A Study to Determine the Prevalence of Catheter Associated Urinary Tract Infection in Surgical Wards and Recovery Room in a Tertiary Healthcare Centre in Central India

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Abstract: _Background_: _Amongst all Hospital Acquired Infections, CAUTI is most commonly encountered. CAUTI impact is reflected from increased duration of hospital stay and antibiotic resistance. This poses a problem in the surgical patients who are debilitated either due to underlying pathology or major surgery. This study was aimed to find the prevalence of CAUTI in such patients. _Methods_: It was prospective observational study conducted between July 2016 to November 2018 in catheterized patients with minimum duration of indwelling catheter to be 3 days. Urine samples were collected immediately, 48 hours and 120 hours after catheterization and subjected to microbiological analysis. _Results_: Out of 400 patients with male to female ratio of 1.23 : 1, 65 developed CAUTI (16.25 %) and 22 patients had symptomatic bacteriuria (non CAUTI – 5.5 %). CAUTI rate was 23.06 per 1000 catheter days. Infection rate among males was 13.12 % while that in female was 20.11 %. 19 and 46 patients developed CAUTI after 48 hours and 120 hours of indwelling urinary catheters respectively. Most common organism was found to be E. coli. _Discussion_: Overall, this study shows a high incidence of CAUTI in females (p = 0.003). This study showed a high incidence of CAUTI in age group 51 – 60 years in males (23.07 %) and in age group 61 – 70 years in females (47.06 %). Acinetobacter and Citrobacter were found to be isolated from patients admitted in ICU with sensitivity to higher antibiotics. C. albicans was associated with a long term antimicrobial treatment and long duration of urinary indwelling catheter._

Keywords: CAUTI, pyuria, Hospital Acquired Infection, prevalence

1. Introduction

Urinary Tract infections (UTI's) are commonly reported Hospital Acquired Infections (HAI's) which accounts for 15 - 30 % of all the HAI's [1]. The Catheter-associated urinary tract infection (CAUTI) is an important cause of morbidity and mortality in the Indian subjects, affecting all the individuals irrespective of age groups and gender [2]. Bacteriuria or candiduria is seen in nearly half of the patients who require an indwelling urinary catheter for more than 5 days. Patients with asymptomatic bacteriuria constitute the submerged part of the iceberg of the infective pool in critical care units (CCUs) with majority being resistant strains [3,4]. Patients in critical care units are often febrile due to causes which may be infectious or non-infectious and by the nature of the surroundings they are in, such patients are at a high risk of developing infections [3,4]. There is paucity of data in regards to Indian population about CAUTI and with this intent, this study was carried out in a Tertiary Healthcare Centre in Central India.

2. Aims and Objectives

- To estimate the prevalence of CAUTI in patients admitted
- in Surgical Wards and Surgical Recovery room in a Tertiary Health Care Centre.
- To study the common organisms responsible for CAUTI
- To study the antibiotic sensitivity and resistance patterns
- amongst the causative organisms in CAUTI patients

- To calculate the CAUTI rate which is calculated by the formula:

$$\frac{Diagnosed\ cases\ of\ CAUTI}{Total\ number\ of\ catheter\ days} \times 1000$$

Secondary Objectives
1) To establish relation, if any, between the duration of indwelling urinary catheter and the presence of UTI.
2) To identify the "at risk" group for Urinary Tract infections among the surgical patients.

3. Materials and Methods

In the present study, a total of 400 patients were included who were catheterized in our setup.

3.1 Study Design

The study was a prospective observational study conducted in the between July 2016 to November 2018.

3.2 Inclusion Criteria

1) Patients with an indwelling urinary catheter for > 2 days.
2) Patients with positive urine cultures, with not more than 2 bacterial species isolated from culture.

3.3 Exclusion criteria

1) Patients having Supra - pubic catheters or condom catheters or any other conduit to drain urine
2) Patients who were intermittently catheterized or were catheterized outside the Tertiary Care Centre.

3.4 Methodology

Fresh urine samples were collected in a sterile, leak-proof universal container from patients at the time of urinary catheterization, at 48 hours and at 120 hours after catheterization and samples were subjected to direct wet mount and culture using semi-quantitative standard loop technique. Inoculation was done on Cystine Lactose Electrolyte Deficient medium (CLED) and blood agar. Kirby-Bauer disc diffusion method was adopted for antimicrobial susceptibility testing using appropriate antimicrobial discs as per CLSI (Clinical and Laboratory Standard Institute) guidelines

After assessing all the points in inclusion criteria of this study, the patient was categorized as CAUTI or Catheter Associated – Aymptomatic Bacteriuria.
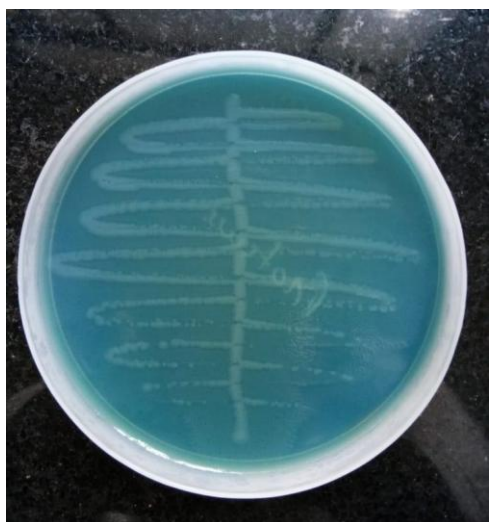

Figure 1: P. mirabilis seen on CLED culture media

Figure 2: Antibiotic Sensitivity Testing

4. Results and Observations

This was a hospital based prospective observational study. A total of 400 patients were enlisted in this study. Statistical test of significance that was employed was a Chi square test and accordingly p value was calculated considering confidence intervals to be 95 %. The male to female ratio was 1.23:1. The minimum age encountered in this study was 2 years and maximum was 80 years. Following table shows the demographic distribution of the study population.

Table 1: Demographic distribution of study population

	Total number of Male patients	Total number of Female patients	Total number of patients
0 – 10 Yrs	20	17	37
11 – 20 Yrs	11	10	21
21 – 30 Yrs	21	25	46
31 – 40 Yrs	38	42	80
41 – 50 Yrs	42	43	85
51 – 60 Yrs	39	21	60
61 – 70 Yrs	35	17	52
71 – 80 Yrs	15	4	19
Total	221	179	400

Out of the total 400 patients, 65 patients had CAUTI and 22 patients had a positive culture immediately following foley's catheterization (non - CAUTI). Of the 65 patients who had CAUTI, 29 were males and 36 were females and out of the 22 patients who were categorized as non – CAUTI, 13 were females and 9 were males. This data can be tabulated as follows:

Table 2: Gender Wise Distribution of Cauti and Non Cauti in this Study

	Infected (UTI)	Non Infected	Total
Females	49 (36 CAUTI + 13 non CAUTI)	130	179
Males	38 (29 CAUTI + 9 non CAUTI)	183	221
Total	87	313	400

Out of the 400 patients, 22 patients had culture positive (13 female and 9 male patients), immediately following catheterization, indicating a prevalence of the causative organisms in the urinary tract of the patients, causing UTI. However, since this sample was drawn immediately after catheterization, it cannot be categorized as a CAUTI.

Of the 9 male patients that had non – CAUTI, 2 had age < 50 years and 7 had age > 50 years. After forming a 2 x 2 contingency table, this data can be tabulated as shown in table no. 3:

Table 3: Showing Infection Rate, Immediately after Catheterization in males with Less Than 50 Yr and more than 50 Yr

	Males with age > 50 yr	Males with age < 50 yr	Total
non CAUTI	7	2	9
Non Infected	82	130	212
Total	89	132	221

On applying Chi square test, the value was found to be 0.013 which is statistically significant indicating that age plays a definitive role in initial infection following foley's catheterization, in male patients.

Of the 22 patients having non CAUTI, 13 were females with 9 females having age < 50 years and 4 having age > 50

years. After forming a 2 x 2 contingency table, this data can be tabulated as shown in table no. 4:

Table 4: showing infection rate, immediately after catheterization in females with age less than 50 yr and more than 50 yr

	Females with age >50 yr	Females with age < 50 yr	Total
Non CAUTI	4	9	13
Non Infected	38	128	166
Total	42	137	179

On applying Chi square test, the p value found was 0.261 indicating that age did not play a significant role in female sex contributing towards initial infection following foley's catheterization.

In this study, 19 patients were reported to have CAUTI after 48 hours of catheterization out of which 11 were females and 8 were males.

Of the 11 females who had developed CAUTI after 48 hours of catheterization, 4 had age < 50 years and 7 had age > 50 years. After forming a 2 x 2 contingency table, this data can be tabulated as shown in table no. 5:

Table 5: Showing infection rate at 48 hrs of catheterization in females with age less than 50 yr and more than 50 yr

	Females with age >50 yr	Females with age < 50 yr	Total
Infected (CAUTI)	7	4	11
Non Infected	35	133	168
Total	42	137	179

The p value on applying Chi square test was found to be 0.0021 which is statistically significant indicating that age is an important factor in female sex in the causation of CAUTI.

Of the 8 male patients who had CAUTI after 48 hours, 4 were having age < 50 years and 4 were having age > 50 years. After forming a 2 x 2 contingency table, this data can be tabulated as shown in table no. 6:

Table 6: Showing infection rate at 48 hrs of catheterization in males with age less than 50 yr and more than 50 yr

	Males with age > 50 yr	Males with age < 50 yr	Total
Infected (CAUTI)	4	4	8
Non Infected	86	127	213
Total	90	131	221

The p value in this case was found to be 0.301 which is not significant indicating that CAUTI affects male patients independent of the age. The incidence of CAUTI cases increased to 46 after 5 days of an indwelling urinary catheter out of which, both male and females were 23. Of the 23 females, 16 were having age < 50 years and 7 were having age > 50 years. P value in this case was found to be 0.712 which is not significant. Also among the 23 male patients, 11 were having age < 50 years and 12 were having age > 50 years. The p value in this case came out to be 0.484 which is not significant.

Following table no. 8 gives the incidence and CAUTI rate calculated in this study:

Table 8: Cauti Incidence and Cauti Rate

Total Culture Positive Cases	87
Non Cauti	22
Cauti Cases After 48 Hrs	19
Cauti Cases After 120 Hrs	46
Total Number of Cases of Cauti	65
Percentage	16.25 %
Total No. of Catheter Days	2818
Cauti Incidence Rate	65/2818 X 1000 23.06 CAUTI cases per 1000 catheter days

The following table no. 9, shows the relation between duration of indwelling urinary catheter and CAUTI cases:

Table 9: Relation between duration of indwelling urinary catheter and cauti cases

Duration of catheterization (days)	Number of CAUTI cases	
	Infection at 48 hours	Infection at 120 hours
0 – 5	3	9
6 – 10	13	30
>10	3	7
TOTAL	19	46

Following fig. no. 3 shows above data on a line diagram, showing individual incidences of CAUTI cases at 48 hours and 120 hours of catheterization:
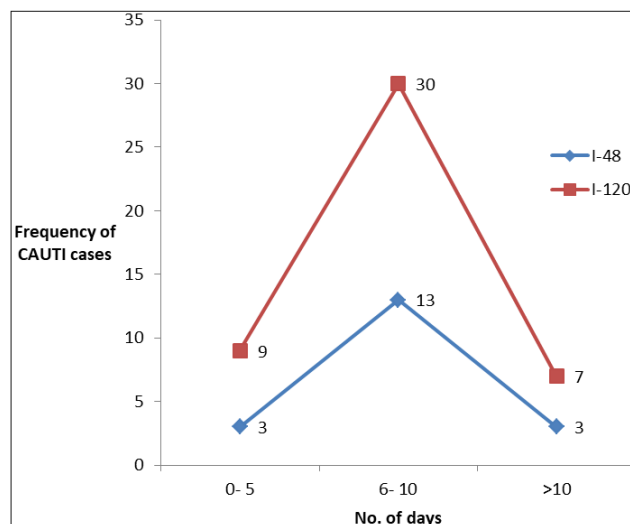

Figure 3: Line Diagram showing CAUTI cases

From the above table and graph, it can be deduced that the maximum number of CAUTI cases were evident when an indwelling catheter was in place for a duration between 6 – 10 days.

The most common organism isolated in this study from positive culture was E. coli. Other organisms that were isolated are as follows along with their frequency and order of isolation (whether appeared at catheterization or after 48 hours or after 120 hours) is as shown in table no. 21:

Table 10: Organisms Isolated in the Present Study

	48 hrs after catheterization (CAUTI)	120 hrs after catheterization (CAUTI)	Total	Percentage
E. coli	9	14	31	35.63 %
K. pneumoniae	4	7	15	17.24 %
Acinetobacter	1	6	9	10.34 %
S. aureus	0	4	7	8.04 %
P. aeruginosa	1	3	6	6.9 %
Citrobacter	2	2	6	6.9 %
Enterococcus	1	3	5	5.74 %
C. albicans	0	5	5	5.74 %
P. mirabilis	1	2	3	3.44 %
TOTAL	19	46	87	

The organisms Acinetobacter and Citrobacter were mostly isolated from the samples of patients who were admitted in the Recovery Room and had an indwelling urinary catheter for a long period. S. aureus was isolated in relation to formation of abscess within the urinary tract (perinephric abscess, perineal abscess). C. albicans was seen in patients who were treated with broad spectrum antibiotics from a long time and were associated with frequent negative cultures initially. P. mirabilis was associated with stone formation within the urinary tract.

The sensitivity and resistance of the isolated organisms was studied using a standard Kirby Bauer Disc Diffusion method using antibiotic discs on Mueller – Hinton Agar. The area of clearing (zone of inhibition) around the antibiotic disc implies sensitivity whereas no change around the disc implies resistance to the antibiotic.

Following table no. 11 shows the antibiotic profile (sensitivity and resistance pattern) of the isolated organisms in this study:

Table 11: Antibiotic Sensitivity And Resistance Patterns of Micro – Organisms Isolated In The Present Study

Organism Grown	Sensitive To	Resistant To
E. coli	Gentamicin-nitrofurantoin-norfloxacin	Amoxiclav-cotrimoxazole-cefoperazone
K. pneumoniae	Amikacin-norfloxacin-piptaz	Amoxiclav-nitrofurantoin-cefazolin
P. aeruginosa	Piptaz-amikacin-meropenem	Amoxiclav-norlfloxacin-cefoperazone
Enterococcus	Amoxiclav-piptaz-meropenem	Gentamicin-norfloxacin-cefazolin
S. aureus	Amoxiclav-piptaz-meropenem	Gentamicin-norfloxacin-cefazolin
Acinetobacter	Piptaz-meropenem-imipenem	Gentamicin-norfloxacin-cefazolin
Citrobacter	Piptaz-meropenem-imipenem	Amoxiclav-nitrofurantoin-gentamicin
C. albicans	Fluconazole-amphoterecin B-cotrimoxazole	Amoxiclav-nitrofurantoin-cefazolin
P. mirabilis	Gentamicin-norfloxacin-piptaz	Amoxiclav-cotrimoxazole-cefazolin

As seen from the above tabulated data, majority of the isolates are sensitive to Piperacillin + Tazobactam and high resistance is seen in isolates of Acinetobacter and Citrobacter species.

5. Discussion

CAUTI is a common nosocomial infection with the patients having symptomatic bacteriuria forming the tip of iceberg while the submerged part is formed by the patients having asymptomatic bacteriuria constituting resistant organisms. The present study aims at finding the prevalence of CAUTI while comparing the antibiotic sensitivity of the bacterial isolates from the urine of such infected patients. Following are the parameters that are compared :

5.1 Age of the patients

The number of CAUTI cases are recorded more in the extremes of age in both sexes in the present study. Such results are also documented by the studies conducted by Leelakrishna P et al [5] and Gordon et al [6]. The above studies show that age is an independent variable in the causation of CAUTI.

5.2 Sex of the patients

The present study showed a female preponderance in CAUTI cases (20.11 %) which is also documented by studies conducted by Devendra et al [7] (14.14 %), Tambyah et al [8] (23.2 %) and Bond et al [9] (57.84 %).

5.3 Duration of Catheterization

In the present study, recorded number of CAUTI cases were 19 at 48 hours which increased to 46 new cases, after 120 hours of catheterization. The studies conducted by Kamath et al [10], Devendra et al and Tambyah et al show that risk for CAUTI increases with increase in duration of catheterization. Infectivity rate was found to be 100 % when duration of catheterization exceeded 22 days and 30 days in the studies conducted by Devendra et al and Tambyah et al.

5.4 CAUTI cases

Infection was seen in 16.25 % cases in the present study. IT is high when compared to similar studies conducted by Garg et al [11] (28 %), Devendra et al (12.25 %) and Sanghamitra et al [12] (46 %). High rates of infection seen in the Indian studies due to the following facts : Improper techniques for catheterization, faulty handling by untrained staff, poor catheter hygiene, extremes of age, increased duration of catheterization.

5.5 CAUTI rate

The CAUTI rate in the present study was found to be 23.06 cases per 1000 catheter days. It is high when compared to studies conducted by Kazi et al [13] (4.59), Devendra et al (13.14) and Hanumantha et al [14] (3.65). It is high in the present study because the total number of catheter days were

low, while an increased CAUTI cases which contributed to the high CAUTI rate in the present study.

5.6 Organism isolated

E. coli was the common organism isolated in the present study (35.63 %) which was also found by studies conducted by Sanghamitra et al (36 %), Kazi et al (30.5 %), Garg et al (40 %) and Devendra et al (44 %).

5.7 Antibiotic Sensitivity

Present study showed maximum isolates sensitive to Piperacillin and Tazobactam. In other studies by Devendra, Sanghamitra, Kazi, Garg and Hanumantha et al, maximum of the bacterial isolates were sensitive to Amikacin, Imipenem, Imipenem, Amikacin and Meropenem respectively.

Thus the sensitivity of the urinary bacteria isolated from documented cases of CAUTI are seen to have a higher sensitivity pattern.

6. Conclusion

The present study, which was conducted in a tertiary healthcare centre in Central India, the prevalence of CAUTI was found to be 16.25 % with the CAUTI rate of 23.06 cases per 1000 catheter days. There was a female preponderance in the study with E. coli grown in the almost 35 % of the cases. Piperacillin and Tazobactam was found to be sensitive to most of the bacterial isolates.

7. Limitations

In this study, the new cases of CAUTI were not demonstrable after 5 days (120 hours) since urine analysis was not done after 5 days of catheterization due to certain limitations.

8. Conflicts of Interest

This study was a non funded study. There are no conflicts of interest for this study.

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