

Health Care Acquired Catheter-Associated Urinary Tract Infections in Surgical Cases

Indira Kumari Verma¹, Dharmendra Kumar Bairwa², Jahnavi Manthri³, V S Randhawa⁴, Sonal Saxena⁵, Manoj Andley⁶, Ravinder Kaur⁷

¹Assistant professor, Microbiology, SKGMC, Sikar, Rajasthan

²Senior resident, Radio diagnosis, Safdarjung hospital, New Delhi

³Senior resident, Surgical Oncology, Government Cancer Hospital, Chhatrapati Sambhajinagar, Maharashtra

⁴Director professor, Microbiology, LHMC, Delhi

⁵Director professor, Microbiology, LHMC, Delhi

⁶Director professor, Surgery, LHMC, Delhi

⁷Director professor, Microbiology, LHMC, Delhi

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Corresponding author: Dr. Indira Kumari Verma

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Abstract

Background: In India, only a few microbiological studies have been done on healthcare-acquired catheter-associated urinary tract infections, so there is a lack of sufficient data on this aspect. The present study would estimate the proportion of CAUTI, CA-ASB, and Candiduria using culture system and identify causative agents & antimicrobial susceptibility patterns.

Materials and Methods: It's a cross-sectional hospital-based study, conducted in the Department of Microbiology and the Department of Surgery at Lady Hardinge Medical College and associated Smt. Sucheta Kriplani Hospital (S.S.K.H.), New Delhi, during the period November 2018 to April 2020.

Every catheterized patient admitted to the surgical ward was asked about signs and symptoms of UTI and further followed by urine culture and sensitivity.

Results: Seventy-four (41.1%) cases of healthcare-acquired catheter-associated urinary tract infections were obtained, nineteen cases (26%) developed Catheter-associated UTI (CAUTI). Thirty-four (46%) cases has Catheter-associated asymptomatic bacteriuria (CA-ASB). Twenty-one (28%) cases in the study developed Candiduria. The commonest disease associated with CAUTI was BPH and the common diseases associated with Candiduria were Hernia and cholelithiasis. The commonest reason for catheterization in CA-ASB cases was urinary output monitoring. The majority of E. coli isolates, i.e., eight cases in CAUTI, were susceptible to nitrofurantoin (80%). Twelve isolates of Enterobacteriaceae from CAUTI cases, and fourteen from CA-ASB cases, were carbapenem resistant.

Conclusion: It may be concluded from our studied that health care acquired catheter-associated urinary tract infections has varied etiology. Prospective data collection on outcomes including urinary catheter use, duration, CAUTI, CA-ASB and Candiduria isolates and their antimicrobial susceptibility will enable quality and process improvement.

Keywords: Catheter associated Urinary Tract Infections, Catheter associated asymptomatic bacteriuria, Candiduria, Antimicrobial susceptibility.

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Introduction

Health care-acquired infections (HCAIs) are one that are acquired in a hospital or healthcare facility (i.e., the infection was not present or incubating at the time of contact with the health care environment) [1]. The term HCAIs initially referred to those infections linked with admission to an acute-care hospital (earlier it was called as nosocomial infections), but this term now includes infections developed in various settings, where

patients obtain health care facility (for example long-term care, home care, and ambulatory care, family medicine clinics). HCAIs are infections that first appear 48 hours or more after hospitalization [2]. Health care-acquired catheter-associated urinary tract infections account for up to 40% of all hospital-acquired infections [3]. According to NHSN 2011 surveillance report, in adult critical care units, 45- 79% of patients had an indwelling

catheter, 17% of those in medical wards, 23% in surgical wards, and 9% in rehabilitation units[4]. Development of UTI is associated with increased duration of hospital stay, increased incidence of various infections, and increased mortality in the hospital. Among 40% hospital hospital-acquired UTIs, 80% are due to CAUTI [5]. The associated morbidity and mortality are a heavy burden on the hospital resources.

Incidence of symptomatic CAUTIs is a major health concern due to the complications and recurrence associated with this type of infection. Research is directed at understanding the CAUTIs and should lead to new and improved diagnosis, prevention, and treatment options [6].

Four factors have been repeatedly observed in representative studies to be major risk factors for CAUTI: female gender, duration of catheterization, absence of systemic antimicrobials, and catheter care violations. Comorbidity is a significant risk factor for non-CAUTIs, which are HAIs in the absence of a catheter. However, other risk factors have been identified in specific populations and individual studies. There are four risk factors that are of sufficient reproducibility that investigators should adjust analyses for these factors when evaluating new preventive methods for UTI [7]. Catheter-associated bacteriuria is the most frequent health care-associated infection worldwide [8]. Differentiating asymptomatic bacteriuria from CAUTI poses a tough challenge in the current state.

Patients having indwelling urinary catheters, female gender, patients undergoing urological manipulations, patients with debilitating diseases, and long-stay elderly patients are at high risk of developing CAUTIs. Data on etiology and resistance obtained from laboratory surveys demonstrate an increase in resistance of gram-negative bacteria to commonly used antibiotics [9].

Since resistance rates vary by local geographic region, individual patient characteristics, it is important to use current and local data when choosing a treatment regimen empirically, before antibiotic susceptibility patterns become available. HAIs may be caused by infectious agents from endogenous or exogenous sources. Exogenous sources are those external to the patient, such as patient care personnel, visitors, patient care equipment, medical devices, or the healthcare environment. Infection control policies are important in limiting the number of CAUTIs. Other important aspects include catheterization using an aseptic technique and sterile equipment, and the use of closed drainage systems [10].

In India, only a few microbiological studies have been done on healthcare-acquired catheter-associated urinary tract infections, so there is a lack

of sufficient data on this aspect. The present study would estimate the proportion of CAUTI, CA-ASB, and Candiduria using a culture system and identify causative agents & antimicrobial susceptibility patterns. The data generated would be helpful in providing better management of patients.

Materials and Methods

It's a cross-sectional hospital-based study, conducted in the Department of Microbiology and the Department of Surgery at Lady Hardinge Medical College and associated Smt. Sucheta Kriplani Hospital (S.S.K.H.), New Delhi, during the period November 2018 to April 2020. The study was approved by the scientific review board and ethics committee of Lady Hardinge Medical College, New Delhi.

180 surgical patients who were catheterized and admitted to the surgery ward were enrolled in the study. Subjects were enrolled in the study only after obtaining written informed consent. Patients having preexisting UTI, known congenital abnormality of the urinary tract, or patients on condom or straight in and out catheters were excluded from the study. After signing an informed consent, relevant medical, surgical, and treatment profiles were gathered using pre-approved questionnaires and kept confidential during the research. Every catheterized patient admitted to the surgical ward was asked about signs and symptoms of UTI (dysuria, urgency, fever, suprapubic tenderness, costovertebral pain, increased frequency of micturition) within 2 days of removal of the catheter and history of using prophylactic antimicrobials. Self-designed, pre tested proforma was used to collect data such as age, sex, date of admission, pertinent history with emphasis on past medical and surgical history, clinical presentation, associated risk factors, indication of foley catheterization, duration of catheterization, and empirical treatment with presence of any risk factor or chronic illness history, surgery, duration of hospitalization and others.

Sample collection & Processing of the urine specimen: Urine sample was collected on the day of enrolment after giving proper instructions to subjects, using aseptic technique; from a Foley catheter or by standard mid-stream "clean catch" method within 2 days of catheter removal, in a sterile, wide-mouthed, properly labelled universal container with a tightly fitted lid. The catheter tubing was clamped off above the port to allow collection of freshly voided urine. The catheter port or wall of the tubing was disinfected with 70% ethanol, and urine was aspirated via a needle and syringe; the integrity of the closed drainage system was maintained to prevent the introduction of organisms into the bladder.⁸⁴ In long-term indwelling catheterization, the ideal method of

obtaining urine for culture was followed, in which the catheter was replaced and the specimen was collected from the freshly placed catheter. In a symptomatic patient, this was done immediately prior to initiating antimicrobial therapy.³² Culture specimens from the urine bag were not obtained. Fluids were not forced on patients in order to have them void urine; excessive fluid intake may dilute the urine and decrease the colony count. The specimens were immediately transported to the laboratory and processed within 2 hours of collection. Appropriate culture testing and antimicrobial susceptibility testing were done.

Statistical Analysis: Data was transformed /coded and entered in SPSS version 16. Analysis was tested by the mean and the Chi-square test. p (predictive value) <0.05 was considered a significant association between the variables tested. Univariate analysis was performed on the various parameters. For the parameters that came positive with the previous parameters, multivariate analysis was performed.

Results

The present study was based on one hundred and eighty surgical patients, who were catheterized and admitted to the surgery ward of S.S.K.H., New Delhi.

Seventy-four (41.1%) cases of healthcare-acquired catheter-associated urinary tract infections were obtained, which were further subdivided into CAUTI, CA-ASB, and Candiduria categories. Nineteen cases (26%) in the study developed Catheter-associated UTI (CAUTI). Thirty-four (46%) cases in the study developed Catheter-associated asymptomatic bacteriuria (CA-ASB). Twenty-one (28%) cases in the study developed Candiduria.

The majority of the cases of CAUTI (84.21%) and Candiduria (90.5%) belonged to the > 40 years category. However, this trend was not seen in the CA-ASB category cases. There was a predominance of female cases (57.14%) in the Candiduria cases. These cases had varied disease profile, for which they were admitted. This profile is depicted in Table 1. The commonest disease associated with CAUTI was BPH and the common diseases associated with Candiduria were Hernia and cholelithiasis.

One hundred and sixty-one (89.4%) cases received empirical antimicrobials after admission to the surgical ward. Ceftriaxone was the commonest antimicrobial administered in 84 (46.7%) cases, followed by ciprofloxacin in 41 (22.8%) cases. Fever was the most common sign present in both CAUTI and candiduria cases. Suprapubic tenderness was common in candiduria cases than CAUTI cases. Urinary frequency and urgency were

present only in the CAUTI cases in comparison to the candiduria cases (p value <0.05).

The commonest reason for catheterization in CA-ASB cases was urinary output monitoring. In candiduria cases, urinary output monitoring and surgery were the predominant reasons for catheterization. The urethral catheterization was of the short-term category of <30 days in all the study cases. The duration of catheterization varied between 2 to 26 days. The mean duration of catheterization in various categories is depicted in Table 2. The duration (mean) of catheterization was maximum for the candiduria cases, followed by CAUTI cases. The value was least for the CA-ASB cases. (p value <0.05 for duration of catheterization).

The etiological profile of these study cases is depicted in Table 3 with their number and percentage. *E. coli* was the most common pathogen in the CAUTI and CA-ASB cases. In candiduria cases, *Candida tropicalis* was the commonest *Candida* species to be isolated. All the case studies were analyzed for the various risk factors. Long-term catheterization and history of previous hospitalization were risk factors in the CAUTI, CA-ASB, and Candiduria categories, by univariate analysis ($p < 0.05$). However, only long-term catheterization was significant by both univariate and multivariate analysis ($p < 0.05$).

The susceptibility profile of isolates from CAUTI cases is depicted in Table 4 according to the disc diffusion method (CLSI 2017). *Serratia marcescens* was isolated only from one case, which was resistant to ampicillin, cefazolin, and nitrofurantoin and susceptible to other antimicrobials.

The majority of *E. coli* isolates, i.e., eight cases in CAUTI, were susceptible to nitrofurantoin (80%) in contrast to ampicillin, to which most of the isolates were resistant. In CA-ASB, the majority of *E. coli*, i.e., isolates in fourteen cases, were susceptible to nitrofurantoin (73.7%) in contrast to ampicillin, for which most of the isolates were resistant. This pattern is similar to the CAUTI isolates. Antimicrobial susceptibility profile of isolates from CA-ASB cases is depicted in Table 5. Twelve isolates of Enterobacteriaceae from CAUTI cases, and fourteen from CA-ASB cases, were carbapenem resistant. All these isolates were tested for colistin susceptibility by the Colistin NP test and the Vitek 2 system.

All of these isolates were susceptible to colistin (MIC $\leq 0.5 \mu\text{g/ml}$). 63.2% Enterobacteriaceae isolates in CAUTI cases were carbapenem resistant, whereas CRA (carbapenem resistance *Acinetobacter*) were absent in CAUTI cases. In CA-ASB, 41.2% of Enterobacteriaceae and 5.9% of *Acinetobacter* isolates were carbapenem

resistant. Only two isolates of *Candida albicans* were resistant to fluconazole, one was intermediately susceptible to voriconazole, others were susceptible to all the antifungals. All patients

recovered and improved, except for one case of Candiduria having carcinoma gall bladder and succumbed to infection.

Table 1: Disease profile of the study cases

DIAGNOSIS	CAUTI	CA-ASB	CANDIDURIA
Malignancy	4 (22.2%)	10 (29.4%)	3 (14.3%)
Cholelithiasis	0 (0.0%)	1 (2.9%)	4 (19.0%)
Hernia	1 (5.6%)	3 (8.8%)	4 (19.0%)
BPH	5 (27.8%)	4 (11.8%)	0 (0.0%)
Nephrolithiasis	3 (11.1%)	1 (2.9%)	2 (9.5%)
Appendicitis	0 (0.0%)	0 (0.0%)	0 (0.0%)
Pancreatitis	0 (0.0%)	2 (5.9%)	1 (4.8%)
Hydronephrosis	0 (0.0%)	2 (5.9%)	0 (0.0%)
Kochs Abdomen	0 (0.0%)	0 (0.0%)	1 (4.8%)
Septicaemia	0 (0.0%)	0 (0.0%)	1 (4.8%)
Others	6 (33.3%)	11 (32.4%)	5 (23.8%)

Table 2: Duration of catheterization in the study cases

Duration of Catheterization (Days)	CAUTI	CA-ASB	CANDIDURIA
Mean (SD)	10.11 (6.81)	8.85 (5.18)	13.00 (5.21)
Median (IQR)	7 (7.5)	6.5 (3.75)	11 (7)
Range	3 – 26	2 - 22	6 - 25

*SD- Standard deviation, IQR- Interquartile range

Table 3: Etiological profile of the study cases

Category	Organism	Number	Percentage
CAUTI	<i>E. coli</i>	10	52.60%
	<i>Klebsiella</i> spp.	4	21.10%
	<i>Pseudomonas aeruginosa</i>	4	21.10%
	<i>Serratia marcescens</i>	1	5.30%
CA-ASB	<i>E. coli</i>	19	55.90%
	<i>Enterococcus</i> spp.	7	20.60%
	<i>Klebsiella</i> spp.	4	11.80%
	<i>Pseudomonas aeruginosa</i>	2	5.90%
	<i>Acinetobacter baumannii</i>	2	5.90%
CANDIDURIA	<i>Candida tropicalis</i>	11	52.40%
	<i>Candida albicans</i>	5	23.80%
	<i>Candida parapsilosis</i>	5	23.80%

Table 4: Antimicrobials susceptibility profile of isolates from CAUTI cases

Antimicrobial	Pattern	<i>E. coli</i> (n = 10)	<i>Klebsiella</i> spp. (n = 4)	<i>Pseudomonas aeruginosa</i> (n = 4)
Ampicillin	S	0 (0.0%)	0 (0.0%)	0 (0.0%)
	R	10 (100.0%)	4 (100.0%)	4 (100.0%)
Gentamicin	S	6 (60.0%)	3 (75.0%)	1 (25.0%)
	IS	1 (10.0%)	0 (0.0%)	0 (0.0%)
	R	3 (30.0%)	1 (25.0%)	3 (75.0%)
Ciprofloxacin	S	0 (0.0%)	1 (25.0%)	1 (25.0%)
	R	10 (100.0%)	3 (75.0%)	3 (75.0%)
Trimethoprim-sulfamethoxazole	S	2 (20.0%)	3 (75.0%)	0 (0.0%)
	R	8 (80.0%)	1 (25.0%)	4 (100.0%)
Nitrofurantoin	S	8 (80.0%)	1 (25.0%)	0 (0.0%)
	IS	0 (0.0%)	1 (25.0%)	0 (0.0%)
	R	2 (20.0%)	2 (50.0%)	4 (100.0%)
Piperacillin- Tazobactam	S	4 (40.0%)	1 (25.0%)	2 (50.0%)
	IS	3 (30.0%)	2 (50.0%)	1 (25.0%)

	R	3 (30.0%)	1 (25.0%)	1 (25.0%)
Ertapenem	S	3 (30.0%)	2 (50.0%)	2 (50.0%)
	R	7 (70.0%)	2 (50.0%)	2 (50.0%)
Meropenem	S	6 (60.0%)	2 (50.0%)	2 (50.0%)
	R	4 (40.0%)	2 (50.0%)	2 (50.0%)
Imipenem	S	3 (30.0%)	2 (50.0%)	2 (50.0%)
	IS	0 (0.0%)	1 (25.0%)	0 (0.0%)
	R	7 (70.0%)	1 (25.0%)	2 (50.0%)
Amikacin	S	0 (0%)	0 (0%)	1 (25.0%)
	R	0 (0%)	0 (0%)	3 (75.0%)
Colistin Np Test	S	10 (100.0%)	4 (100.0%)	4 (100.0%)

*S- Susceptible, R- Resistant, IS- Intermediate susceptible

Table 5: Antimicrobials susceptibility profile of isolates from CA-ASB cases

Antimicrobial	Pattern	E. coli (n = 19)	Klebsiella spp. (n = 4)	Acinetobacter baumannii (n = 2)	Pseudomonas aeruginosa (n = 2)	Enterococcus spp. (n=7)
AMP	S	0 (0.0%)	0(0.0%)	0 (0.0%)	0 (0.0%)	1(14.3%)
	R	19(100%)	4(100%)	2(100%)	2(100%)	6(85.7%)
GENT/HLG.	S	12(63.2%)	4(100%)	1 (50.0%)	0 (0.0%)	1(14.3%)
	IS	1 (5.3%)	0(0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	R	6(31.6%)	0(0.0%)	1 (50.0%)	2(100%)	6(85.7%)
CIP	S	0 (0.0%)	2(50.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)
	R	19 (100%)	2(50.0%)	1 (50.0%)	2 (100%)	7 (100%)
COT	S	4 (21.1%)	2(50.0%)	1 (50.0%)	0 (0%)	3(42.9%)
	R	15 (78.9%)	2(50.0%)	1 (50.0%)	2(100%)	4(57.1%)
NIT	S	13 (68.4%)	1 (25.0%)	0 (0.0%)	0 (0.0%)	5 (71.4%)
	IS	1 (5.3%)	2(50.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	R	5(26.3%)	1(25.0%)	2 (100%)	2 (100%)	2(28.6%)
PIT	S	8 (42.1%)	4 (100%)	1 (50.0%)	0 (0.0%)	-
	IS	1 (5.3%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	-
	R	10(52.6%)	0 (0.0%)	1 (50.0%)	1 (50.0%)	-
ERT	S	7 (36.8%)	3 (75.0%)	1 (50.0%)	0 (0.0%)	-
	R	12(63.2%)	1(25.0%)	1 (50.0%)	2(100%)	-
MRP	S	10 (52.6%)	3 (75.0%)	0 (0.0%)	1 (50.0%)	-
	R	9(47.4%)	1(25.0%)	2(100%)	1 (50.0%)	-
IMP	S	8 (42.1%)	3 (75.0%)	1 (50.0%)	0 (0.0%)	-
	IS	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	-
	R	11 (57.9%)	1(25.0%)	1 (50.0%)	2 (100%)	-
AK	S	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	-
	R	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (100%)	-
COL	S	19(100%)	4 (100%)	2 (100%)	2 (100%)	-
VAN/ TEI	R	-	-	-	-	5(71.4%)
	S	-	-	-	-	2(28.6%)

*S- Susceptible, R- Resistant, IS- Intermediate susceptible, AMP-Ampicillin, GENT- Gentamicin, HLG- High level gentamicin (for enterococcus spp.), CIP- Ciprofloxacin, COT- Cotrimoxazole (Trimethoprim-sulfamethoxazole), NIT- Nitrofurantoin, PIT- Piperacillin-Tazobactam, ERT-Ertapenem, MRP - Meropenem, IMP- Imipenem, AK- Amikacin, COL- Colistin, VAN- Vancomycin, TEI- Teicoplanin

Discussion

In our study, CA-ASB constituted the biggest category (46%) of health care-acquired catheter-associated urinary tract infections to be followed by Candiduria in 28% of cases and CAUTI in 26% of cases. A study by Tambyah and Maki found 90% of cases to be in the category of CA-ASB [11]. This may be explained on the basis that the cases in the previous study were from a general hospital and

a broad category of specialties. The same reason may be responsible for none of the cases to be in the candiduria category in their study.

The incidence of CAUTI rate in the present study was 14.83 per 1000 urinary catheter days. An Indian study from Vishakhapatnam has found the catheter rate to be 3.65 per 1000 urinary catheter days [12]. A study conducted at a Brazilian hospital between 2003 and 2006 showed a CAUTI rate of

9.6 per 1000 urinary catheter days [13]. Another study under the International Nosocomial Infection Control Consortium (INICC) in 98 ICU settings in 18 limited resource countries over four continents for 10 years reported CAUTI incidence to be varying from 6.9 to 8.2 CAUTI per 1000 urinary catheter days [14]. These studies have shown a lower incidence rate of CAUTI than our study. The higher incidence in our study may be explained because study cases in our study were from a specialized clinic in a tertiary care hospital. Benign prostatic hyperplasia (BPH) constituted the biggest disease category in which the maximum cases of CAUTI were seen. In a study by Kundu et al., it was seen that most of the patients had neurological problems [15]. This is understandable, as the place of study was a neurology research centre. The mean duration of catheterization in our study was 10.11 ± 6.81 days in comparison to 14 ± 7.9 days by a study of Patil et al. The median duration of catheterization in our study was 7 days [9]. The latter aspect has not been adequately addressed in other studies [9,12].

In the present study, *E. coli* (52.6%) was the commonest pathogen in the CAUTI cases, followed by *Klebsiella* spp. (21.1%). *Pseudomonas aeruginosa* (21.1%) and *Serratia marcescens* (5.3%) were the other common pathogens isolated in our study. Many of the Indian studies have also reported *Escherichia coli* to be the commonest pathogen, followed by *Klebsiella* species [12,16,17].

In our study, >90% of cases were under empirical antimicrobial cover during their study period. It is well known fact that more than 75% of cases are under antimicrobial cover during their hospital stay [18-19]. This strategy initially may offer a short-term benefit but in the long run leads to colonization by antimicrobial-resistant uropathogens [12].

In our study majority of *E. coli* isolates were susceptible to nitrofurantoin (80%). A similar trend was reported by a study from Aligarh, in which 75% of isolates were susceptible to nitrofurantoin [20]. Another study from Nepal also reported high susceptibility to nitrofurantoin, but did not comment on the percentage [18]. Currently, nitrofurantoin has the status of cost cost-effective drug, which is effectively used in the treatment of urinary tract infections. However, the majority of *E. coli* isolates were resistant to ampicillin. Similar findings were reported by an Ethiopian study, in which they reported more than 80% of the *E. coli* isolates to be resistant to ampicillin [21].

The majority of *Klebsiella* spp. isolates (75%) in our study were susceptible to gentamicin and trimethoprim-sulfamethoxazole (cotrimoxazole), however, all isolates were resistant to ampicillin. A

similar trend was reported by a study from Nepal in which all isolates were susceptible to gentamicin and trimethoprim-sulfamethoxazole, but all isolates were resistant to ampicillin.

The most effective antimicrobial in our CAUTI cases for *Pseudomonas aeruginosa* isolates was piperacillin-tazobactam (50% susceptible, 25% intermediately susceptible). An Indian study of Visakhapatnam reported similar trends [12].

In our study, more than 60% of Enterobacteriaceae isolates were resistant to carbapenem. However, a study from Karad, Maharashtra reported a resistance rate of 40-50% isolates in their study. [12] The higher figure in our study can be explained on the basis that our study centre was in a tertiary care hospital.

CA-ASB is a very important entity that needs to be studied, as it is well known that many of these cases, after a certain period, come in the category of CAUTI. Very few studies are available on this aspect, as these entities are not treated [22-23]. The treatment of the CA-ASB cases is unlikely to confer clinical benefits; in fact, it may encourage antimicrobial resistance. In our study, 46% of cases belonged to the category of CA-ASB. This higher percentage of CA-ASB than CAUTI cases (26%) might be explained on the basis that our CA-ASB cases might have been CAUTI cases. The administration of analgesics and anti-inflammatory drugs in our cases could lead to the reporting of no symptoms. Hence, these cases may get categorized as CA-ASB rather than CAUTI.

The commonest reason for catheterization in CA-ASB cases was urinary output monitoring. This aspect had not been adequately addressed in other studies. The etiological profile of CA-ASB is very similar to CAUTI cases in our study. However, there were two differences. Enterococcus spp. (20.6%) was the second most common pathogen isolated in CA-ASB cases, and *Acinetobacter baumannii* was isolated from 5.9% of CA-ASB cases. CRE was seen in 41.2% of these cases. All *Acinetobacter* bacteria isolated were resistant to carbapenem (CRA). But all CRE and CRA isolates were susceptible to colistin and had an MIC of $\leq 0.5 \mu\text{g/ml}$. In our study, 28 % of cases had candiduria. The rate of catheter-associated urinary tract candiduria was 16.39 per 1000 device days. Another Indian study from Loni, Maharashtra, reported this parameter to be 1.6 per thousand device days [24]. The higher figure in our study might be attributed to the tertiary care status of a hospital in our study. Many other Indian and international scholars have not commented on this aspect [25,17]. The non albicans *Candida* constitute 76.2 % of the isolates leading them to become becoming emerging pathogens causing Candiduria. Our data indicates a trend towards an increasing

prevalence of infections caused by species of non albicans *Candida*. This picture is in concordance with many other Indian studies [24,26]. However, in one international study *Candida albicans* was the commonest species [27].

Our study has few limitations. One, as patients were included only from surgical ward in the study, therefore the findings may not be representative of the other specialties. The study was unicentric and results may not be universally applicable to others. Secondly, only patients with a foley's catheter were included in the study, patients with other types of catheters, the results are not applicable.

Our study was unique in comparison to many other studies, as we have evaluated the catheter-associated urinary tract infections in terms of not only symptomatic UTIs but asymptomatic urinary tract infections as well as candiduria also. This is important as asymptomatic infections often go undetected and this may decrease the sense of accountability on the part of the physicians. Also, bacteria colonizing the catheter surface are a potential source of a CAUTI. This study has highlighted the possible adverse practice of catheterization in the surgical ward, which has contributed to a majority of CA-ASB, CAUTI, and Candiduria.

Conclusion:

It may be concluded from our studied that health care acquired catheter-associated urinary tract infections has varied etiology. Prospective data collection on outcomes including urinary catheter use, duration, CAUTI, CA-ASB and Candiduria isolates and their antimicrobial susceptibility will enable quality and process improvement. The limitations of our study are that as patients were included only from surgical ward in the study and only foley's catheter was included in the study. Therefore, the findings may not be representative of the other specialties, may not apply to those with other types of catheters.

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