Original Article

Catheter-Associated Urinary Tract Infection in Admitted Patients of General Surgery

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Abstract

Objective: To determine the prevalence, risk factors, and microbiological aetiology of catheter-associated urinary tract infection (CAUTI) among patients admitted to a general surgery unit.

Methods: This observational cohort study included 163 patients admitted to the Surgical Ward of a Tertiary Care Hospital in Islamabad from January 2024 to April 2025. Adult patients who required indwelling urinary catheterisation and were admitted to the General Surgery Unit were included. Data on demographics, catheterisation details, clinical outcomes, and microbiological results were also collected. CAUTI was diagnosed based on the CDC criteria. Statistical analyses were performed using SPSS v 28.

Results: The overall mean age was 46.78 (17.71) years (range 17-80 years). Of the 163 cases, 79 (48.5%) were male and 84 (51.5%) were female. The mean length of catheterisation and hospital stay was 2.20 (0.79) days and 3.50 (1.61) days, respectively. Patients were distributed based on their age group as follows: 64 (39.3%) in 17-40 years, 54 (33.1%) in 41-60 years, and 45 (27.6%) in 61-80 years. CAUTI Status was positive or present in 58 (35.6%) patients, whereas 105 (64.4%) had a negative status. The lengths of catheterisation for 1, 2, and 3 days were 37 (22.7%), 56 (34.4%), and 70 (42.9%) patients, respectively. The most common causative organism was *Escherichia coli* (46.6%), followed by *Klebsiella spp.* (20.7%) and *Pseudomonas aeruginosa* (15.5%).

Conclusion: The high prevalence of CAUTI in this cohort underscores a critical patient safety concern in resource-constrained surgical settings. The duration of catheterisation and insertion location (ER) were key, modifiable risk factors. The implementation of stringent catheter insertion and removal protocols and robust antimicrobial stewardship is urgently needed to mitigate this burden.

Keywords: Urinary tract infections, Catheter-associated urinary tract infection (CAUTI), Healthcare-associated infection.

Introduction

Catheter-associated urinary tract infection (CAUTI) poses a substantial burden of disease across all age groups worldwide.[1] It is the most frequent hospital-acquired infection, with a daily incidence rate of 3%–7% in patients with urinary catheters in acute care facilities.[2] Beyond prolonging hospital stays and escalating healthcare costs, CAUTIs are a notable source of patient morbidity and mortality and serve as a reservoir for multidrug-resistant organisms (MDROs), facilitating cross-transmission within healthcare facilities.[3,4]

The pathogenesis of CAUTI involves the formation of microbial biofilms on the catheter surface, which shield bacteria from host defenses and antimicrobial agents.[5,6] The risk is multifactorial, influenced by prolonged catheterisation, suboptimal insertion technique, female sex, diabetes mellitus, and breaches in closed drainage systems. Indwelling catheters contribute to 80% of UTI cases.[7]

In general surgery, indwelling urinary catheters are routinely used for perioperative management, rendering the patient population highly vulnerable. The escalating challenge of antimicrobial resistance in regions such as South Asia, compounded by suboptimal infection control practices, amplifies the threat posed by CAUTIs. [8]

Some patients with catheter-associated urinary tract infections (CAUTIs) may experience haematuria. If left untreated, UTIs can progress to systemic symptoms such as fever and fatigue, while severe infections are often marked by high-grade fever with chills and may lead to acute kidney injury due to ascending infection. The broader term bacteriuria encompasses both UTI and asymptomatic bacteriuria (ASB).[9] The urinary tract serves as a reservoir for resistant microorganisms, increasing the risk of cross-infection. Escherichia coli, Klebsiella spp., Staphylococcus aureus, Enterococcus spp., Proteus, coagulase-negative staphylococci (CoNS), and Pseudomonas are frequently isolated pathogens that cause serious infections that may lead to severe complications such as sepsis, bladder cancer, genitourinary disorders, and skeletal infections.[10] The susceptibility to colonization increases with prolonged catheterisation.

Despite its clinical significance, there is a paucity of local epidemiological data on CAUTI in the surgical wards in Pakistan. This study aimed to determine the prevalence, identify the risk factors, and characterize the microbiological profile of CAUTI in patients admitted to the general surgery unit of a tertiary care hospital in Islamabad, Pakistan.

Materials And Methods

An observational cohort study was conducted at the General Surgery Unit of the Pakistan Institute of Medical Sciences (PIMS), Islamabad, from January 2024 to April 2025. The study was approved by the Hospital Ethical Research Review Board of PIMS, Islamabad (F-5-2/2024(ERRB)/PIMS, dated 11th March 2024).

All adult patients (aged 17–80 years) admitted to the general surgery ward who required an indwelling urinary catheter for at least 48 h were screened for eligibility. Patients with pre-existing UTIs, urological malignancies, congenital genitourinary anomalies, or those discharged or expired within 48 h of catheter insertion were excluded.

18%, as described in a previous study.[4] The standard formula ($n_0 = z^2 \times p(1-p)/e^2$) was used to calculate the sample size with the following parameters: n_0= anticipated sample size, Z= confidence level at 95% (standard value of 1.96), P: population proportion (0.07), e: margin of error (5%) ($n_0 = 1.96^2 \times 0.07(1-0.22) / 0.05^2$). Given the exclusion of patients with incomplete information, the initial sample size was 163 patients.

Data were recorded using a predesigned data collection form. Variables included:

- **Demographics:** Age, sex.
- **Clinical Characteristics:** Primary diagnosis, surgical procedure performed.
- **Catheter Details:** Duration of catheterisation (days) and insertion location (emergency Room/ER, operating theatre/OT, ward).
- **Outcome Variables:** Length of hospital stay (days), CAUTI status (as per CDC criteria: symptoms, e.g., fever, suprapubic tenderness, dysuria, and a positive urine culture with $\geq 10^3$ CFU/ml of ≥1 bacterial species).
- **Microbiological Data:** Pathogen identification and antimicrobial susceptibility patterns from urine cultures.

Data were analyzed using IBM SPSS Statistics version 28. Continuous variables are expressed as mean (standard deviation (SD)) and categorical variables as frequencies and percentages.

Results

A total of 163 patients met the inclusion criteria. The mean age of the cohort was 46.8 (17.7) years, with a nearly equal distribution of males (48.5%) and females (51.5%). The mean duration of catheterisation was 2.2 (0.8) days, and the mean hospital stay was 3.5 (1.6) days (Table I).

Most catheters (42.9%) remained in place for 3 days, and over half (51.5%) were inserted in the ER. The Length of catheterisation for 1, 2, and 3 days was 37/163 (22.7%), 56/163 (34.4%), and 70/163 (42.9%), respectively. The majority of catheters were placed in 84/163 (51.5%) emergency rooms (ER), followed by OT 66/163 (40.5%) and ward 13/163 (8%) (Table II). CAUTI Status was positive or present in 58/163 (35.6%) cases, whereas 105/163 (64.4%) had a negative status (Table III). Table IV shows the procedures performed on the patients. Figure 1 shows the causative organisms of CAUTIs.

Table 1: Demographic distribution of patients (n=163)

Variable	Categories	Frequency (n)	Percentage (%)
Mean Age (years)	Mean (SD)	46.78 (17.71)	
Gender	Male	79	48.5
	Female	84	51.5

Table 2: Catheterization details (n=163)

Variable	Categories	Frequency (n)	Percentage (%)
Mean catheterization days	Mean (SD)	2.20 (0.79)	
Mean hospital stay (days)	Mean (SD)	3.50 (1.61)	
Catheterization duration	1 day	37	22.7
	2 days	56	34.4
	3 days	70	42.9
Catheter placement site	Emergency Room	84	51.5
	Operation Theatre	66	40.5
	Ward	13	8.0

Table 3: Catheter-Associated Urinary Tract Infection (CAUTI) Status (N=163)

CAUTI Status	Frequency (n)	Percentage (%)
Positive	58	35.6
Negative	105	64.4

Table 4: Procedure performed (N=163)

Procedure performed	Frequency	Percent
Amputation Surgery	4	2.5
Conservative Management	46	28.2
Excision with Open Healing	10	6.1
Exploratory Laparotomy	1	.6
Graham's Patch Repair	1	.6
Laparoscopic cholecystectomy	7	4.3
Laparoscopic Cholecystectomy	5	3.1
Laparotomy	4	2.5
Mesh Repair	25	15.3
Open Appendectomy	10	6.1
Seton Placement	5	3.1
Supportive Care	31	19.0
Supportive Care, Pain Management	1	.6
Trendelenburg Procedure	13	8.0
Total	163	100.0

Microbiological Profile: Among the 58 CAUTI cases, *Escherichia coli* was the most frequently isolated pathogen (46.6%), followed by *Klebsiella pneumoniae* (20.7%) and *Pseudomonas aeruginosa* (15.5%) (Figure 1).

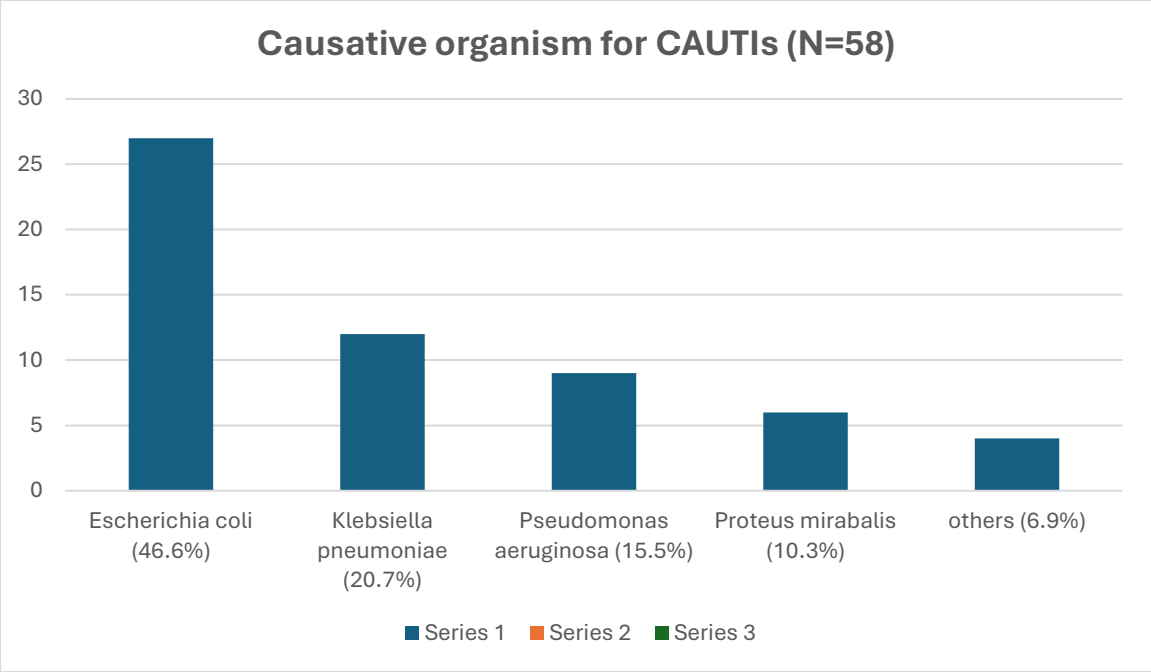

Figure 1: Causative organism for CAUTIs

Discussion

In this cohort, 35.6% of patients admitted to the surgical ward developed CAUTI, a rate driven primarily by prolonged catheterisation and ER-based insertion. The observed incidence of CAUTIs is consistent with regional studies, which reported a 23% to 40% range of CAUTIs among patients admitted for surgery.[11-13] The results underscore the need for strengthening infection prevention and control practices among surgical wards in Pakistan.

The present study observed that the mean age was 46.7 years, with most patients falling in the younger age groups. Remarkably, age was not associated with CAUTIs, suggesting that catheter handling practices, surgical stress, and comorbid conditions play critical roles in the development of infection rather than age. The 2019 EAU Guidelines explicitly identified both advanced age and underlying health conditions (comorbidities) as significant risk factors for developing complicated urinary tract infections.[14] The 2024 EUA Guidelines also acknowledged that advanced age and underlying medical complexities are significant risk factors for acquiring CAUTI.[15] In the current study, the sex distribution was almost equal, making no significant differences, although some previous studies reported that females are more vulnerable due to shorter urethral anatomy than males.[16]

The strongest correlate of CAUTI in our cohort was the duration of catheterisation, consistent with the global literature.[11,17] Each additional day of catheterisation exponentially increases the risk of biofilm formation and subsequent bacteriuria. Notably, even with a mean catheterisation time of only 2.2 days, the infection rate was high, suggesting that factors beyond duration, such as insertion technique and maintenance care, are critically deficient in our setting.

Therefore, the most effective strategy for minimizing CAUTIs is to reduce catheterisation time. The mean duration of catheterisation in this study was 2.2 days, which, although relatively short, was still associated with a substantial infection burden, highlighting that even short-term catheterisation is not risk-free.

A particularly concerning finding was that over half of all catheters were inserted in the emergency department. This setting, often characterized by overcrowding, time pressure, and variable adherence to aseptic non-touch technique (ANTT), likely contributes to early catheter colonisation.[12] The higher CAUTI rate in the ER-insertion group (42.9% vs. 27.3% in OT), though borderline significant (p=0.06), warrants urgent quality improvement initiatives focused on ER catheter insertion protocols.

Earlier studies have also reported similar results, that the insertion of a catheter in an emergency correlates with increased infection rates due to inadequate sterilization, limited resources, and speedy procedure.[12,18]

The microbiological profile, dominated by *E. coli*, *Klebsiella spp.*, and *P. aeruginosa*, aligns with other studies from the region.[13,19] The high prevalence of these gram-negative rods, known for their propensity to develop multidrug

resistance, poses a serious therapeutic challenge. This underscores the necessity of routine microbiological surveillance and robust antimicrobial stewardship programs to guide empirical and definitive therapy and prevent the escalation of resistance.

Irrational antibiotic use and organism dominance in surgical units are the main factors in South Asian countries, especially in Pakistan.[20] This concern is particularly relevant in Pakistan, where antibiotic stewardship programs are still in their early stages.[21]

Surgical emergencies, such as road traffic accidents and intestinal obstruction, often necessitate prolonged hospitalization and immobilization, which indirectly increase catheter dependency and infection risk.[22] Similarly, procedures such as mesh repair and conservative management may not inherently increase infection risk, but the perioperative use of catheters as a routine precaution can inadvertently contribute to the CAUTI burden. These findings highlight the importance of reassessing catheterisation protocols to ensure that catheters are placed only when necessary and removed as early as clinically feasible.

Limitations: This study has limitations inherent to its single-center design, which may limit its generalisability. Furthermore, data on specific comorbid conditions (e.g., diabetes) and detailed antibiotic susceptibility profiles were not fully analyzed, which is suggested for future work.

Conclusions

The high burden of CAUTI identified in this study calls for action. It is primarily driven by modifiable factors, most notably prolonged catheterisation and potentially suboptimal ER insertion practices. To mitigate this risk, we recommend the immediate implementation of a multifaceted strategy:

1. **Nurse-Driven Catheter Removal Protocols:** Empowering the nursing staff to assess daily catheter necessity and remove unnecessary catheters without awaiting physician orders.
2. **Standardized Aseptic Insertion Bundles:** Mandate training and adherence to ANTT for all catheter insertions, especially in the emergency room (ER).
3. **Continuous Surveillance and Audit:** Establish ongoing CAUTI rate monitoring with feedback to the clinical teams.
4. **Antimicrobial Stewardship:** Utilise local antibiograms to inform empirical treatment guidelines and avoid unnecessary antibiotic use.

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