Original Research Paper

Volume - 16 | Issue - 02 | February - 2026 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Urology

CLINICO-DEMOGRAPHIC PROFILE AND ASSOCIATED MORBIDITY OF CATHETER ASSOCIATED URINARY TRACT INFECTION (CAUTI) IN PATIENTS UNDERGOING EMERGENCY SURGERY - AN OBSERVATIONAL ANALYTICAL STUDY.

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ABSTRACT **Background & Aims:** Catheter-associated urinary tract infection (CAUTI) is a frequent and preventable healthcare-associated infection in surgical patients, contributing to increased morbidity. Through this observational study, we aim to determine the incidence of CAUTI in select patients undergoing emergency surgery necessitating catheterization and to assess/analyze the associated risk factors and morbidity due to same. **Methods:** After obtaining local IEC vide (IECHR-2024-64-81-R1 dt 27.03.2024) and written informed consent from eligible patients a prospective observational analytical study was conducted on 100 emergency surgical patients requiring indwelling urinary catheterization for >48 hours with suspected CAUTI diagnosed as per CDC criteria while those with pre-existing urinary infections were excluded as per protocol. The study was registered retrospectively with the Thai Clinical Trials Registry wide https://www.thaiclinicaltrials.org/show/ TCTR20250827010**. Results:** The incidence CAUTI was 6%, with an incidence of 18.8 per 1000 catheter-days. Longer catheter duration, diabetes, and SIRS were associated with CAUTI. E.Coli and Enterobacter were the common isolates, showing multidrug resistance with sensitivity to carbapenems. **Conclusion:** CAUTI was associated with significantly longer ICU stay, prolonged hospitalization, and increased oxygen-support days. Though CAUTI remains a preventable complication we propose that minimizing indwelling catheter duration and adhering to catheter-care bundles may reduce infection and morbidity in select patients undergoing catheterization during emergency surgical procedures.

KEYWORDS : CAUTI, Catheter; Urinary Tract Infection; Emergency surgery, Catheter-days, Morbidity

INTRODUCTION

Catheter-associated urinary tract infections (CAUTIs) remain as a persistent major public health concern and same continues to be the most common healthcare-associated infections reported in acute emergency care hospitals.[1] CAUTIs can lead to complications such as prostatitis, epididymitis, orchitis, cystitis, pyelonephritis, and gram-negative bacteremia. Escherichia coli is the most frequent pathogen, although Proteus mirabilis, Candida, Enterococcus, Pseudomonas aeruginosa, and Klebsiella species, have also been isolated and documented by others.[1] Indwelling urinary catheterization, while often a clinically necessary evil, remains a significant risk factor for introduction of sepsis and infection due to biofilm formation on the catheter surface which protects micro-organisms from the administered antimicrobials and impacts host immunity.[2] According to one study the authors demonstrated that the mean duration of catheterization remained the strongest predictor of CAUTI, with their incidence of bacteriuria increasing at the rate of 3–10% per day and often approaching 100% beyond 30 days of catheterisatrion.[3] CAUTIs prolong hospital stay, increase cost of care, and elevate morbidity and mortality and despite advances in biomaterials, infection and encrustation same continues to limit prolonged catheterization which leads to prolonged treatment duration for symptomatic CAUTI of up to three weeks depending on the organism, co-morbidity status, and patient response. To the best of our knowledge the published Indian data on CAUTI amongst emergency surgical patients has been scarcely documented in the literature, hence the need for the present study evaluation in a tertiary care teaching hospital.

Patient & Methods

This prospective observational study was conducted at a tertiary care teaching hospital in Delhi, India, over a 17-month period from April 2024 to August 2025. The protocol for this study was approved by the IEC vides IECHR-2024-64-81-R1 dt 27.03.2024. The study protocol was registered with the Thai Clinical Trials Registry vide No TCTR20250827010 dated 27.08.2025 vide https://www.thaiclinical-trials.org/show/TCTR20250827010.

Inclusion and Exclusion Criteria

Adult patients undergoing emergency surgery requiring urinary catheterization for ≥48 hours were included in this study while those with pre-existing UTIs, those admitted with positive urine cultures documented prior to catheterization, and patients whose hospitalization was related to urinary system diseases were excluded from this study. CAUTI was defined according to the Centers for Disease Control and Prevention (CDC) criteria namely: [(i) patients with an indwelling urinary catheter for >2 days on the date of the event (day of device placement=Day 1) and was either still present on the date of the event or removed the day before the date of the event, (ii) patients with at least one of the following signs/ symptoms like fever (>38.0 °C), suprapubic and or renal angle tenderness; (iii) patients with an urine culture with no more than two species of organisms and at least one of which was associated with bacteria count of ≥10^5 CFU/ml].

Outcome Measures

The primary outcome was the incidence rate of CAUTI expressed as cases per 1000 catheter-days. Secondary outcomes included identified risk factors associated with CAUTI, organism profile and antimicrobial susceptibility of isolates, and postoperative morbidity assessed using the modified Clavien–Dindo classification. Data was collected prospectively using a structured proforma, including demographic details, clinical presentation, indication and duration of catheterization, comorbidities, postoperative course, urine culture results, and clinical outcomes. The flow of study for the current study protocol is depicted in figure-1

Statistical Methods

Data was analyzed using descriptive statistics. Categorical variables were presented as frequency and percentage, and continuous variables as mean or median as appropriate. Comparative analysis between CAUTI and non-CAUTI groups was performed using the chi-square test, with a p-value <0.05 considered statistically significant.

Sample Size Computation

Considering the prevalence of UTI as 3% in the study by Sheka AC et al 2016 entitled "Urinary tract infection after surgery" in order to estimate a relative margin of error as 30% at α=5%, a sample of 1380 was required but due to short duration of study and logistical constraints, a convenient sample of 100 subjects was approved by the IEC.

OBSERVATIONS & RESULTS

A total of 100 eligible emergency surgical patients requiring urinary catheterisation were included in this study. The incidence of CAUTI was 6%, with a rate of 18.8 per 1000 catheter-days and the total urinary catheter days were 320 days. Table-1 : Shows a comparison of salient patient demographic features, postoperative outcomes in CAUTI versus non-CAUTI patients.

Socio-demographic Profile

The median age was 35 years. CAUTI patients had a slightly lower median age (26 years) compared to no-CAUTI (36 years). Males represented 61% of the cohort, with a higher proportion in the CAUTI group.

Post Operative Outcomes & Morbidity Profile

As per the Clavien–Dindo Complication scores it was observed that severe complications (Grade IV–V) occurred predominantly among CAUTI patients, while most non-CAUTI patients had Grade I minor complications. Patients who developed CAUTI were associated with significantly longer hospitalization, ICU admissions, higher oxygen dependency and ventilator support requirements. Blood transfusion requirements, haematuria, readmissions, appeared to be higher and more common amongst patients with CAUTI . Table-II: Depicting the Antibiotic susceptibility profile isolates of patients with CAUTI Among six culture-positive CAUTI cases, Enterobacter spp. were most common (n=3), followed by E. coli(n=2) and Klebsiella sp(n=1). Most isolates were multidrug-resistant, with limited sensitivity to carbapenems, amikacin, or cotrimoxazole. Table-III depicts the diagnostic profile of emergency surgical patients enrolled in the current study protocol requiring urinary catheterization. Perforation peritonitis was the commonest diagnosis among CAUTI cases.

Some of the above observations demonstrated that patients with (i) diabetes, (ii) high Charlson Co-morbidity Index (CCI) scores, (iii) presence of SIRS, and (iv) longer indwelling catheter duration appeared to be more frequently associated with CAUTI; this has been discussed in the discussion section.

DISCUSSION

Incidence of CAUTI

Urinary catheterization remains a globally common intervention, with over five million patients undergoing the procedure annually, which placing them at risk for (CAUTI) and its complications[24] In the current prospective observational analytical study amongst emergency surgical patients, the incidence of CAUTI was 6%, with a rate of 18.75 per 1000 catheter-days which aligned well with the reported incidence CAUTI literature varying from 1.64 to 27.8 per 1000 catheter-days (Li Shen et al.[7], Letica-Kriegel AS et al.[8], Leblebicioglu H et al.[9] and Asmare Z et al.[10]). The present study focused exclusively on select emergency general surgery patients for CAUTI data for which remains scarce within the Indian healthcare systems. Patient Characteristics (Age and Sex): Older age is a recognized risk factor for CAUTI due to age-related immune decline, greater co-morbidity burden, and increased exposure to healthcare interventions. In the present study, one-third of our CAUTI cases were aged ≥50 years, consistent with earlier evidence. Temiz E et al.[15] similarly reported increased risk with advancing age. However, this association was not statistically significant, possibly due to the small number of CAUTI cases. While larger randomized stratified cohort studies could better delineate the relationship between age and CAUTI in surgical patients. Contrary to published reports on higher female predisposition to CAUTI (Garibaldi et al.[11], Letica-Kriegel AS et al.[8], Rabi R et al.[12] and Wald et al.[13]) due to anatomical and physiological factors, the current study demonstrated a male predominance. This was likely attributable to the male-dominant sample in the emergency surgical cohort (61% male) which should be interpreted in the context of the presenting surgical demographics rather than intrinsic susceptibility.

Systemic Inflammatory Response Syndrome (SIRS)

Presence of SIRS was strongly associated with CAUTI, being present in 83.3% of CAUTI patients compared to only 5.3% without CAUTI. SIRS may reflect underlying systemic infection or physiological stress, potentially increasing vulnerability to nosocomial infections.

Risk Factors and Comorbidities

Diabetes was a strong predictor of CAUTI in the current study, with half of CAUTI patients being diabetic compared to only 1% of non-CAUTI patients with similar associations also reported by Rabi R et al.[10], Hariati et al.[14] and Perrin K et al.[15]. Diabetes predisposes to infection through impaired immunity, autonomic neuropathy leading to urinary stasis, and increased colonization of the urinary tract. The present findings reinforce the need for stringent catheter-use justification and monitoring in diabetic surgical patients.

Duration of Catheterization

In the current study the mean catheter duration (MCD) in CAUTI patients was more than double that of non-CAUTI patients. MCD has been consistently reported to be one of the most important modifiable risk factors for CAUTI (Al-Hazmi H et al.[14], Temiz E et al.[16] and Rabi R et al.[10]) which highlighted MCD as central to the pathogenesis of CAUTI. Global evidence also suggests that risk of CAUTI rises adversely and significantly after 48–72 hours of indwelling catheterization. Thus minimizing unnecessary catheterization and ensuring early timely removal of same remains the most effective preventive strategy for prevention of CAUTI. Although catheterization is deemed essential in the peri-operative period for urine output monitoring, this study emphasizes strict adherence to CAUTI prevention bundles, including sterile insertion technique, closed-drainage systems and daily catheter need reassessment.

Burden of Co-morbidity

In the present study, CAUTI associated co-morbidity objective assessment using the CCI had demonstrated that about 50% of CAUTI patients had CCI ≥1 versus with 3% amongst non-CAUTI patients, which was in harmony with another study by Rabi R et al.[10] in which the authors had identified and demonstrated that co-morbidity burden was a significantly higher amongst CAUTI patients. This could be extrapolated to presume that a higher CCI was more likely to be associated with host immune-suppression, prolonged duration of hospitalization and prolonged indwelling catheterization could be relevant contributory factors and possible reliable predictors of patients at high risk of developing CAUTI.

Postoperative Outcomes

CAUTI was associated with significantly greater postoperative morbidity. The mean hospitalization duration was more than twice as long among CAUTI patients (11.9 vs 5.6 days). Prolonged hospitalization may predispose patients to complications due to infections on account of reduced mobility that may adversely affect recovery[18]. Patients with CAUTI also demonstrated prolonged ICU admissions, contributing to stressing healthcare resource utilization while ICU was typically indicated for clinically unstable post-operative patients a prolonged ICU exposure was associated with poor long-term outcomes including frailty, cognitive decline and reduced quality of life.[25] These findings demonstrate that CAUTI prolongs acute recovery and may be a contributory factor for long-term morbidity. This occurrence of haematuria was more frequently encountered amongst CAUTI patients in this study. This may be attributed to catheter-induced trauma, infection, or encrustation secondary to biofilm formation which potentially raises the threshold for the occurrence of urinary tract injury in patients with CAUTI. The mean oxygen-dependency was markedly higher amongst CAUTI patients indicating an increased requirement for oxygen and ventilator support among patients with CAUTI with possible higher SIRS and postoperative burden. Postoperative pulmonary dysfunction may adversely affects recovery and delay discharge.[16] Prolonged ventilator support is well known to elevate the risk of airway trauma, dysphonia, tracheal stenosis, dysphagia and respiratory complications, contributing to higher postoperative morbidity.[22] The mean blood transfusion requirement was higher in CAUTI patients (50% vs 5%), which carries its risk of share of added complications[20]. The modified Clavien–Dindo score (MCDS) also demonstrated that CAUTI was associated with a disproportionately higher rate of severe complications in this study. While most non-CAUTI patients had experienced only minor MCDS (Gr-I-II) complications versus the patients with CAUTI which encountered higher major (Gr IV) complications (33%) requiring ICU care with one patient suffered mortality (Gr-V). This highlights the possible additional contributory adverse impact of CAUTI on the overall outcome of emergency surgery in patients undergoing necessary urinary catheterization in select surgical patients.

Impact of Hospital Microbiome Profile & Antimicrobial Resistance on CAUTI

Traditionally while, Escherichia coli has been the most prevalent pathogen in CAUTI, accounting for over 30–50% of isolates in a separate study[23] never the less other micro-organisms like Klebsiella, Enterobacter, Pseudomonas aeruginosa and Enterococcus species are not unknown to occur. In the present study Enterobacter species had accounted for 50% of isolates, followed by E. coli (33%) and Klebsiella (17%) which variation could be relate to local antimicrobial usage patterns and hospital ecology microbiome. Antimicrobial resistance among isolates was strikingly notable as four of six isolates were pan-resistant, exhibiting resistance to multiple antibiotics with only one E. coli isolate retained sensitivity to Amikacin, and one Enterobacter isolate retained sensitivity to cotrimoxazole and

Imipenem, global surveillance has also shown rising ESBL and carbapenem-resistant Enterobacteriaceae in hospital settings.[21] The high degree of drug resistance in this cohort limited our therapeutic options and increased the risk of treatment failure and possibly contributed to higher morbidity. These findings support the need for effective local antibiogram-guided empirical therapy to reinforce preventive strategies as the most effective means of mitigating CAUTI-associated antimicrobial resistance.

Limitations

Though the current study had a prospective design with integrated clinical and microbiological endpoints and a robust systematic data collection protocol and a qualitative modified MCDS complication scoring for adding objectivity, we do acknowledge certain inadvertent limitations. The small sample size, single centre study could have restricted the statistical power and limited the current study, generalizability to select emergency surgical patients needing urinary cauterization. No multivariate analysis was feasible due to the small sample size. Findings reflect local hospital microbiome ecology which may not apply universally in our resource constrained setting (owing to unavailability/non-supply of some higher antibiotic discs). Thus our conclusions though consistent with the published literature on the subject, same should be interpreted in the light of these limitations accordingly.

CONCLUSIONS

The incidence of CAUTI in our study was 6% among catheterized patients with an incidence of 18.8/ 1000 urinary catheter days. CAUTI was associated with significantly higher rate of adverse clinical outcome/higher grade complications versus non-CAUTI patients. The hospital microbiome profile was dominated by Enterobacter spp. (50%), followed by E. coli and Klebsiella spp., with most isolates showing extensive multidrug resistance with limited therapeutic options. In view of limited effective antibiotics, preventing CAUTI through stringent catheter care, early removal, and infection-control measures remains the most reliable strategy to counter a possible adverse outcome of CAUTI in select patients undergoing emergency surgery needing urinary cauterization. Authors declare that no artificial intelligence (AI) was used in the preparation of this manuscript.

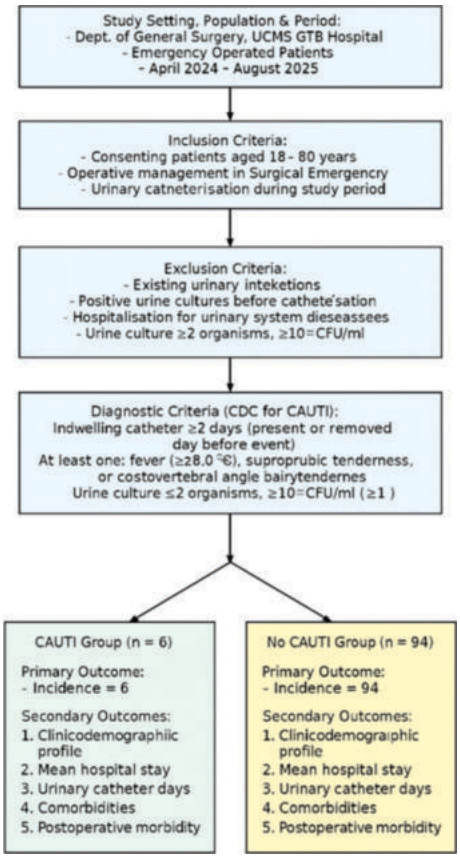

Figure-I: Depicts the Flow Sequence Design of the Current Study Protocol.

Table-1 : Depicts a Comparison of Salient Patient Demographic Features, Postoperative Outcomes in CAUTI Versus Non-CAUTI Patients.

Table-1 Depicting Salient Patient Parameters & Outcomes In Two Groups			
PARAMETER	CAUTI (N=6)-Group-I	NO CAUTI (N=94)-Group-II	P VALUE
MEAN AGE	37.17	38.53	-
AGE ≤50: >50	4(66.6%): 2(33.3%)	73(77.7%): 21(22.3%)	-
MALE: FEMALE	4(66.6%): 2(33.3%)	57(60.6%) : 37(39.3%)	-
CO-MORBIDITIES-RF	3(50%)	1(1%)	-
DIABETES	?	?	0.0005
CCI (≥1)	3(50%)	3(3%)	<0.0001
SIRS	5 (83%)	5 (5.3%)	<0.0001
MEAN UCD (Days)	6.5	2.9	<0.0001
MCDS GR I:II:III:IV:V	93:1:0:0:0:0	3:0:0:2:1	<0.001
POO			
-Mean HS	11.9	5.6	<0.0001*
-Mean ICUS	8	4	0.0026*
-OSD	22	4	<0.0001*
-Mean VD	3	2	0.0002*
-BT Rate	3(50%)	5(5.0%)	0.0061*
-Hematuria	3(50%)	2(2%)	0.001*
-RA	1(16%)	1(1%)	0.12

*Denotes Significant P Value;
RF: Risk Factors CCI- Charlson Comorbidity Index; MCDS : Modified Claven Dindo Score; UCD: Mean Urinary Catherisation Duration; POO: Post Operative outcomes; HS-Hospital Stay(d); ICUS: Mean ICU Stay(d) ; OSD: Mean Oxygen Support Duration (d); VD: Mean Ventilator Duration (d); BT: Blood transfusion Rate; RA: Readmission within 30 days.

Table-II: Depicting the Antibiotic Susceptibility Profile Isolates of Patients with CAUTI

Table-II Depicting Antibiotic Susceptibility Profile Isolates of Patients With CAUTI						
Organism isolated (n)	Ami-kacin	Imi-penem	Cotrimo-xazole	Cipro-floxacin	Cef-triaxone	Colistin *
Esch. Coli (2)	50%	0%	0%	0%	0%	NT
Enterobacter spp. (3)	0%	33%	33%	0%	0%	NT
Klebsiella spp. (1)	0%	0%	0%	0%	0%	NT
*NT: Not tested due to unavailability of sensitivity discs						

Table-III: Depicting the Clinical Diagnostic Profile of Emergency Surgical Patients Requiring Urinary Catheterization.

Table-III Patient Diagnostic Profile Of Emergency Surgical Patients Requiring Urinary Catheterization		
Diagnosis	CAUTI	Non-CAUTI
Perforation Peritonitis	2	29
Intestinal Obstruction	0	4
Appendicitis	1	8
Penetrating Trauma Abdomen	0	8
Necrotising fasciitis	1	6
Absolute Dysphagia	1	6
Blunt Trauma Abdomen	1	3
Stoma Prolapse	0	5
Strangulated Hernia	0	4
Misc. Others	0	11

List of Abbreviations

CAUTI: Catheter associated urinary tract infection
SIRS: Systemic inflammatory response syndrome
CDC: Centers for Disease Control and Prevention
ICU: Intensive Care Unit
SSI: Surgical Site Infection
CCI- Charlson Comorbidity Index;
MCDS: Modified Claven Dindo Score;
UCD: Mean Urinary Catherisation Duration;
POO: Post Operative outcomes;
HS-Hospital Stay(d);
ICUS: Mean ICU Stay(d) ;
OSD: Mean Oxygen Support Duration (d)
VD: Mean Ventilator Duration (d)

BT: Blood transfusion Rate
RA: Readmission within 30 days.

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