Original Research Article

Study of incidence and risk factors of urinary tract infection in catheterized patients admitted at tertiary care hospital, Nizamabad, Telangana State, India

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International Archives of Integrated Medicine, Vol. 3, Issue 8, August, 2016.

Available online at http://iaimjournal.com/
ISSN: 2394-0026 (P) **ISSN: 2394-0034 (O)**
Received on: 02-07-2016 **Accepted on:** 14-07-2016
Source of support: Nil **Conflict of interest:** None declared.
How to cite this article: Md. Yousuf Khan, C. Venkateshwarlu, G. Sreenivas, P. Rahul. Study of incidence and risk factors of urinary tract infection in catheterized patients admitted at tertiary care hospital, Nizamabad, Telangana State, India. IAIM, 2016; 3(8): 83-92.

Abstract

Background: Catheter-associated urinary tract infections (CAUTIs) are the most common hospital acquired infections and a leading cause of morbidity and mortality in hospitalized patients with various life threatening complications. Hence, this study was aimed to determine the incidence, risk factors of CAUTI in a tertiary care hospital so as to find out better preventive measures to reduce the prevalence of CAUTI and their complications so as to reduce the hospital stay and mortality.

Materials and methods: Present study included 200 adult patients who received indwelling urethral foley's catheter and urinary drainage system in various wards in Government General Hospital, Nizamabad from Jan 2015 - May 2016. Patients were diagnosed to have CAUTI according to CDC guidelines to study its incidence and associated risk factors which were analyzed using multi variate analysis.

Results: Overall incidence of CAUTI was 59%. The incidence of CAUTI was maximum (70.58%) in the age group of 51-70 years. The incidence of CAUTI was more (69.44%) in females and was directly proportional to the duration of catheterization. The high incidence in the present study reflects the practice of frequent disconnections of urinary closed systems. Multi-variate analysis shows age, duration of catheterization, catheter- tubing disconnections, absence of antibiotic use and renal

insufficiencies as important risk factors for CAUTI. 88.66% of CAUTIs were asymptomatic among 75 clinically evaluable CAUTIs.

Conclusion: CAUTI is an important preventable hospital acquired infection seen in all age groups however incidence increases with age, common in both sexes, incidence can be reduced by minimizing the catheter procedures, taking the maximum aseptic precautions, reducing the duration of catheterization and avoiding frequent disconnections, this becomes more significant in patients with underlying renal disease , prophylactic antibiotics prevent CAUTI. As most of the CAUTI are asymptomatic, all catheterized patients should be screened for CAUTI and be treated depending upon antibiotic sensitivity of uropathogens.

Key words

Hospital acquired infection, Catheter associated UTI (CAUTI), Incidence, Risk Factors, Multi-variate analysis.

Introduction

Catheter- associated UTI (CAUTI) are the most common hospital acquired infections accounting for more than 40% of infections reported by acute care hospitals and 34% in nursing homes [1-3]. Majority (80%) of infections of urinary tract are associated with the use of indwelling urinary catheters [4]. CAUTI has been a leading cause of morbidity and mortality in hospitalized patients [5, 6].

CAUTI occurs at an incidence of 3-10% per day of catheterization [7, 8]. The infection is followed by bacteremia in 2-4% [5], and in a few patients by septic shock and death. Bacteremia as a result of CAUTI has been associated with case fatality rate three times as high as non-bacteriuric patients [5].

Duration of catheterization is the most important risk factor for the development of catheter associated bacteriuria [9], other risk factors being female sex, lack of anti-microbial therapy, microbial colonization of drainage bag, catheter care violation and rapidly fatal underlying illness, old age and diabetes mellitus [9, 10].

Complications in short term catheterized patients include cystitis, acute pyelonephritis, gram negative bacteremia, prostatitis, epididymitis, endocarditis, vertebral osteomyelitis and septic arthritis. Patient with long term catheters in place are at risk of catheter obstructions, urinary tract stones, local periurinal infections, chronic renal inflammation, chronic pyelonephritis and over years bladder cancer [6]. Complication can cause prolonged hospital stay and increased cost and mortality. CAUTI can be prevented by maintaining closed urinary drainage system and early removal of catheter. Complications of infection can be prevented by giving antibacterial therapy for bacteriuria immediately prior to any invasive urological procedure and by avoiding catheter blockage, twisting or trauma [11].

So, this study was aimed to determine the incidence, risk factors of CAUTI in a tertiary care hospital to find better preventive measures to reduce the prevalence of CAUTI and their complications.

Materials and methods

Present study included 200 adult patients who received indwelling urethral foley's catheter and urinary drainage system in medical wards and Medical Intensive Care Unit in Government General Hospital, Nizamabad from Jan 2015-May 2016.

Patients who were already catheterized before admission, patient with history or clinical examinations suggestive of UTI or patients with positive catheter urine sample on first day of catheterization and patients with benign prostatic hypertrophy were excluded from the study.

Urethral foley's catheters were inserted by trained nursing staff and resident doctors under all aseptic techniques. An indelible ink mark was made across catheter-collecting tubing junction. Closed catheter system were maintained, patients were subjected to detailed history taking, physical examination and laboratory investigations. Daily observation of patient's clinical status, disconnection of catheter and use of antimicrobial were noted. Urine culture were done immediately after catheterization and as on when required. Patients were followed for symptoms of UTI. Collection of urine sample was done at the time of symptoms like fever; supra pubic tenderness, costovertebral angle tenderness or any other related to UTI. Urine specimen was obtained by aspirating the required amount (5-10 ml) from clamped and disinfected catheter with a sterile needle and a syringe under strict aseptic precautions. After collection of sample it was transported to laboratory within 2 hours.

Microscopic examination of centrifuged urine sediment was done by wet preparation method. According to CDC guidelines of CAUTI, >5 pus cells/ HPF in spun urine or more than or equal to 10 pus cells/ mm^3 of unspun urine was taken as a positive test indicative of infection [12]. Gram stained smear from urine sediment was prepared and examined when bacteria or pus cells are seen in wet preparation. A standard calibrated sterile chromium loop (1 mm) delivered 0.001 ml of uncentrifuged urine was used to inoculate nutrient agar, sheep blood agar and MacConkey agar plates. These plates were incubated aerobically at 37^0C for 18-24 hours. Next day colony count for organisms showing growth and colony count more than or equal to 10^5/CFU with no more than two species of microorganisms was taken significant [12].

To determine the significance of individual risk factors predisposing to CAUTI, multivariate analysis was applied. Before applying multivariate analysis, coding system was made. For coding system of quantitative variables (age, duration of catheterization) absolute values were taken as a code and for qualitative variables coding system was made considering the effect of factor on UTI. For applying the multivariate analysis SPSS software for Windows version 10.0 was used.

Results

Present study included 200 adult patients who received indwelling urethral foley's catheter and urinary drainage system in Medical wards and Medical Intensive Care Unit in Government General Hospital, Nizamabad from Jan 2015-May 2016.

Mean age of cases was 37.12 years (SD $\pm$ 15.34). Maximum number of patients were in the age group of 11-30 years. Male to female ratio was 1.77:1. Overall incidence of CAUTI was 59%, incidence of CAUTI was maximum in the age group of 51-70 years i.e. 70.58% and least in age group of 11-30 years i.e. 54.65% **(Table - 1)**.

Incidence of CAUTI was more after the age of 50 years as compared to patient with age of less than or equal to 50 years (70.27% v/s 56.44%) as per **Table - 2**. Incidence of CAUTI was more in females (69.44%) than in males (53.125%) as per **Table - 3**. Incidence of CAUTI was higher in second week (54.23%), followed by first week (33.71%) as per **Table - 4A**. Duration of catheterization varied from 3-28 days with a mean of 8.63 $\pm$ 5.34 days. Incidence of CAUTI was directly proportional to duration of catheterization as per **Table – 4B**.

Incidence of CAUTI was more among patients who were catheterized by nursing staff (69.01%) than by resident doctors (53.48%) as per **Table - 5**. Incidence of CAUTI was more among patients with catheter tubing disconnections as compared to patients without disconnections (89.36 % v/s 49.67%) as per **Table – 6**. Incidence of CAUTI was more among patients with absence of antibiotic use during the period of catheterization as compared to patients who received antibiotics (76.92% v/s 57.75%) as per **Table - 7**.

Table – 1: Age and sex distribution.

Age (Years)	No. of patients catheterized			CAUTI (%)
	Male	Female	Total (%)	Present
11-30	50	36	86 (100)	47 (54.65)
31-50	55	22	77 (100)	45 (58.44)
51-70	21	13	34 (100)	24 (70.58)
>or70	02	01	03 (100)	02 (66.66)
Total	128	72	200 (100)	118 (59.00)

Table – 2: Relationship of age (50 years) with CAUTI.

Age (years)	No. of patients	CAUTI (%)
Less than 50	163	92 (56.44)
More than 50	37	26 (70.27)
Total	200	118 (59.00)

Table – 3: Relationship of sex with CAUTI.

Sex	No. of patients	CAUTI (%)
Male	128	68(53.125)
Female	72	50(69.44)
Total	200	118(59.00)

Table - 4A: Interval between catheterization and the first bacteriuria (n=118).

Interval (days)	No.	%
1-7	35	33.71
8-14	64	54.23
15-21	16	13.55
22-28	03	2.54

Table - 4B: Duration of catheterization and CAUTI.

Duration (days)	No. of patients	CAUTI n (%)
1-7	111	35 (31.53)
8-14	70	64 (91.42)
15-21	16	16 (100.00)
22-28	03	03 (100.00)
Total	200	118 (59.00)

Incidence of CAUTI was more among patients who expired than who survived (63.88% v/s 57.92%) as per **Table – 8.** Incidence of CAUTI was more (90.90%) among patients with renal insufficiency than who do not have it (57.14%) as per **Table - 9**. Incidence of CAUTI was lower in diabetes as compared to non-diabetic patients (40.00% v/s59.48%) as per **Table - 10**.

Table – 5: Relationship of person performing catheterization with CAUTI.

Person performing catheterization	No. of patients	CAUTI (%)
Resident doctors	129	69 (53.48)
Nursing staff	71	49 (69.01)
Total	200	118 (59.00)

Table – 6: Relationship of catheter-tubing disconnections with CAUTI.

Catheter tubing disconnections	No. of patients	CAUTI (%)
Yes	47	42(89.36)
No	153	76(49.63)
Total	200	118(59)

Table – 7: Relationship of antibiotics use with CAUTI.

Antibiotic use	No. of patients	CAUTI (%)
Yes	187	108(57.57)
No	13	10(76.92)
Total	200	118(59.00)

Table – 8: Relationship of mortality with CAUTI.

Death	No. of patients	CAUTI (%)
Yes	36	23 (63.88)
No	164	95 (57.92)
Total	200	118 (59.00)

Table – 9: Relationship of renal insufficiency with CAUTI.

Serum creatinine >2mg	No. of patients	CAUTI (%)
Yes	1	10 (90.90)
No	189	108 (57.14)
Total	200	118 (59.00)

Table – 10: Relationship of diabetes with CAUTI.

Diabetes	No. of patients	CAUTI (%)
Yes	05	02(40.00)
No	195	116(59.48)
Total	200	118(59.00)

Above 9 factors shown in the **Table – 11** (Coefficients) were subjected to multivariate analysis (Linear regression, inter method). The last column in the table indicates the significance of association of factors with CAUTI even after considering the confounding effects of other 8 factors. It is clear from this table that the factors age in years, duration of catheterization, catheter-tubing disconnections, absence of antibiotic use and renal insufficiency have significant association with CAUTI as the respective significance value (p) levels are below 0.05. Other factors studied wich were not significantly associated with CAUTI were sex, person performing catheterization, mortality of patient, presence of diabetes as the respective significance (P) levels were above 0.05.

Table – 11: Results of multi-variate analysis of 9 factors with CAUTI coefficient.

	Unstandardised coefficients		Standardized coefficient	T	Significance p value
Model	**B**	**Std. Error**	**Beta**		
(Constant)	-0.242	0.095		-2.539	0.012
Age (years)	5.472E-03	0.002	0.170	2.905	0.004 (**S.**)
Sex	0.410	0.393	0.400	1.043	0.298 (NS.)
Duration of catheterization	6.219E-02	0.008	0.485	7.488	0.000 (**S.**)
Person performing catheterization	-0.227	0.395	-0.221	-0.575	0.566 (NS.)
Catheter-tubing disconnections	0.216	0.081	0.187	2.664	0.008 (**S.**)
Absence of antibiotic use	0.296	0.114	0.149	2.597	0.010 (**S.**)
Mortality	1.621E-02	0.078	0.013	0.209	0.835 (NS.)
Renal insufficiency	0.382	0.124	0.177	3.088	0.002 (**S.**)
Diabetes	0.184	0.178	0.058	1.038	0.301 (NS.)

86.66% of patients with CAUTI were asymptomatic among 75 clinically evaluable CAUTIs **(Table-12)**.

Discussion

In present study, the overall incidence of CAUTI was 59% which was compared with other studies as per **Table - 13**. The Incidence of CAUTI varied from 9-73.3% in different studies (**Table - 13**). Incidence in our study was 59% which is more than most of the above studies. High incidence of CAUTI in our study group may be due to more catheter-tubing disconnections.

Present study shows maximum incidence of CAUTI in the age group of 51-70 years i.e. (70.58%) and was least in age group of 11-30 years (54.65%) (**Table - 1**), CAUTI was more common after the age of 50 years (70.27%) (**Table - 2**). After multivariate analysis age factor was significantly associated with the incidence of CAUTI. Garibladi, et al. (1974) [14] noted that

patients over the age of 50 years had approximately a two-fold incidence of bacteriuria and they concluded that advance age is responsible for high prevalence of catheter associated bacteriuria similar to Chih-Cheng Lu, et al. (2000) [3]. Similarly S.G. Kulkarni, et al. (2011-2013) [30] found that patients aged >40 years were having more risk of developing CAUTI than who were aged <40 years similar association of CAUTI with advanced age was seen in N. Bhatia, et al. [31]; Joon Ho Lee, et al. [32]; and Jaggi N, et al. [33]. However, A.B. Mulhall, et al. (1988) [23] found that age is not independently associated with the risk of acquiring bacteriuria. Similarly Johnson, et al. (1990) [16] found no association of UTI with advanced age. Our finding of association of CAUTI to age is similar to that of above studies [3, 14, 30-33]. However, A.B. Mulhall, et al. [23] and Johnson, et al. [16] do not show any association of CAUTI with age.

Table – 12: Relationship of symptoms and CAUTI.

Clinically Evaluable patients	No. of patients	CAUTI (%)	Symptoms of UTI (%)	
			Present	Absent
Yes	141	75	10 (13.33)	65 (86.66)
No.	59	43	---	--
Total	200	118	---	--

Table – 13: Comparison of incidence of CAUTI in different studies.

Study	Incidence
Present study (2015-16)	59%
A.G. Keresteci and W.D. Leers (1973) [13]	33%
Garibaldi, et al. (1974) [14]	23%
Platt, et al. (1986) [15]	9%
Johnson, et al. (1990) [16]	10%
W.N.M. Hustinx, et al. (1991) [17]	35%
Karina Billote-Domingo, et al. (1998) [18]	51.40%
Chih-Cheng Lu, et al. (2000) [3]	57%
S. Danchaivijitr, et al. (2002-2003) [19]	73.30%
Mangukiya JD, et al. (2010-11) [20]	31%
Bagchi, et al. (2011-12) [21]	29.09%
Dund JV, et al. (2012-13) [22]	32%
S.G. Kulkarni, et al. (2011-2013) [30]	21.47%

In present study the incidence of CAUTI among males and females was 53.125% and 69.44% respectively (**Table - 3**). Gender wise comparison of present study with other studies was as per **Table – 14**.

Our finding of female preponderance of CAUTI is similar to all of the above studies. However after multivariate analysis sex factor did not remain statistically significant (**Table - 11**). Hence, our finding of no independent association of female sex to CAUTI is similar to A.B. Mulhall, et al. (1988) [23].

In present study, incidence of CAUTI was directly proportional to the duration of catheterization which was found to be significantly associated with the incidence of CAUTI after multivariate analysis. Our finding of significant association of CAUTI with

duration of catheterization is in agreement with most of the previous studies [13-16, 23]. Studies [19, 20, 22, 28] below shows higher incidence of CAUTI in the first week, followed by second and third week. In contrast to above studies, our study shows higher incidence of CAUTI in second week (54.23%) followed by in first week (33.71%) and third week (13.55%) as per **Table – 15**.

Table – 14: Gender wised comparison of present study with others.

Study	Male	Female
Present study	53.125%	69.44%
Garibaldi, et al. (1974) [14]	4.0%	10.4%
Platt, et al. (1986) [15]	5.4%	13.2%
R.P Stark and D.G. Maki (1984) [24]	45%	48%
Johnson, et al. (1990) [16]	7%	15%
S. Danchaivijitr, et al. (2002-2003) [19]	29.7%	43.6%
Mangukiya JD, et al. (2010-11) [20]	43.54%	56.46%
Dund JV, et al. (2012-13) [22]	23.63%	42.23%

Table – 15: Week wise comparison of present study with others.

Week	Present study	S. Danchaivijitr (2002-2003) [19]	Mangukia JD, et al. (2010-11) [20]	Dund JV, et al. (2012-13) [22]	Karina Billote-Domingo (1998) [28]
First	33.71%	37.6%	54.83%	53.12%	58.20%
Second	54.23%	27.7%	32.26%	34.37%	30.90%
Third	13.55%	4.00%	12.91%	12.50%	--

In present study the incidence of CAUTI among patients catheterized by nursing staff and resident doctors was 69.01% and 53.48% respectively. However, after multivariate analysis this factor did not remain statistically significant. Garibaldi, et al. (1974) [14] found that female patients catheterized by licensed practical nurses had almost twice the rate of acquired bacteriuria during first 48 hours of catheterization than patients catheterized by registered nurses and physicians (34.3% v/s 21.0% and 10.1%), male patients who were catheterized either by specially trained catheter team or by physicians had too low a rate of bacteriuria in first 48 hours. Similarly Platt, et al. (1986) [15] concluded patients were more likely to acquire infection if the catheter was inserted by nurse than if it was inserted by physician (13.3% v/s 4.0%) however adjustment for the nine significant factors reduced the relative odds of infection if a nurse inserted the catheter from 3.6 to 1.0%. Our findings are similar to that of above two studies however statistically above factor is not significant in causation of CAUTI.

In present study incidence of CAUTI was more among patients with catheter tubing disconnections (89.36%) which remained statistically significant after multivariate analysis. Platt, et al. (1986) [15] found that infection rate among patients with disconnection of collection junction was 16% as compared to 6.9% in patients without disconnections. Johnson, et al. (1990) [16] noted that catheter care violations was associated with a nearly threefold increase in UTI however survival analysis showed no difference in UTI incidence among patients with catheter care violations. Our observation of high incidence of CAUTI in

catheter tubing disconnection is similar to above studies [15, 16].

In present study the incidence of CAUTI among patient receiving antibiotics during the period of catheterization was 57.75% compared to 76.92% among patients, not receiving antibiotics. After multivariate analysis absence of antibiotic use was significantly associated with CAUTI which was observed in most of the studies [14-17, 23, 25], however, above studies [13, 26] did not find any significant difference among the patients with and without antibiotics.

In present study we did not find any correlation of mortality with CAUTI after multivariate analysis (p=0.835) however the incidence of CAUTI among patients who expired was more than that among who survived (63.88% v/s 57.92). Platt, et al. (1982) [27] found that acquisition of infection was not associated with the severity of underlined disease similiarly Platt, et al. (1986) [15] noted that severity of underlined illness showed crude association with infection , however much of its predictive value was explained by other variables and did not remain significant after adjustment for the other variables. Our findings are similar to above two studies [15, 27].

In present study the incidence of CAUTI in patients with renal insufficiency was 90.90% compared to 57.14% among patients without renal insufficiency, multivariate analysis showed significant association of renal insufficiency with CAUTI (p=0.002), results are comparable with Johnson, et al. [16]; S.G. Kulkarni, et al. [30]; Yonit Wiener Well, et al. [34]; and E. Tissot, et al. [35]. However, Platt, et al. (1986) [15] found that renal insufficiency has not been directly noted to be a risk factor for infection. The explanation of the association between infection and renal insufficiency was unclear.

In present study incidence of CAUTI among diabetics was lower (40.00%) than that in non diabetics (59.48%) however Mangukiya JD, et al. (2010-11) [20] found 63.33% of CAUTI among diabetic patients similarly S.G. Kulkarni, et al. [30] and Platt, et al. (1986) [15] noted an increased risk of acquiring infection among individuals with diabetics.. After multivariate analysis diabetes was not found to have significant association with CAUTI (p=0.301) as in our study sample size of diabetic patient was only 5, in future further studies are required with more number of diabetic patient to find out its association with CAUTI. In present study all HIV positive patients had CAUTI, however multivariate analysis could not be applied because other patients HIV status was not known. In present study out of 75 clinically evaluable CAUTI 86.66% of patients had asymptomatic UTI finding similar to most of the studies [24, 28, 29].

Conclusion

To conclude, the overall incidence of CAUTI was 59% and most of them were asymptomatic found in both sexes in all age group of patients. The high incidence of CAUTI reflects poor catheter care and practice of disconnections of closed systems. Multivariate analysis showed age, duration of catheterization, catheter disconnection, absence of antibiotic use and renal insufficiency as important independent risk factors for CAUTI. Female sex, person performing catheterization, mortality and diabetes did not show any association with CAUTI, further studies with more number of patients are required to find out exact association between underlying medical disorders like diabetes. We recommend that even for the bladder wash, disconnections to be avoided to reduce the incidence of CAUTI similarly incidence of CAUTI can be reduced by minimizing the catheter procedure, taking maximum aseptic precautions, reducing the duration of catheterization which becomes more significant with underlying renal disease. Prophylactic antibiotic prevents CAUTI. As most of the CAUTI were asymptomatic, patients who were catheterized should be screened for CAUTI and should be treated depending upon antibiotic sensitivity of uropathogen.

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