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Original Research Article

Catheter associated urinary tract infection: antibiotic resistance and pathogen profile in a tertiary care hospital, South India

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ABSTRACT

Background: Urinary catheters serve as a fertile milieu for a wide range of aerobic bacterial pathogens. The added caveat of antimicrobial resistance among these uropathogens accentuates the importance of routine region-specific catheter associated urinary tract infection (CAUTI) monitoring. Present study aimed to assess the incidence of CAUTI in a tertiary care hospital in Karnataka and identify the pathogen profile and antimicrobial susceptibility pattern of the uropathogens causing CAUTI.
Methods: This retrospective study was carried out for a period of three months after taking ethical clearance. Patients on indwelling urinary catheter admitted in the hospital between October-December 2024 were included in the study. The uropathogen profile, positivity rate and demographic association with CAUTI was studied.
Results: Present study documented CAUTI in 7 out of 583 catheterized urine samples (1.2%) in the 3-month study period. The total catheter days was 13,193 for a period of 3 months. The CAUTI rate was found to be 0.53 per 1000 catheter days. Hypertension along with uncontrolled diabetes was the most common associated comorbidity. The highest incidence of CAUTI was in the 61-70 age bracket. *Klebsiella pneumoniae* was the most common uropathogen associated with CAUTI.
Conclusions: The CAUTI rate during the three-month study period (0.53) was well within the hospital benchmark of 1.03. CAUTI remains a lurking threat for patient safety and a constant challenge to the infection control team. CAUTI surveillance forms the cornerstone for implementation of care bundles and directing perpetual health care worker education.

Keywords: CAUTI, Co-morbidity profile, Incidence, Uropathogen profile

INTRODUCTION

The healthcare associated infection (HAI) risk significantly increases with medical instrumentation during the course of a patient's stay in a hospital. Indwelling urinary catheters are foremost among such invasive medical devices required for managing urinary retention, maintaining continence and measuring urinary output during patient care activities. However, despite benefits they expose patients to a plethora of infectious as well as non-infectious complications. Approximately 12-16% of hospitalized patients may require catheterization during their period of hospital stay.[1] The reported rates of urinary tract infections among patients with indwelling catheters is one such infectious complication which hinges on multiple factors in a tertiary care hospital.[1] The risk of developing catheter associated bacteriuria increases with the number of catheter days and the patient location. (ward versus ICU) A fraction of these patients progresses to develop symptomatic urinary tract infection (SUTI). Worldwide the prevalence of hospital associated urinary tract infections inclusive of CAUTI ranges between 1.4% to 5.1% with higher spiraling rates among low and middle income (LMIC) countries.[2,3]

The presence of an indwelling catheter serves as a nidus for potentially pathogenic bacteria predisposing to the development of CAUTI. The pathogens may gain entry during insertion, manipulation or removal of the urinary draining system.[4] Further the risk factors such as extremes of age, female gender, comorbidities like diabetes mellitus, diarrhea, renal insufficiency, errors in catheter care, debilitated or immunocompromised states predispose towards the development of CAUTI.[5] The rising alarm in LMIC countries is inflicted by the economic cost and resistance sequel inflicted by CAUTI episodes thereby making it a significant liability.

The pathogen profile and susceptibility pattern of CAUTI varies considerablywith time and geographical location. Incongruous antibiotic use is associated with long term consequences attributable for treatment failure and drug resistance. CAUTI rates reflect the quality of catheter care in a particular healthcare setting. Assessing the basal CAUTI rate and pathogen profiling of the causative organisms is fundamental to implement the necessary infection control system to prevent CAUTI to the maximum possible extent.[6]

Present study aimed to identify the microorganisms causing CAUTI and their susceptibility profile from a tertiary care hospital in Mysuru, Karnataka and thereby determine the CAUTI rate during the three-month period (October-December 2024).

METHODS

A retrospective cross-sectional study was conducted in the department of Microbiology of JSS Medical Hospital, Karnataka, India for a timeframe of 3 months-1 October 2024 to 31 December 2024. The Patients admitted to the hospital and placed on urinary catheter for >48 hours during the study period were included in the study. 583 catheterised urine samples were studied during the study period. Patients with history of primary immunodeficiency syndromes, sexually transmitted diseases, children <18 years of age and those on immunosuppressant therapy were excluded from the study.

Institutional ethics committee (IEC) clearance was obtained. The demographic data and history of the patients including the number of catheter days, treatment and personal history was recorded from the case sheets.

All urine samples from catheterized patients were aseptically collected and sent to the microbiology laboratory as per hospital protocols for analysis within 30 minutes of sample collection. In case of delay, the urine samples were stored under refrigeration and sent to the lab within a maximum acceptable time frame of 2 hours.

Sample processing

The samples were processed as per the laboratory protocol, in short: wet mount preparation of uncentrifuged urine sample was done for evaluation of host cells and microorganisms. Semi-quantitative culture was done using a calibrated loop of 2 mm internal diameter holding 0.001 ml of urine and was inoculated on to urochrome agar. Cultures yielding 1-2 organisms with colony count of at least one organism 10^5 CFU/ml in patients fulfilling the surveillance criteria (Table 1) were confirmed as CAUTI cases. The isolates grown in the culture were subjected to antimicrobial susceptibility testing (AST) and identification was performed by automated VITEK-2 advanced colorimetric technology. Antimicrobial susceptibility was interpreted as per the CLSI guidelines. The CAUTI rate per 1000 urinary catheter days was calculated by dividing the number of confirmed CAUTI cases with the number of catheter days and multiplying the result by 1000. Device utilization rate was calculated by dividing the indwelling catheter days with the number of patient days. The occurrence of CAUTI among various age groups, gender, pathogenic isolate profile, antibiotic susceptibility pattern and associated co-morbidities were expressed as percentages.

Table 1: CAUTI surveillance criteria.

Catheter criteria
Duration of catheter insertion (>2 consecutive days)
Symptom criteria (presence of any one of the following symptoms)
Fever (>38.0ºC), suprapubic tenderness, Costovertebral angle pain/tenderness, urinary frequency, dysuria
Culture criteria
1 or 2 organisms isolated from urine with colony count of atleast one organism 10^5 CFU/ml (>2 organisms-taken as contaminant). Colony count <10^5 CFU/ml not considered for surveillance.

RESULTS

The microbiology laboratory received 3142 urine specimens during the study period (October-December 2024). Out of the 3142 urine specimens the catheterized urine specimens accounted to 583 (18.43%). Among the catheterized urine specimens 467 (80.10%) samples yielded no growth. 12 (2.05%) samples were contaminated and yielded mixed growth. 97 (16.6%) samples yielded insignificant aerobic culture growth with 10^3 CFU/ml. Catheter and duration surveillance criteria was fulfilled in 12 catheterised urine samples collected. Culture surveillance growth criteria was satisfied in 7 samples. The average catheter days for all patients admitted during the study period ranged from 4 to 6 days catheter days per patient.

A total of 13,193 catheter days was documented during the study period. Therefore, the CAUTI rate was found to be 0.53 per 1000 catheter days. In the month of October and December 5 and 2 cases of CAUTI were documented as depicted in Figure 1.

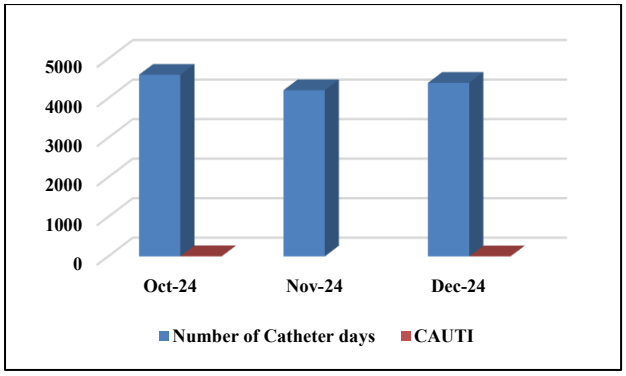

Figure 1: Month-wise CAUTI surveillance during the study period.

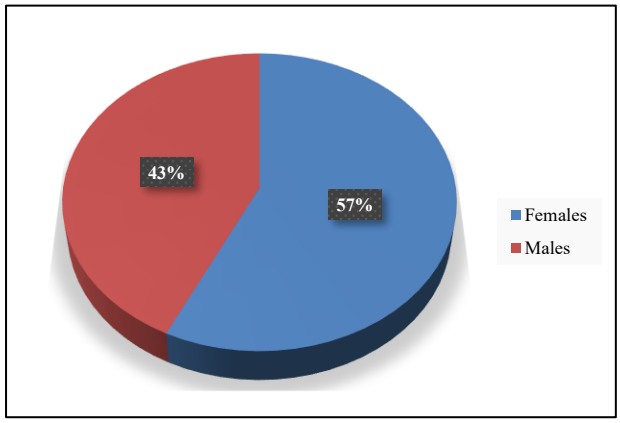

Figure 2: Male to female ratio.

The incidence of CAUTI was higher among females (57.14%) in comparison to males (42.85%) as depicted in Figure 2.

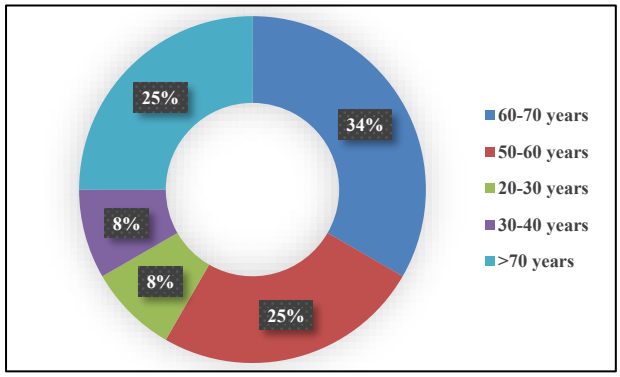

Figure 3: Age wise distribution.

CAUTI incidence was highest among the age group 61-70 (34%) as depicted in Figure 3.

Hypertension along with uncontrolled diabetes mellitus was the most common co-morbidity documented in 43% of the patients. Chronic kidney disease was present in 14.28% of the patients. All confirmed CAUTI cases yielded Gram negative aerobic pathogens, *Klebsiella pneumoniae* (42.857%), was the most predominant pathogen, followed by *Pseudomonas aeruginosa* (28.57%). *Escherichia coli* and *Acinetobacter baumannii* were isolated from one patient each as depicted in Figure 4.

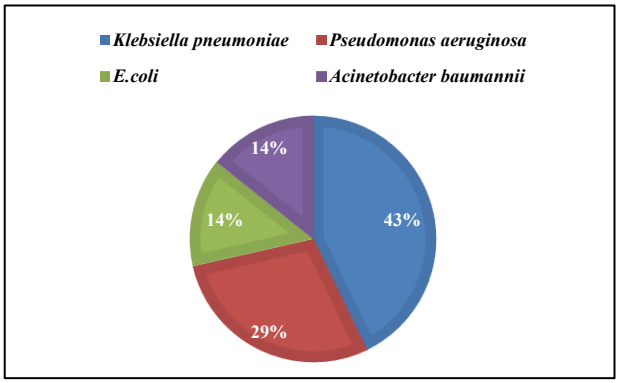

Figure 4: Pathogen profile.

All the 7 Gram negative isolates causing CAUTI were found to be MDR pathogens. The 3 isolates of *Klebsiella pneumoniae* and *E. coli* were also multidrug resistant exhibiting complete resistance to nitrofurantoin and third generation cephalosporins as depicted in Figure 5.

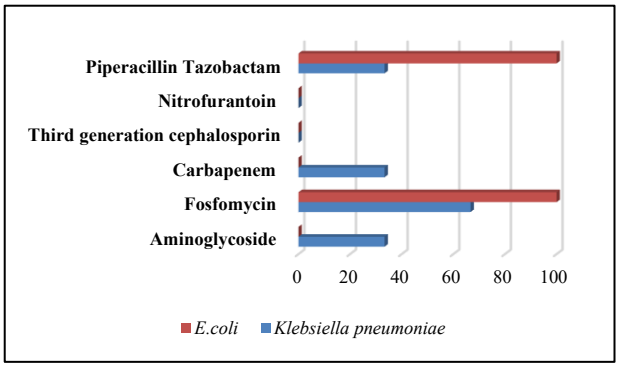

Figure 4: Susceptibility profile of enterobacterales.

The two *Pseudomonas aeruginosa* isolates remained resistant to ceftazidime and showed excellent susceptibility to piperacillin tazobactam, co-trimoxazole and carbapenems. The single *Acinetobacter baumannii* isolate showed susceptibility to minocycline alone while remaining resistant to piperacillin tazobactam, co-trimoxazole and carbapenems.

DISCUSSION

CAUTI is a substantial continued healthcare challenge which continues to impact the healthcare resource utilization, patient morbidity and mortality. The present study was conducted for a period of three months in a tertiary care center of southern Karnataka to provide insights to CAUTI rates, pathogen profile and antimicrobial susceptibility pattern in this geographical location. The study documents a CAUTI rate of 0.53 per

1000 catheter days which was notably below the hospital's internal benchmark of 1.03 per 1000 catheter days. A study by Poddar et al documents a CAUTI rate of 1.9 per 1000 catheter days and a study conducted in a tertiary care hospital of southern India documents a CAUTI rate of 36.3 per 1000 catheter days.[8] The low rate of CAUTI in our institution could be attributed to standardised diagnostic criteria and aseptic sampling of catheterised urine specimens. Despite geographical, patient related and hospital setting based factors attributing to differing rates of CAUTI in various settings the common requirement for all healthcare setups is the presence of a robust continued process driven surveillance system and timely interventions.

Advancing age (61-70) and the presence of comorbidities heightened the risk of CAUTI as per the present study. Similar findings were documented in several other Indian studies.[8-10] Advancing age exposes the patients to factors such as impaired immunity, frequent hospitalization and requirements of prolonged catheter use. The advocation of condom catheters and intermittent catheters wherever applicable along with strict care bundle compliance are favourable to reduce the heightened CAUTI risk in this category of patients. Despite the progressive age related prostatic enlargement in males the study found female patients were susceptible to higher rates of CAUTI due to shorter urethral length, anatomical predisposition and the waning protection of estrogen.[10]

Interestingly the uropathogen profile in this study was entirely composed of Gram-negative bacilli. *Klebsiella pneumoniae* (42.85%) as the predominant isolate, followed by *Pseudomonas aeruginosa* (28.57%), and single isolates of *Escherichia coli* and *Acinetobacter baumannii*. The pattern recorded in the present study aligns with the recent Indian surveillance data which revealed an increasing trend of non-*E.coli Enterobacterales* and non-fermenters associated CAUTI in hospitals as well as community acquired settings highlighting the possibility of environmental as well as healthcare setting associated reservoirs coupled with increase in device utility rates.[11,12]

The alarming rates of drug resistance documented in the study especially to the empirical UTI management agents such as nitrofurantoin and third generation cephalosporins highlight the obvious importance of targeted antibiotic therapy as well as continued surveillance for the management of CAUTI cases in the days to come. The ominous sign of creeping resistance similar to the findings of the present study has also been documented in the Indian as well as global scenario.[11,12] The fluctuating susceptibility pattern of non-fermenter pathogens such as *Psuedomonas aeruginosa* corroborate with the findings of a study from Southern India.[13] The single isolate of minocycline resistant *Acinetobacter baumannii* parallels the global concerns regarding the notorious resistance repertoire of this organism. [14] With the accentuating trend of antimicrobial resistance local antibiogram based empirical therapy reinforcement alongside periodic review of CAUTI prevention bundles are warranted.

This study contributes local data to the evolving geographical CAUTI landscape. The results of the present study can help optimize empirical, targeted antibiotic therapy and support the ongoing efforts to curtail antimicrobial resistance in tertiary care hospitals.

The study has a retrospective design with a short study duration thereby lacking longitudinal outcome tracking ability. Asymptomatic culture positive CAUTI cases could not be traced in the present study. Clonal outbreaks were not tracked in the present study.

CONCLUSION

The emergence of multidrug resistant Gram-negative pathogens is an eminent treat to CAUTI prevention in tertiary care hospitals. Rigorous CAUTI surveillance, adherence of care bundles along with geographically tailored antimicrobial stewardship practices are vital in safeguarding vulnerable patient population.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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