growth by providing a surface for the attachment of microbial adhesion. Such infections may ascend to bladder, ureters, and kidney[8].

The current study encompasses 150 patients from various wards of the hospital. The mean age was 47.5 years and there was a male preponderance. These results were in concordance with Verma et al., where the majority of catheterized patients were male[8]. However, this is contradictory to Kakaria et al., who observed a higher incidence of CAUTI in females as compared to males[9]. 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. Apisarnthanarak et al[10]. suggested catheter utilization ratio in medicine 0.52, in surgery 0.24, and the ICUs 0.32. Our study emphasizes the need for careful evaluation of the initial reason for urinary catheterization and the continual reassessment of the need for continued catheter use. Educating physicians on the risk of unnecessary urinary catheterization to their patients is critical. Careful attention to this aspect of medical care may reduce IUC use and CAUTIs by at least one in six of these patients. In our set up also, the higher number of catheterized patients were from medicine ward which could also be the outcome of inappropriate urinary catheters usage in our tertiary care center.

Several risk factors have been cited to be associated with UTI. We included the previous history of catheterization/UTI, associated comorbid condition as diabetes and obstructive uropathy as potential risk factors in our study. These findings were similar to Kakaria et al., who identified three risk factors associated with CAUTI: female gender, diabetes mellitus, and duration of catheterization[9]. 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[11]. 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. The incidence of CAUTIs as observed in other studies, 1.9 − 2.4/1000 catheter-days in Polish ICUs[12,13]; 6.4 − 12/1000 catheter-days according to the SPIN-UTI Project of the Italian Nosocomial Infections Surveillance in ICUs[14] and 1.46 − 0.57/1000 catheter-days reported by the Krankenhaus Infections Surveillance System[15]. 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[16]. Similar to our finding, Santhose et al also reported E. coli as the predominant organism followed by Klebsiella spp[17]. 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[18].

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[19]. In the present study, the prevalence of resistance was high to cotrimoxazole (88.89%) and ciprofloxacin (88.89%). This is in accordance with Bhani et al., where CAUTIs due to GNB were significantly resistant to norfloxacin and levofloxacin but susceptible to nitrofurantoin[20]. 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[21]. 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[20].

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[3]. 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 hydrogel and nitrofural, are considered effective in preventing CAUTI because of suppression of bacterial growth on the catheter surface[22].

Conclusion

Catheterized urinary tract provides an ideal environment for bacterial growth. Such infection adds up to the morbidity. It is utmost important to avoid unnecessary catheterization. The present study helped us to generate institutional data regarding such infections. The development of universal resistance among uropathogens to antibacterial agents is clinically important and has to be considered when instigating antibiotic therapy for symptomatic infections. Replacing the old catheters before antibiotic treatment is a sensible option. The treatment should be based on the susceptibility of organisms that are isolated from urine aspirated from the new catheter. Thus, the study underscores the pressing need for the development of antimicrobial urinary catheters and their deployment when longer duration of catheter access is required.

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