

A prospective observational study on urethral catheter-associated complications among general surgical inpatients.

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Abstract

Background:

Urethral catheterization is frequently employed in general surgical inpatients for perioperative and critical care management. However, its use is associated with a spectrum of complications, which may impact patient outcomes and prolong hospitalization. To determine the prevalence, spectrum, and risk factors of urethral catheter-associated complications among general surgical inpatients.

Methods:

This prospective observational study was conducted on 100 consecutive general surgical inpatients who required urethral catheterization during hospitalization. Detailed demographic, clinical, and peri-catheterization parameters were recorded. All patients were followed for 30 days to identify catheter-related complications, including catheter-associated urinary tract infection (CAUTI), urethral trauma, blockage, and accidental dislodgement. Potential risk factors were analyzed using the chi-square test and logistic regression to determine statistical significance.

Results:

The mean age was 54.2 ± 15.6 years, with 62% males. Perioperative urinary monitoring was the commonest indication for catheterization (58%). The mean catheterization duration was 6.4 ± 2.8 days. Overall, 33% of patients developed at least one complication. CAUTI occurred in 14%, urethral trauma in 8%, blockage in 6%, and dislodgement in 5%. Complication rates were significantly higher in patients catheterized for >7 days (28.1% vs. 7.4%, $p = 0.010$), with diabetes mellitus (25.0% vs. 9.7%, $p = 0.040$), and with breach in aseptic technique (50.0% vs. 11.7%, $p = 0.030$). All complications resolved with appropriate management.

Conclusions:

One-third of general surgical inpatients with urethral catheters experience complications, most frequently CAUTI. Prolonged catheterization, diabetes, and aseptic breaches significantly increase risk.

Recommendations:

Limiting catheter duration, ensuring strict asepsis, and close monitoring of high-risk patients are essential to reduce morbidity associated with urethral catheterization.

Keywords: urethral catheterization, catheter-associated urinary tract infection, postoperative complications, general surgery, risk factors

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Introduction

Urethral catheterization is one of the most frequently performed invasive procedures in hospitalized surgical patients, most often indicated for perioperative urine output monitoring, management of acute urinary retention, and precise fluid balance assessment in critically ill individuals [1,2]. While clinically valuable, its use is associated with a spectrum of complications, the most significant being catheter-associated urinary tract infection (CAUTI), which represents a substantial proportion of healthcare-associated infections globally [1,2]. Other important adverse outcomes, including urethral trauma, catheter blockage, and accidental dislodgement, can lead to patient discomfort, prolongation of hospital stay, and escalation of healthcare costs [3].

The incidence of catheter-related complications varies widely and is influenced by patient comorbidities, catheterization technique, duration of use, and compliance with infection prevention measures [4,5]. Prolonged catheterization, particularly beyond one week, is consistently associated with a marked increase in infection risk [1,2]. Patient-related factors, such as diabetes mellitus, further predispose to infectious and non-infectious sequelae through impaired immune defense mechanisms [2,5]. Additionally, technical factors such as breaches in aseptic technique during insertion or maintenance may precipitate early-onset complications [4].

Despite extensive literature on CAUTI prevention and management, there is limited evidence specific to general surgical inpatients in the Indian healthcare setting [1–5]. Variations in epidemiology, procedural practices, and patient characteristics highlight the need for context-specific research to guide preventive and management strategies in this population.

This study was designed to evaluate the incidence, spectrum, and risk factors of urethral catheter-associated complications in general surgical inpatients. The findings aim to inform targeted preventive strategies, optimize catheter management protocols, and ultimately improve surgical patient outcomes.

Materials and Methods

Study Design and Setting

This study employed a prospective, hospital-based observational design conducted in the Departments of General Surgery and Urology at Government General Hospital, Bhadradi Kothagudem, Telangana, India, a tertiary care teaching hospital affiliated with the

Government Medical College, Bhadradi Kothagudem. The institution serves as a major referral center catering to both urban and rural populations across the district, with comprehensive surgical, urological, and critical care facilities. The study was conducted over 12 months, from January 2024 to December 2024.

Study Population and Sample Size

A total of 100 consecutive general surgical inpatients requiring urethral catheterization during their hospital stay were enrolled based on inclusion and exclusion criteria.

The sample size of 100 was determined using a single-proportion formula:

$$n = Z^2 \times P(1-P) / d^2$$

Where:

$Z = 1.96$ (for 95% confidence level),

$P = 0.3$ (expected prevalence of catheter-associated complications from prior studies [6,11]),

$d = 0.09$ (allowable error, 9%).

The calculated minimum sample size was 89, which was rounded up to **100** to compensate for potential losses to follow-up and ensure adequate statistical power.

Inclusion Criteria

Adult patients (≥ 18 years) admitted under General Surgery requiring urethral catheterization.

Patients who provided informed consent for study participation.

Exclusion Criteria

Patients with pre-existing indwelling catheters on admission.

Patients with documented urinary tract infection before catheterization.

Patients undergoing urological procedures as the primary surgery.

Data Collection

Demographic details (age, sex), comorbidities (including diabetes mellitus, hypertension, and chronic kidney disease), indication for catheterization, type of catheter, insertion technique, and duration of catheterization were recorded. Perioperative details such as type of surgery, operative time, and use of prophylactic antibiotics were also documented.

Follow-up and Outcome Measures

Patients were monitored daily during hospitalization and reviewed up to 30 days post-catheterization for the occurrence of complications. Complications assessed included:

Catheter-associated urinary tract infection (CAUTI) – diagnosed based on CDC criteria (presence of urinary symptoms/signs with $\geq 10^5$ CFU/mL of a urinary pathogen in culture).

Urethral trauma/hematuria – visible blood in urine associated with catheterization.

Catheter blockage/obstruction – inability to drain urine, requiring intervention.

Accidental dislodgement – unplanned catheter removal before the intended time.

Risk Factor Assessment

Potential risk factors for complications included duration of catheterization (>7 vs. ≤ 7 days), presence of diabetes mellitus, and breach in aseptic technique during insertion.

Bias and Quality Control

To minimize selection bias, all eligible general surgical inpatients requiring catheterization during the study period were included consecutively.

Information bias was reduced by employing a pre-structured data collection form and maintaining standardized definitions for each complication (as per CDC criteria for CAUTI).

Observer bias was minimized by ensuring that outcome assessment was performed by investigators blinded to patient comorbidity details, and all data were cross-verified by a senior faculty member.

Additionally, confounding variables such as diabetes and duration of catheterization were statistically adjusted using logistic regression analysis.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as frequencies and percentages, and continuous variables as mean $\pm$ standard deviation. The chi-square test or Fisher's exact test was used to assess associations between categorical variables. Variables with $p < 0.05$ in univariate analysis were entered into logistic regression to identify independent predictors of complications. A p -value < 0.05 was considered statistically significant.

Ethical Considerations

Ethical clearance was obtained from the Institutional Ethics Committee of Government Medical College, Bhadradi Kothagudem, before study initiation. Written informed consent was obtained from all participants, and patient confidentiality was strictly maintained throughout the study.

Results

Participant Flow

During the study period, 118 general surgical inpatients who required urethral catheterization were screened for eligibility. 10 patients were excluded due to pre-existing indwelling catheters on admission. 5 patients had documented urinary tract infections before catheterization. 3 patients underwent primary urological procedures. A total of 100 eligible patients were enrolled, all of whom completed the 30-day follow-up and were included in the final analysis.

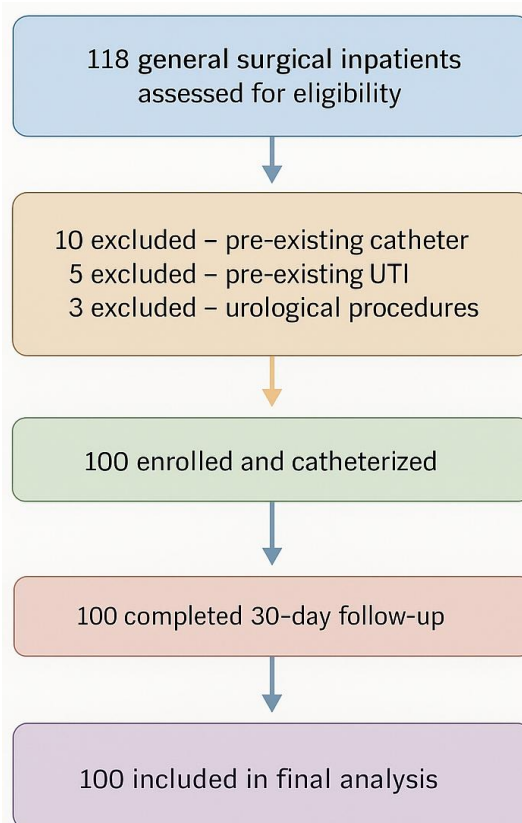


Figure 1. Participant Flow Diagram

Baseline Demographic and Clinical Profile

The mean age of participants was 54.2 ± 15.6 years (range: 18–82 years), with a **male-to-female ratio of 1.63:1**. Most patients (42%) were aged 51–70 years, followed by 31–50 years (28%), >70 years (18%), and 18–30 years (12%).

Perioperative urinary output monitoring was the most frequent indication for catheterization (58%), followed by urinary retention (24%) and critical care fluid balance monitoring (18%).

The mean duration of catheterization was 6.4 ± 2.8 days (Table 1).

Table 1. Baseline Demographic and Clinical Profile (n = 100)

Parameter	Number of Patients	Percentage (%)
Age Group (years)		
18–30	12	12.0
31–50	28	28.0
51–70	42	42.0
>70	18	18.0
Gender		
Male	62	62.0
Female	38	38.0

Indication for Catheterization		
Perioperative monitoring	58	58.0
Urinary retention	24	24.0
Fluid balance in critical care	18	18.0
Mean duration of catheterization (days)	6.4 ± 2.8	—

Prevalence and Spectrum of Catheter-Associated Complications

Catheter-associated complications occurred in 33 patients (33%).

The most frequent complication was catheter-associated urinary tract infection (CAUTI) in 14 patients (14%), followed by urethral trauma or hematuria (8%), catheter blockage (6%), and accidental dislodgement (5%) (Table 2).

Table 2. Prevalence of Catheter-Associated Complications (n = 100)

Complication Type	Number of Patients	Percentage (%)
Catheter-associated UTI (CAUTI)	14	14.0
Urethral trauma/hematuria	8	8.0
Catheter blockage/obstruction	6	6.0
Accidental dislodgement	5	5.0
Total with complications	33	33.0

Chi-Square Analysis of Risk Factors

Association between categorical variables and complication occurrence was tested using the chi-square (χ^2) test.

Complication prevalence was significantly higher in patients catheterized for >7 days ($\chi^2 = 6.59$, $p = 0.010$), in those with diabetes mellitus ($\chi^2 = 4.22$, $p = 0.040$), and in cases with breach in aseptic technique ($\chi^2 = 4.72$, $p = 0.030$) (Table 3).

Table 3. Chi-Square Analysis of Risk Factors for CAUTI

Risk Factor	Complication Present n (%)	Complication Absent n (%)	χ^2 value	p-value	Significance
Duration >7 days (n = 32)	9 (28.1)	23 (71.9)	6.59	0.010	Significant
Diabetes mellitus (n = 28)	7 (25.0)	21 (75.0)	4.22	0.040	Significant
Breach in aseptic technique (n = 6)	3 (50.0)	3 (50.0)	4.72	0.030	Significant

Clinical Outcomes

All complications resolved following appropriate management.

CAUTI: Treated with culture-guided antibiotic therapy.

Urethral trauma: Managed conservatively with catheter repositioning.

Catheter blockage: Managed by catheter replacement.

Accidental dislodgement: Managed by re-catheterization. All patients achieved complete recovery without long-term sequelae (Table 4).

Table 4. Management and Outcomes of Catheter-Associated Complications

Complication Type	Intervention	Recovery (%)
CAUTI	Culture-guided antibiotic therapy	100.0
Urethral trauma	Catheter repositioning/conservative care	100.0
Catheter blockage	Catheter change	100.0
Accidental dislodgement	Re-catheterization	100.0

Discussion

This prospective observational study demonstrated that one-third of general surgical inpatients undergoing urethral catheterization experienced at least one catheter-associated complication, with CAUTI being the most frequent (14%), followed by urethral trauma (8%), catheter blockage (6%), and accidental dislodgement (5%). These findings underscore that, despite being a routine procedure, urethral catheterization continues to pose significant risks to patient safety.

The CAUTI incidence in this study cohort aligns with contemporary reports, which document rates ranging from 10% to 20% in surgical populations [6]. The predominance of CAUTI reflects the persistent burden of catheter-related infections even after implementation of advanced catheter systems and prevention protocols [6]. Prolonged catheterization beyond one week emerged as a strong predictor of CAUTI in this study, consistent with the established understanding that extended indwelling time facilitates biofilm development, increasing bacterial colonization and infection risk [7].

Diabetes mellitus was another significant risk factor for CAUTI, in agreement with prior studies demonstrating that hyperglycemia impairs host immune function, predisposing patients to urinary infections [11]. Furthermore, breaches in aseptic technique during catheter insertion were strongly linked to early-onset CAUTI, reinforcing the importance of meticulous adherence to infection control guidelines as advocated by the CDC and WHO [12].

In this study, the urethral trauma rate of 8% is slightly higher than some published series [8], potentially due to the higher proportion of elderly male patients with prostatic enlargement, which increases catheter insertion difficulty. Catheter blockage (6%) and accidental dislodgement (5%) were less common but clinically relevant, as they can cause discomfort, impair drainage, and increase the likelihood of secondary infection [10].

All complications resolved with appropriate interventions, and no patient progressed to urosepsis. This favorable

outcome may be attributed to early detection through daily monitoring and prompt management, an approach supported by studies highlighting the importance of close surveillance and patient-centered catheter care in preserving quality of life [9].

The implications of these findings are twofold. First, catheter use should be restricted to clear clinical indications, with removal at the earliest opportunity, particularly in high-risk patients such as those with diabetes mellitus. Second, rigorous aseptic insertion, adherence to catheter care bundles, and continuous staff education are crucial to lowering complication rates [12].

Generalizability

The findings of this study are generalizable to similar tertiary care surgical settings in India where urethral catheterization is routinely performed for perioperative or critical care purposes. Because the study included a broad range of adult surgical patients with diverse comorbidities, the results reflect the real-world pattern of catheter-associated complications encountered in general surgical practice. However, extrapolation to specialized urological or intensive care populations should be done cautiously, as their risk profiles and catheterization protocols may differ. Future multicentric studies encompassing varied healthcare levels would help strengthen the external validity of these results.

Conclusion

This prospective study highlights that urethral catheterization in general surgical inpatients carries a substantial risk of complications, with one-third of patients affected, most commonly by catheter-associated urinary tract infection. Prolonged catheterization beyond seven days, diabetes mellitus, and breaches in aseptic technique were identified as significant risk factors. All complications resolved with timely, appropriate interventions, underscoring the importance of vigilant monitoring and early management. These findings

emphasize the need for strict adherence to aseptic protocols, judicious use of catheterization, and minimizing duration wherever possible. Targeted preventive strategies, particularly in high-risk groups, can reduce morbidity, improve recovery, and optimize patient safety in surgical care settings.

Limitations

This study had certain limitations. Being a single-center observational study, its findings were influenced by the institutional practices and patient demographics, which limited wider representativeness. The relatively small sample size restricted the subgroup analysis for less common complications. Additionally, microbiological profiling of CAUTI pathogens was not performed, which restricted detailed antimicrobial correlation. Despite these constraints, the prospective design, uniform follow-up, and strict adherence to inclusion criteria ensured methodological strength and reliability of outcomes.

Recommendations

Strict adherence to aseptic technique during catheter insertion and maintenance is essential to minimize infection risk. Catheterization should be reserved for clear clinical indications, and the duration should be kept to the shortest possible period, particularly in high-risk patients such as those with diabetes mellitus. Regular staff training on catheter care protocols and daily evaluation of catheter necessity should be implemented. For patients requiring prolonged catheterization, enhanced monitoring for early signs of complications is recommended. Use of catheter care bundles, timely replacement of blocked catheters, and early intervention for trauma can further improve outcomes. Larger, multicenter studies are warranted to validate these findings and develop targeted prevention strategies.

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Abbreviations

CAUTI – Catheter-Associated Urinary Tract Infection

CDC – Centers for Disease Control and Prevention

CKD – Chronic Kidney Disease

OR – Odds Ratio

SD – Standard Deviation

UTI – Urinary Tract Infection

Source of funding

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Conflict of interest

The authors declare no conflict of interest.

Author contributions

NK-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript. **CPB**- Design of the study, results interpretation, review of literature and preparing first draft of manuscript, revision of manuscript.-Review of literature and preparing first draft of manuscript. Statistical analysis and interpretation. **YS**-results interpretation, review of literature and preparing first draft of manuscript, revision of manuscript.-Review of literature and preparing first draft of manuscript. Statistical analysis and interpretation.

Data availability

Data available on request

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In 2019, Dr. Sudhakar commenced his academic career as an Assistant Professor in the Department of General Surgery at Government Medical College, Suryapet, Telangana. Over the next five years, until June 2024, he made significant contributions to undergraduate and postgraduate training, refining his expertise in surgical education, operative techniques, and clinical mentoring.

In mid-2024, he was appointed Associate Professor at Government Medical College & General Hospital, Bhadradi Kothagudem, where he continues to integrate evidence-based practice into both patient care and academic teaching. Known for his commitment to professional growth, Dr. Sudhakar combines scholarly rigor with compassionate care, fostering an environment that encourages innovation, research engagement, and high standards of surgical excellence. **ORCID ID:** <https://orcid.org/0009-0005-2330-241X>

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