

Original Research Article

Incidence of urinary tract infection in surgical patients after short term catheterization in a tertiary care institute

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ABSTRACT

Background: We aim to assess the rate of catheter associated urinary tract infection in patients undergoing catheterization in our surgical ward. Urinary catheters pose a potential risk of introducing infections in the urinary system. We observed the setting of catheterization and incidence of UTIs, prevalence, contributing factors, and potential preventive measures. We aim to enhance the quality of patient care and reduce the burden of post-catheterization complications.

Methods: The research methodology involves a retrospective analysis of patient records, encompassing a large sample size from the tertiary care institute. Data collection includes patient demographics, duration of catheterization, underlying health conditions, and microbial profiles. Statistical analyses will be employed to discern patterns, risk factors, and correlations.

Results: 322 patients admitted in our surgical ward were catheterized as a part of this study, out of which 170 patients came under the inclusion criteria, including 63 males and 107 females. It was found that 19 patients, 13 female and 6 males, had developed positive urine cultures on day 3 of catheterization, with 6 patients showing symptoms of UTI. 14 out of 19 cultures were positive for *E. coli*, 3 for *Klebsiella* sp., 1 for *Citrobacter* spp. And 1 for *E. gallinarum*.

Conclusions: In this study, we concluded that maximum cases of CAUTI were due to inappropriate catheterization in emergency surgical procedures, where proper aseptic standards were not applied. Preventive strategies should be applied to minimize the incidence and complications of CAUTI.

Keywords: Foley catheterization, Urinary tract infection, Catheter, Tertiary care

INTRODUCTION

Catheter acquired urinary tract infection is one of the most common health care acquired infections.^{1,2} The use of indwelling urethral catheters is rampant in health care facilities. Among UTIs acquired in the hospital, approximately 75% are associated with a urinary catheter. Between 15-25% of hospitalized patients receive urinary catheters during their hospital stay.³ The most important risk factor for developing a catheter-associated UTI

(CAUTI) is prolonged use of the urinary catheter, which further strengthens the principle of using catheters only for appropriate indications and their immediate removal when no longer needed. Urinary tract infections (UTIs) are characterized by a range of symptoms that can vary in intensity, referred to as lower urinary tract symptoms (LUTS).

Common signs include increased urge to urinate, accompanied by a burning sensation during urination.

Individuals with UTIs may experience frequent and small amounts of urine, and the urine itself may appear cloudy or have an unusual odour. Discomfort or pressure in the lower abdomen, as well as pelvic pain, are also common symptoms.

Additionally, some individuals may notice traces of blood in their urine. Untreated UTIs can lead to systemic symptoms such as fever and fatigue. Severe UTI is usually characterized by high grade fever with chills, and the patient may present in a state of AKI due to ascending infection into the kidneys. Catheter associated infection refers to an infection occurring in an individual who currently has a catheter in their urinary tract or has had one within the past 48 hours.⁴ UTI denotes significant bacteriuria in a patient displaying symptoms or signs related to the urinary tract without any alternative source of infection. ASB signifies significant bacteriuria in a patient lacking symptoms or signs related to the urinary tract. Bacteriuria is a general term encompassing both UTI and ASB. In the context of urinary catheter literature, CA-bacteriuria predominantly comprises CA-ASB. In the context of this study, CA-UTI, CA-ASB, and CA-bacteriuria are all considered indicative of urinary tract infection, as bacteria are not typical inhabitants of the urinary tract.⁴

Pathogenesis

The pathogenesis of CAUTI can be explained by the biofilm phenomenon. Biofilm formation along the catheter surface is the most important cause of bacteriuria.⁵ Biofilm is a complex organic material consisting of micro-organisms growing in colonies within an extra-cellular mucopolysaccharide substance which they produce. Urine components, including Tamm-Horsfall protein and magnesium and calcium ions, are incorporated into this material.⁶

The formation of a biofilm begins soon after catheter insertion, which can be further accelerated by improper aseptic techniques. The process occurs on both internal and external surfaces of the catheter. The stagnant urine in the drain bag is usually the first to get infected by bacteria, after which they ascend along the tubing to the catheter. Only about 5% of episodes of CA-ASB follow introduction of periurethral organisms into the bladder at the time of catheter insertion.⁷

Microbiology

Urinary tract is a vast reservoir of resistant microorganisms with threat of cross infection. The common culprits include *Escherichia coli*, *Klebsiella* spp., *Proteus*, *Pseudomonas*, *Staphylococcus aureus*, *CONS* and *Enterococcus* spp. It can cause genitourinary complications, septicemia, skeletal involvement, and over the years, bladder cancer.⁸ *Proteus mirabilis* is not common in patients undergoing short term catheterization.⁹ The longer a catheter is in place the

more likely it will be present. It produces more copious biofilm than other bacteria, and these strains also tend to persist for longer periods of time.¹⁰

Diagnosis of CA-UTI

Microbiologic diagnosis

Urine specimens for culture should be collected directly from the catheter or tubing, to maintain a closed drainage system. This can be done through the catheter collection port or by puncturing the tubing with a needle.⁴ The diagnosis of CA-ASB is established when one or more organisms are present at quantitative counts $\geq 10^5$ CFU/ml in a properly collected urine specimen from a patient showing no symptoms attributable to urinary infection.⁴ Lower quantitative counts may be identified in urine specimens before reaching $\geq 10^5$ CFU/ml, but these are likely indicative of organisms present in the biofilm forming along the catheter rather than bladder bacteriuria.⁵

Clinical diagnosis

The diagnosis of symptomatic CA-UTI is often a diagnosis of exclusion.^{4,11} Fever without specific localizing findings is typically the common presentation of CA-UTI. Identifying signs or symptoms include catheter obstruction, acute hematuria, suprapubic pain, or costovertebral angle tenderness. These are present in only a minority of cases, but can be useful in recognizing a urinary source of fever. In the absence of these findings, attributing fever to urinary infection in bacteriuric patients should only be done if the same organism is isolated from both the urine and a simultaneous blood culture.

Preventive measures

Avoiding catheterization altogether is the single most important measure in prevention of CAUTI. If a catheter is inevitable, it must be placed by a trained professional under strict aseptic conditions with zero contact between the catheter and exposed genitals. Strategies for prevention include avoiding unnecessary catheter usage, implementing guidelines for catheter insertion and upkeep, selecting appropriate catheters, monitoring both CA-UTI occurrences and catheter utilization, and suggesting criteria for assessing quality.

Catheters are often left in place longer than necessary, occasionally due to healthcare personnel being unaware of their presence.¹² Alternate measures may be used to measure urine output in a patient. These include but are not limited to usage of Uro-pots, Condom catheters and intermittent bladder emptying techniques like usage of K-90. Usage of antimicrobial coated catheters in prevention of CAUTI was tested by Picard et al with the conclusion that they are not clinically useful in preventing CAUTI.¹³

The objective of this study was to observe the rates of CA-UTI in our surgical ward and its association with various demographic and patient-dependent factors.

METHODS

We conducted a retrospective observational study for 322 patients who underwent catheterization between the 7 and 13 January 2024 in the Department of General Surgery, SMS Hospital, Jaipur, Rajasthan. Demographic data, receiving complaints, comorbidities, and relevant blood investigations were taken and recorded. Proper written and informed consent had been obtained from all subjects involved in the study.

Inclusion criteria

All patients who were admitted in our unit who required catheterization were included in this study. Intra-operative urine output monitoring in patients undergoing major surgery, Output monitoring in acutely ill patients and Patients with complaints of incontinence, strangury or dysuria

Exclusion criteria

Patients with pre-existing UTI (diagnosed by urine routine and cultures at admission), Ongoing sepsis or positive blood culture at admission, History of type II diabetes, renal stones, patients referred with a catheter in-situ, h/o indwelling catheter in the last 15 days, patient age <15 years, patients not giving consent for catheterization. Recent history of surgery on Genitourinary tract.

All the patients who came into our inclusion criteria underwent a complete hemogram, along with urine routine and culture at the time of admission. Then, they were catheterized by a surgical resident. The patients were then managed either medically, or surgically depending on their condition, and started on antibiotic regime as per their diagnosis. The urine samples were drawn fresh from the catheter on day 3 and urine cultures were sent. Data was collected, analysed by calculating means and percentages with a manual calculator tool, and represented as shown below.

RESULTS

170 patients were included in this study including 63 (37%) male and 107 (63%) female and maximum number of patients were from the 46-60 years age group, the median age being 44.5 years (range 16-77) as indicated by (Table 1).

All patients were catheterized in an emergency scenario. The various reasons for catheterization are shown as in (Table 1 and Figure 1), the most common of which was found to be prior to major surgical procedure, which accounted for 114 cases (67%, 46 male and 68 female)

followed by patients with acute illness in 50 cases (29.5%, 11 male and 39 female) and for difficulty in micturition in 6 cases (3.5%, 6 male).

Table 1: Patient characteristics (n=170).

Parameters	N	%
Gender		
Male	63	37
Female	107	63
Mean age (years)	44.6	
15-30	9	5.3
31-45	38	22.3
46-60	83	48.8
>60	40	23.6

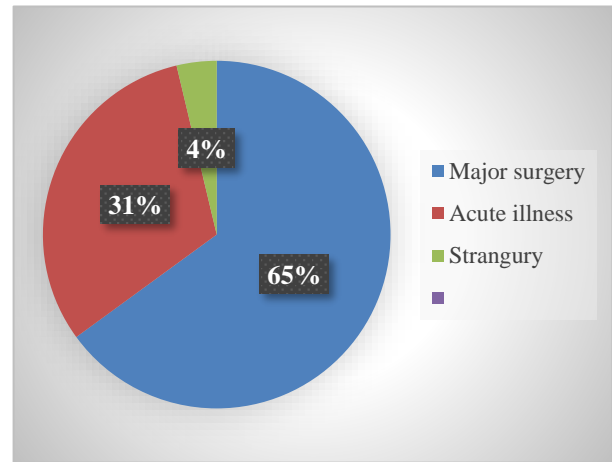


Figure 1: Causes of catheterization.

After 48 hours of catheterization, patient urine cultures were sent again by drawing fresh samples from the catheter with an aseptic syringe. Of the above 170 patients, 19 patients (11.1%) were found to have a positive urine culture report (>10⁵ CFU/ml). Of these 19 patients, 6 were found to have symptoms of UTI (3.52%) along with a urine routine suggestive of pyuria, thus establishing a diagnosis of CAUTI. The above findings are summarized in (Table 2).

Table 2: Investigative findings.

Variables	N	%
Urine culture (n=170)		
Positive for bacteria	19	11.2
Negative for bacteria	151	88.9
Symptoms of UTI (in patients with positive urine culture) (n=19)		
Present (CAUTI)	6	3.52
Absent (CA-ASB)	13	7.64

A closer study of the urine cultures of the above 19 patients revealed that the causative organism was *E. coli* in 14 cases, *Klebsiella spp.* In 3 cases, *E. gallinarum* in 1 case and *Citrobacter* in 1 case (Figure 2 and 3).

The one case in which *E. gallinarum* was isolated was sensitive to fosfomycin, and linezolid, while resistant to nitrofurantoin, ticarcillin, vancomycin, aminoglycosides and fluoroquinolones. The one case in which *Citrobacter spp.* was isolated was sensitive to fluoroquinolones and tetracycline group of drugs, while resistant to 3rd generation cephalosporins, carbapenems, piperacillin/tazobactam, aminoglycosides and cotrimoxazole.

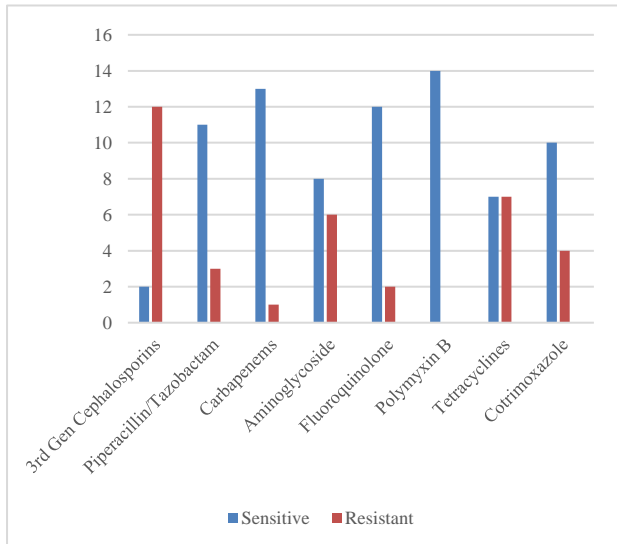


Figure 2: *E. coli* antibiotic sensitivity.

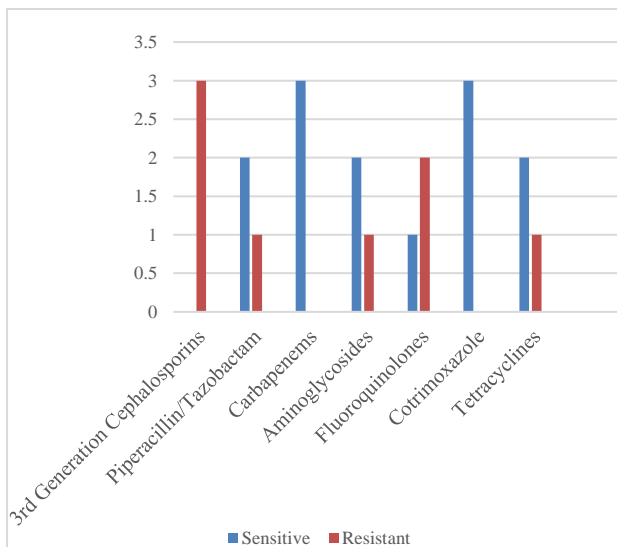


Figure 3: *Klebsiella* antibiotic sensitivity.

DISCUSSION

In this retrospective observational study of 170 cases consisting of 63 males and 107 females, we found that 19 patients (10.1%) developed CA-ASB, out of which 9 patients developed CAUTI (3.3%), giving us a CAUTI rate of 3 per 1000 catheter days. Sullivan et al reported that the risk of bacteraemia during initial catheter insertion may be similar, whether there is a pre-existing

UTI (7%) or sterile urine (8.2%).¹⁴ Of the 114 patients catheterized for major surgical procedure, 15 (13.1%) patients developed CA-ASB, 11 female and 4 male, which was a lower rate than in a study done by Farsi et al, where he found that CAUTI occurred in 20.6% of colorectal procedures.¹⁵ Bregenzer et al did a study on geriatric patients with long term catheters, reported that Of 480 blood cultures, 27 (5.6%) were positive.¹⁶ However, the same species grew from blood and urine in only 5 catheter replacements. The most common cause of CAUTI was *Escherichia coli*, with 14 out of 19 cultures showing colonization (73.7%). This was in accordance with a study done by Nicolle et al, which showed 69.3% of cultures positive for *E. coli*. We found that out of the 19 patients with CA-ASB, 6 were male and the remaining 13 were female, with a female: male ratio of 2.2:1. A study by Tambyah et al on 224 patients with CAUTI revealed 66% of patients to be female and 34% male, with a female: male ratio of 1.9.^{7,12} The mean age of patients with CA-ASB was 44.6 years, with 2 patient in the age group of 30-45 years, 12 patients in the age group of 46-60yrs and 5 patients aged over 60 years. The higher age range suggests neglect and lowered immunity in the older patients to be a causative factor for UTI.

In patients with symptomatic UTI, the most common symptom was Fever and burning micturition, with 6 out of 6 cases (100%). 2 patients had chills accompanying the fever. One patient had complaints of pain abdomen, and one patient had complaints of increased frequency of micturition. This was in contrast to a study conducted by Warren et al who evaluated 47 women in a nursing home with long-term urinary catheters, all of whom had chronic bacteriuria, and reported a very low incidence of febrile episodes of urinary tract origin, suggesting that chronic and acute UTI may have different presentations.¹⁰ Of the 14 patients with urine cultures positive for *E. coli* 12 patients were resistant to 3rd generation cephalosporins, 3 patients were resistant to Piperacillin+Tazobactam, one patient was resistant to Carbapenems, 6 patients were resistant to aminoglycosides, 1 to Fluoroquinolones, 4 to Cotrimoxazole and all strains were sensitive to Polymyxin B. An alarmingly high resistance to cephalosporins can probably be attributed to the irrational antimicrobial use in the country. A similar study done by Kazi et al on 1380 patients showed Imipenem to be the single best antibiotic for this condition.¹⁷ One of the positive urine cultures showed the causative organism to be a highly resistant strain of *E. gallinarum*, sensitive only to Fosfomycin and Linezolid. However, no serious complications were noted in this patient. The relatively high incidence of UTI in our centre is probably due to multiple factors, including but not limited to inadequate aseptic practices, poor patient hygiene and associated co-morbidities.

Limitations

The limitations of this study stem from the comparatively smaller sample size, and a larger size would be required

to establish any definitive associations. If the patient is in the incubation period at the time of admission, it can lead to false positives. Finally, poor hygiene standards at the hospitals and patient hygiene can cause further errors in judgement.

CONCLUSION

From the above study, we can conclude that CAUTI is a cause for significant patient morbidity during hospital stay, incurring heavy costs on the patients, hospitals and also placing unnecessary burden on govt. insurance schemes. Proper preventive measures and personnel training is necessary to reduce the morbidity associated with urinary catheters and improve patient care.

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