



RISK FACTORS ANALYSIS FOR CATHETER-ASSOCIATED URINARY TRACT INFECTION IN ICU IN A RURAL TERTIARY HOSPITAL - A CROSS SECTIONAL STUDY FROM SOUTH INDIA

Venugopal Reddy L

Junior Resident Department of General Medicine, P.E.S Institute of Medical Sciences & Research Andhra Pradesh, India.

Rahul Reddy Karnati*

senior Resident Department of General Medicine, P.E.S Institute of Medical Sciences & Research Andhra Pradesh, India. *Corresponding Author

ABSTRACT

Background: The objective of this study is to examine the independent risk factors for catheter-associated urinary tract infections in medical intensive care unit [ICU] patients.

AIM: To assess the independent risk factors for catheter-associated urinary tract infections.

OBJECTIVES: 1. To know the incidence of CAUTI in ICU patients 2. To know the risk factors 3. To check the causative agents and their antimicrobial susceptibility.

Materials and Methods: Study Period: 18 months [January 2018 to June 2019] in PES HOSPITAL KUPPAM on MEDICAL ICU Patients

Results: In our study, 54.4% (49/90) patients were found to have CAUTI. Diabetes has been identified as a risk factor for the development of CAUTI. CKD and COPD patients were significantly associated with CAUTI ($P < 0.05$).

Conclusion: It is concluded that incidence of CAUTI was 54.4%. As the duration of catheterization increases risk of CAUTI was also more, but this association was not significant ($P > 0.05$). COPD and diabetes cases were significantly associated with CAUTI ($P < 0.05$).

KEYWORDS :

INTRODUCTION

Urinary tract infections (UTI) are the most prevalent healthcare-acquired infections with an estimated prevalence of 1-10%, representing 30-40% of all nosocomial infections. Approximately 10% of UTIs are associated with mortality, along with cost upsurge and increased morbidity. In ICUs, presence of urinary catheterization is the major independent risk factor for the development of UTI.¹

The presence of an indwelling catheter predisposes to asymptomatic infection because it provides a surface for attachment of microbial adhesion. Symptomatic disease can cause ascending infection of bladder, ureter, and kidney, with subsequent need for antimicrobial agents. Catheter-Associated Urinary Tract Infections (CAUTI) are a common reservoir of resistant pathogens with the risk of cross-infection of other patients.^{2,3}

CAUTI is defined by CDC as a UTI in a patient who was catheterized for more than 2 days with at least one of the following signs or symptoms: fever ($>38^{\circ}\text{C}$); urgency; frequency; suprapubic tenderness; dysuria; costovertebral angle pain or tenderness and a positive urine culture of ≥ 105 colony-forming units (CFU)/ml with not more than 2 species of microorganisms. If an indwelling urinary catheter was in place for more than two days and then removed, the Urinary Tract Infection criteria must be fully met on the day of discontinuation or the next day.⁴

It has been recognized that the rates of CAUTI can be decreased by following proper protocols regarding the need and duration of catheterization and catheter care. Different guidelines have been formulated to control and decrease the rates of CAUTI in hospitals.^{4,5}

However, due to lack of awareness, the paucity of researches, and financial constraints, there is a lack of hospital-specific data on CAUTIs in India. This study was conducted to determine the incidence of Catheter-Associated Urinary Tract Infections (CAUTI) in ICU patients and find the risk factors for its development and to identify the causative agents and their antimicrobial susceptibility. This will help plan effective infection control policies and also prevent unnecessary antibiotic use in ICUs.

MATERIALS AND METHODS

The present study was conducted at PES Hospital after taking written informed consent from all the patients taking part in the study. Ethical committee clearance was obtained prior to start study.

STUDY SITE: This study is conducted in MEDICAL ICU Patients, PES Hospital, Kuppam.

STUDY DESIGN: A Cross-sectional observational study.

SAMPLE SIZE WITH JUSTIFICATION:

Based on Iran study, where the incidence of CAUTI was 21.8%, by using the formula:

$$n = (Z1 - a/2)^2 p(100 - p) / d^2 \\ = (1.96)^2 21.8(100 - 21.8) / 92 \\ = 80.4$$

However, the sample size for this study is taken as 90.

Study Population: Patients admitted to the ICU of PES hospital.

Inclusion criteria:

- 1) Patients are required to have a negative urine culture at the time of admission.
- 2) Duration of catheterization > 48 hours.

Exclusion criteria:

1. Patients whose sample taken on the time of catheterization showed culture positivity.
2. Patients catheterized prior to admission in ICU
3. Patients who showed signs and symptoms of UTI within two calendar days of catheterization.
4. Patients with condom catheters, suprapubic catheters, and percutaneous nephrostomy tubes.
5. Patients with renal anomalies.

Sampling technique: simple random sampling method
A time frame of study: 24 months

Procedure for data collection:

After obtaining approval from the institutional ethics committee, informed consent was taken from 210 patients that meeting the requirements of inclusion criteria. Demographic and clinical data including gender, age, underlying systemic diseases including diabetes mellitus and cancer, recent surgery, immunosuppressive therapy, and the indication for catheterization was collected and recorded. Urine culture was done at the time of catheterization 2 days after catheterization and also when the patient had symptoms of fever, loin pain, suprapubic pain, or urine color change. Samples were also sent on the day of catheter removal in all patients. The duration of catheterization was recorded as the date when symptoms appeared or when the urine specimen was sent for culture sensitivity, whichever was earlier. Hemoglobin and RFT were done on the admission day. 3 ml of urine was aspirated from the sampling port of the catheter after sterilizing the port with 10% betadine. Every sample was immediately sent to the micro lab for inoculation into growth agar plates. Quantitative analysis for the growth and type of organisms was monitored at day 1 and 2nd. Antibiotic susceptibility testing was done using the Kirby-Bauer disk diffusion technique.

Tools & techniques to be used: A quantitative urine culture was performed once weekly or prior to removal of catheter or when clinical manifestations of UTI occur (fever>38C, dysuria, suprapubic tenderness, pyuria). The urine specimen was aspirated aseptically from the sampling port of the catheter with a sterile syringe after the port had been disinfected & immediately sent to the microbiology laboratory. Standard culture and bacteriological techniques were used to identify isolated organisms

Plan of Analysis of data:

Data were analyzed using the statistical analysis package SPSS version 23 . Two analyses were undertaken: univariate analyses of the association of each variable with CAUTI and multivariable regression to predict CAUTI outcome. In the univariate analysis, Chi-square test and Fisher's Exact Test was used for categorical variables, and Student's t-test or Mann-Whitney test was used for continuous variables. All testing was two-sided.

RESULTS AND OBSERVATIONS

The present study was conducted among 90 catheterized patients to assess the independent risk factors for catheter-associated urinary tract infections in MEDICAL ICU, PES Hospital, Kuppam.

Table 1: Distribution According To Microbiological Analysis

MICROBIOLOGICAL ANALYSIS	Frequency	Percentage
NO GROWTH	11	22.4
ACINETOBACTER BAUMANI	1	2.0
CANDIDA SPECIES	3	6.1
CITROBACTER FRENDI	4	8.2
ESCHERICHIA COLI	11	22.4
KLEBSIELLA PNEUMONIAE	12	24.5
PROTEUS	2	4.1
PSEUDOMANAS AERU	5	10.2
TOTAL	90	100.0

Table 2: association Between Duration Of Cathetrization And Cauti

DURATION OF CATHETERISATION	CAUTI				TOTAL
	Yes		No		
	Num	%	Num	%	
<5days	20	48.8	21	51.2	41
≥Five days	29	59.2	20	40.8	49
TOTAL	49	54.4	41	45.6	90

Chi-Square =0.974*,df=1,P=0.397

Maximum CAUTI cases were found ≥5days duration of catheterization group compare to another group. But this association was not significant. (P>0.05)

Table 3: Association Between Duration Of Diabetes And Cauti

DIABETES	CAUTI				TOTAL
	Yes		No		
	Num	%	Num	%	
YES	34	89.5	4	10.5	38
NO	15	28.8	37	71.2	52
TOTAL	49	54.4	41	45.6	90

Chi-Square =32.538*,df=1,P=0.000

Maximum CAUTI cases were found in diabetes patients compared to nondiabetic cases. But this association was statistically significant. (P<0.05)

Table 3: Association Between Neurological Diseases And Cauti

NEUROLOGICAL	CAUTI				TOTAL
	Yes		No		
	Num	%	Num	%	
YES	22	62.9	13	37.1	35
NO	27	49.1	28	50.9	55
TOTAL	49	54.4	41	45.6	90

Chi-Square =1.634*,df=1,P=0.278

Maximum CAUTI cases were found with neurological deficits. But this association was not significant. (P>0.05)

Table 4 Association Between Chronic Obstructive Pulmonary Disease And Cauti

COPD	CAUTI				TOTAL
	Yes		No		
	Num	%	Num	%	
YES	8	88.9	1	11.1	9
NO	41	50.6	40	49.4	81
TOTAL	49	54.4	41	45.6	90

Chi-Square =4.783*,df=1,P=0.036

Maximum CAUTI cases were found with COPD. But this association was statistically significant. (P<0.05)

Table 5 Association Between Kidney Disease And Cauti

CHRONIC KIDNEY DISEASE	CAUTI				TOTAL
	Yes		No		
	Num	%	Num	%	
YES	4	57.1	3	42.9	7
NO	45	54.2	38	45.8	83
TOTAL	49	54.4	41	45.6	90

Chi-Square =0.022*,df=1,P=1.000

Maximum CAUTI cases were found with CKD. But this association was not significant. (P>0.05)

Table 6 Association Between Indication Of Cathetrization And Cauti

INDICATION OF CATHETERIZATION	CAUTI				TOTAL
	Yes		No		
	Num	%	Num	%	
CKD	7	36.8	12	63.2	19
INTUBATION	14	56.0	11	44.0	25
PYELONEPHRITIS	2	50.0	2	50.0	4
SEPSIS	10	58.8	7	41.2	17
SEPTIC SHOCK	4	66.7	2	33.3	6
STROKE	12	63.2	7	36.8	19
TOTAL	49	54.4	41	45.6	90

Chi-Square =3.504*,df=5,P=0.623

The above table describes the association between CAUTI and the indication of catheterization. There was no significant association found between any indication and CAUTI.

DISCUSSION

In dwelling urinary catheters are a routine in more urological patients. As with any new medical innovation, the benefits of the catheters must be weighed against its potential adverse effects. The commonest adverse effect being was CAUTI.

The incidence of CAUTI reported in the literature varies from 8.7-59%.^{6,7} This difference could be attributed to variation in study protocols, type of patients included a number of centers where the study was performed and the duration of the study. In our study, 54.4% (49/90) patients were found to have CAUTI. But in a study by Verma S et al⁶ showed very less incidence, i.e., 15.85%. As other studies also showed less incidence.^{8,9}

Similar to our study high incidence of CAUTI was found in a study by Leelakrishna P, Karthik Rao B⁶⁵ is comparable to studies done by Danchaivijitr et al. and Domingo et al. who reported a CAUTI incidence of 73.3% and 51.4% respectively.^{10,11}

Though we predominantly had male patients (49males, 41 females), it was observed that the incidence of CAUTI was more among the females (61%) as compared to males (49%), although the difference did not reach statistical significance (p=0.293). Many authors have failed to find female gender a risk factor for CAUTI. Our finding is in strong disagreement with the findings of other researchers that females

have a stronger predilection for CAUTI compared to males.^{12,13} Less number of female patients in our study could be a possible reason for this result.

In our study, the increased duration of catheterization was not significantly associated with CAUTI. But in a study by Verma S et al²⁴ found a significant association between duration of catheterization and CAUTI. In this study, Catheterization beyond five days increased the risk of CAUTI by six times and it was found statistically significant ($p=0.03$). A study by Tasseau F et al⁸⁰ found that the risk of developing CAUTI rises from 19% to 50% if the duration of catheterization increases from 5 days to 14 days.²³ The risk of developing CAUTI increases by 5% with each day of catheterization and virtually all patients are colonized by day 30. The urinary catheter disrupts host defense mechanisms and provides a surface for the attachment of microbes, eventually leading to biofilm formation.⁽²⁵⁻²⁷⁾ Studies suggest the number of CAUTI cases increase with advancing age.⁽²¹⁻²³⁾ But we failed to find any correlation of CAUTI with advanced age. These reports are an agreement with the study by Verma S et al²⁴.

Although female patients more associated with CAUTI, there was no statistical association found. But many other studies showed significant association with female genders like Leelakrishna P and Karthik Rao B⁶⁵; Verma S et al⁶⁹.

In our study, more commonly septic shock patients, stroke patients, sepsis patients were more prone to CAUTI, but the association was not significant. ($P>0.05$). In a study by Verma S et al⁶⁹, the patients requiring ventilator support were at eight times higher risk of acquiring CAUTI, and it was also found to be statistically significant.

Diabetes has been identified as a risk factor for the development of CAUTI.^{15,16} Our results confirm the previous reports that maximum diabetes cases were diagnosed with CAUTI. This association was statistically significant.

In the present study, CKD and COPD patients were significantly associated with CAUTI. ($P<0.05$)

In our study, the incidence of CAUTI was more in 2nd week of catheterization patients compare to others. But this association was not significant. But in many studies, highest CAUTI cases were found within one week of catheterization^{7,17}

70% of CAUTIs were found to be of bacterial aetiologies, and 6.1% were due to yeast. Bacterial agents were predominant causes of CAUTI in the 1st week (22/49=44.8%), while yeast and bacteria caused equal cases of CAUTI after a week of catheterization.

Klebsiella pneumonia (24.5%) was the single most common organism isolated amongst the CAUTI isolates (30.8%) followed by Escherichia coli (22.4%), Enterococcus faecalis (19.2%), Pseudomonas aeruginosa (10.2%), and Citrobacter (8.2%). Enterobacteriaceae are the more common organisms isolated from CAUTI cases, with Escherichia coli being the most commonly isolated species.^{5,18} Candida also emerged as one of the organisms causing CAUTI. Though not included in the CDC list of CAUTI pathogens, the high percentage of Candida causing CAUTI cannot be ignored.^{22,19} Repeat samples taken with freshly inserted catheters also grew Candida confirming it as a cause of CAUTI.

Other studies microbiological profile also almost comparable to present study.

Antimicrobial susceptibility pattern of the isolates obtained in the present study showed that most of the Gram-negative bacilli were multidrug-resistant. Enterobacteriaceae isolated showed a high level of resistance to beta-lactam antibiotics and Carbapenems. Acinetobacter baumannii and Pseudomonas aeruginosa were found to be resistant to most of the classes of antibiotics in current use, including Carbapenems.

Previous studies have suggested that selective pressure from the use of antimicrobial agents is a major determinant of the emergence of resistant strains.⁸⁶ In our study, all the Enterobacteriaceae were found to be resistant to Ampicillin. 4 out of 5 Escherichia coli isolates and all 3 Klebsiella pneumonia isolates were ESBL producers making the use of 3rd generation Cephalosporins like Cefotaxime, Ceftriaxone, and

Ceftazidime ineffective in these patients.

A high incidence of Carbapenem resistance in the isolates was obtained in the present study. Rising Aminoglycoside resistance across all organisms was also observed, with 33.3% of Enterobacteriaceae isolates being resistant to both Gentamicin and Amikacin. All the isolates of Pseudomonas aeruginosa and Acinetobacter baumannii were resistant to Amikacin, while 75% of them were resistant to Gentamicin. Amongst the Candida isolates, seven were Candida tropicalis, and 1 Candida albicans was isolated. All the Candida isolates were sensitive to Amphotericin B, while 50% were sensitive to Fluconazole. The results of antifungal susceptibility were found to be consistent with similar studies.⁸⁷

Diabetics were significantly found to be associated with increased risk of CAUTI in the study, which is similar to our study.⁸⁸ The possible explanation was that diabetics had increased colonization of organisms in their perineum, and in diabetics, urine also supports the growth of microorganisms. Altered host immunity in diabetics may also play a key role though yet to be investigated.

CONCLUSION

It is concluded that incidence of CAUTI was 54.4%. As the duration of catheterization increases risk of CAUTI was also more, but this association was not significant ($P>0.05$). C/O diabetes was significantly associated with CAUTI ($P<0.05$). Most commonly COPD cases were significantly associated with CAUTI ($P<0.05$) neurological disorders, indications of catheterization, sex, and age were not associated with CAUTI.

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