COMPARATIVE STUDY OF INCIDENCE RATES AND ANTIBIOGRAM OF CATHETER-ASSOCIATED URINARY TRACT INFECTIONS IN INTENSIVE CARE UNIT VERSUS NON-INTENSIVE CARE UNIT AT A TERTIARY CARE TEACHING HOSPITAL

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ABSTRACT

Objective: Catheter-associated urinary tract infections (CAUTI) is the most common HAI which leads to increased hospital stay and morbidity. The study aimed to compare the incidence rates of CAUTI per 1000 catheter days and their antimicrobial susceptibility pattern between ICU and non ICU and to determine predisposing risk factors, indications, and outcomes of CAUTI.

Methods: A comparative observational study was conducted in ICU and non ICU for a period of 6 months. The sample size of the study was 120. The data were collected, analyzed in terms of both inferential and descriptive statistics.

Results: The incidence rate per thousand catheter days in non ICU was more as compared to ICU. The significant risk factors associated with CAUTI were the duration of catheterization and type 2 diabetes mellitus. The majority of the patients were catheterized for indications such as critically ill and unconsciousness followed by measurement of urine output. The outcomes of CAUTI were increased duration of hospitalization and recovery of patients. All the Gram-positive and Gram-negative isolates from non ICU were sensitive to piperacillin + tazobactam and meropenem. All the isolates from ICU and non ICU were resistant to co-trimoxazole.

Conclusion: The urinary catheter is an essential part of modern medical care. Unfortunately, when used inappropriately or when left in place for too long, it is a hazard to the patient. This study helps to prevent indiscriminate and irrational use of antibiotics which contribute to emerging of drug resistance strains.

Keywords: Catheter-associated urinary tract infections, Hospital Acquired Infection, Urinary catheter, Uropathogens.
sex of all age groups. This study excluded all the subjects whose initial urine culture at the onset of catheterization was positive, intermittent catheterization, pregnant women, recurrent UTI patients, and patients transferred from other hospitals with a catheter.

All the data required for the study were collected from the patient’s case sheets. The patient was followed up till they remove the catheter. The demographic details, drugs prescribed, details of catheterization, and culture sensitivity results were recorded in a properly designed data collection form. All the collected data were analyzed for risk factors, outcomes of CAUTI, indications of catheterization, and for the comparison of incidence rates and antibiogram among ICU versus non ICU.

**RESULTS**

A total number of 120 patients were enrolled in the study. Among that 60 were from ICU and 60 from non ICU. Out of 13 confirmed CAUTI cases that occurred during the study period, seven CAUTI cases were from non ICU patients and 6 were from ICU patients. The incidence rate per thousand catheter days in non ICU was more as compared to ICU and it was found to be 20 and 16.17, respectively (Table 1).

Out of 120 subjects, 66.7% of the studied population were males and 33.3% were females. The rate of CAUTI was more in males than in females (Fig. 1 and Table 2).

Most of the subjects belonged to the age group of above 60 years (46%). The mean age of patients included in the study was 51.49. The incidence

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**Table 1: Distribution of subjects based on incidence rate per 1000 catheter days in ICU and non ICU**

| Department | Catheter-associated urinary tract infections +ve | Incidence rate per 1000 catheter days |
|------------|-----------------------------------------------|--------------------------------------|
| ICU (n=60) | 6                                             | 16.17                                |
| non ICU (n=60) | 7                                             | 20                                   |

ICU: Intensive care unit

**Table 2: Distribution of cases based on gender**

| Gender | No. of subjects | Percentage | Catheter-associated urinary tract infections +ve n=13 | Percentage |
|--------|-----------------|------------|------------------------------------------------------|------------|
| Male   | 80              | 66.7       | 10                                                   | 77         |
| Female | 40              | 33.3       | 3                                                    | 23         |

**Table 3: Distribution of cases based on age**

| Age (years) | No: of subjects | Percentage | Catheter-associated urinary tract infections +ve n=13 | Percentage |
|-------------|-----------------|------------|------------------------------------------------------|------------|
| <18         | 13              | 11         | -                                                    | -          |
| 18–30       | 10              | 8          | 1                                                    | 7.6        |
| 31–40       | 11              | 9          | 1                                                    | 7.6        |
| 41–50       | 12              | 10         | -                                                    | -          |
| 51–60       | 19              | 16         | 4                                                    | 31         |
| >60         | 55              | 46         | 7                                                    | 53.8       |

**Statistical analysis**

All the collected data were gathered in the form of an excel spreadsheet with all protected health information that was removed prior to any statistical analysis. Data analysis was done through IBM SPSS Statistics, Version 23.0. Pearson correlation matrices were used to evaluate for relationship within data. p≤0.05 was used to determine the statistical significance.
of CAUTI was common in patients above 60 years of age (53%) (Fig. 2 and Table 3). Majority of the patients were catheterized for 5–10 days and the rate of CAUTI was more in 5–10 days of catheterization (Fig. 3 and Table 4).

The greater number of subjects included in the study was having normal weight and the rate of CAUTI was more in normal-weight patients (Fig. 4 and Table 5).

The most common co-morbidities in catheterized patients were found to be hypertension and Type 2 diabetes mellitus (DM) in which Type 2 DM was more prominent among CAUTI patients (69.2%) (Table 6).

Duration of catheterization and Type 2 DM had a significant association with CAUTI, with p=0.04 and 0.01, respectively, whereas age, sex, and BMI had no significant association with CAUTI (Table 7).

The outcomes of CAUTI were increased duration of hospitalization in 62% of patients and recovery in 38% of patients (Table 8).

The majority of the patients were catheterized for other indications such as critically ill and unconsciousness, followed by measurement of urine output (Table 9).

A total of five microorganisms were isolated from 13 cases of CAUTI. Among the bacterial isolates, Gram-negative bacilli predominate. Uropathogens isolated from ICU include *E. coli*, MRSA, methicillin-resistant coagulase-negative staphylococci, *K. pneumonia*, and *Pseudomonas* species whereas in case of the non ICU, *E. coli*, *Klebsiella*, and *Pseudomonas* were the isolated organisms (Table 10).

All the Gram-positive isolates from ICU were sensitive to linezolid whereas all the Gram-positive and Gram-negative isolates from non ICU were sensitive to piperacillin + tazobactam and meropenem (Table 11).

The incidence of antibiotic resistance was high in all the isolated organisms. All the Gram-positive and Gram-negative isolates from non-ICU and Gram-positive isolate from ICU were resistant to co-trimoxazole (Table 12).

DISCUSSION

CAUTI is the most common nosocomial infection which constitutes a major source of nosocomial septicemia and related mortality in acute care hospitals. In our study, it was found that the incidence rate of CAUTI per 1000 catheter days is more in non ICU patients than ICU patients.

Table 4: Distribution of cases based on duration of catheterization

| Duration of catheterization | No. of subjects | Percentage (n=120) | CAUTI +ve (n=13) | Percentage |
|-----------------------------|-----------------|-------------------|-----------------|------------|
| <5 days                     | 41              | 34.1%             | 1               | 7.7%       |
| 5–10 days                   | 71              | 59.2%             | 10              | 76.9%      |
| 11–20 days                  | 8               | 6.7%              | 2               | 15.4%      |
| 21–30 days                  | -               | -                 | -               | -          |
| >30 days                    | -               | -                 | -               | -          |

Table 5: Distribution of cases based on BMI

| BMI category | No. of subjects (n=120) | Percentage | CAUTI-associated urinary tract infections +ve (n=13) | Percentage |
|--------------|-------------------------|------------|-----------------------------------------------|------------|
| Underweight (<18.5) | 22 | 18.3% | 1 | 7.6% |
| Normal weight (18.5–24.9) | 56 | 46.7% | 7 | 53.9% |
| Overweight (25–29.9) | 37 | 30.8% | 5 | 38.5% |
| Obesity (>30) | 3 | 2.5% | - | - |

BMI: Body mass index

Table 6: Distribution of catheter-associated urinary tract infections cases based on their co-morbidity condition

| Co-morbidity | No. of subjects | CAUTI-associated urinary tract infections +ve | Percentage |
|--------------|-----------------|-----------------------------------------------|------------|
| Type 2 diabetes mellitus | 43 | 9 | 69.2% |
| Hypertension | 43 | 7 | 53.8% |
| Chronic kidney disease | 6 | 3 | 23 |
| Ischemic heart disease | 6 | 1 | 7.6% |
| Chronic obstructive pulmonary disease | 2 | 1 | 7.6% |
| Seizure | 1 | - | - |
| Tuberculosis | 1 | 1 | 7.6% |

Table 7: Correlation of risk factors to CAUTI

| Age group | CAUTI +ve n=13 | % | -ve n=107 | % | Odd’s ratio (95% CI) | p |
|-----------|----------------|---|-----------|---|----------------------|---|
| <18       | -              | - | 13        | 12.4 | 1.02 (0.97–1.06) | 49 (NS) |
| 18–30     | 1              | 7.6 | 9 | 8.4 | - | - |
| 31–40     | 1              | 7.6 | 10 | 9.3 | - | - |
| 41–50     | -              | - | 12 | 11.2 | - | - |
| 51–60     | 4              | 30.7 | 15 | 14.01 | - | - |
| >60       | 7              | 53.84 | 48 | 44.85 | - | - |
| Sex       |                |     |           |    |                      | |
| Male      | 10             | 76.92 | 70 | 65.42 | 0.57 (0.15–2.19) | 0.54 (NS) |
| Female    | 3              | 23.07 | 37 | 34.57 | - | - |
| BMI       |                |     |           |    |                      | |
| 23.63±3   | 23.35±4.36     | 0.97 (0.83–1.13) | 0.71(NS) |
| Duration of catheterization |                |     |           |    |                      | |
| <5 days   | 1              | 7.6 | 40 | 37.38 | 1.23 (1.01–1.48) | 0.04* |
| 5–10 days | 10             | 76.9 | 61 | 57 | - | - |
| 11–20 days | 2           | 15.38 | 6 | 5.6 | - | - |
| 21–30 days | -            | - | - | - | - | - |
| >30 days  | -              | - | - | - | - | - |
| Type 2 diabetes mellitus | 9 | 69.2 | 34 | 31.77 | 4.83 (1.39–16.80) | 0.01* |

*p<0.05 Statistically Significant, p>0.05. NS: Non significant
The decreased rate of CAUTI in ICU might be due to the increased aseptic environment than non ICU. A similar study conducted by Zahran et al. [12]. on the comparison of the incidence rate of CAUTI among ICU and non ICU patients had found that the incidence rate is more in non ICU.

Risk factors associated with the development of CAUTI include female gender, age, impaired immunity, co-morbidity, and increased duration of catheterization [6]. On the contrary, our study found no significant association of CAUTI with age, gender, and BMI. Out of 13 CAUTI patients, 77% were male and 23% were female. This result was in concordance with the study conducted by Sandhu et al. [9]. This result might be due to a greater number of male samples as compared to female samples received and males are prone to obstructive urinary lesion especially from benign prostate hypertrophy and stricture associated with advanced age.

The incidence of CAUTI cases increases with the age of the patient. This might be due to the age-associated changes in immune function, exposure to nosocomial pathogens, and increased number of co-morbidities in the elderly. Garibaldi et al. [13] noted that patients over the age of 50 years had approximately a two-fold incidence of bacteriuria and they concluded that advanced age is responsible for the high prevalence of catheter-associated bacteriuria. Similarly, Kulkarni et al. [14] found that patients aged 40 years and more were having more risk of developing CAUTI than those who were aged <40 years.

The duration of catheterization was found to be a significant risk factor of CAUTI. A similar study was conducted by Leelakrishna and Karthik [15] also revealed the same result. The longer the catheter is placed, the higher is the incidence of urinary tract infection. The incidence of bacteriuria in catheterized patients is directly related to the duration of catheterization; the daily rate of acquiring bacteriuria is approximately 3–10%. In our study, we found that the rate of CAUTI was more in 5–10 days of catheterization.

In the present study, we found that patients with DM had a 4.83 times more risk of developing CAUTI than those without DM. Various impairments in the immune system, poor metabolic control, and incomplete bladder emptying due to autonomic neuropathy may all contribute to the enhanced risk of CAUTI in these patients. Sugar in the urine also promotes bacterial growth. This finding is comparable with the study conducted by Kulkarni et al. [14] and Platt et al. [16] and noted an increased risk of acquiring infection among individuals with diabetics.

In the present study, the outcomes of CAUTI were increased duration of hospitalization and recovery of patients whereas a similar study conducted by Leelakrishna and Karthik [15] also revealed the same result. The longer the catheter is placed, the higher is the incidence of urinary tract infection. The incidence of bacteriuria in catheterized patients is directly related to the duration of catheterization; the daily rate of acquiring bacteriuria is approximately 3–10%. In our study, we found that the rate of CAUTI was more in 5–10 days of catheterization.

In most of the studies done in UTI till today, the most common organism isolated is E. coli. However, there is a reduction in the frequency of E. coli (although it remains the usual cause) in patients with indwelling catheters.
catheters. A similar finding was seen in our study where the most common isolate was *E. coli* followed by Klebsiella in ICU as well as non ICU. This observation seems to agree with several other studies with *E. coli* isolation rate ranged from 22% to 40.47% [17].

Regarding susceptibility, all the Gram-positive isolates from ICU were sensitive to linezolid whereas all the Gram-positive and Gram-negative isolates from non ICU were sensitive to pipemidic acid + tazobactam and meropenem. All the Gram-positive and Gram-negative isolates from non-ICU and Gram-positive isolates from ICU were resistant to co-trimoxazole.

### CONCLUSION

The urinary catheter is an essential part of the modern medical care. Unfortunately, when used inappropriately or when left in place for too long, it is a hazard to the patient. The urinary tract of a catheterized patient is highly susceptible to severe infection resulting in increased hospitalization, medication, morbidity and also adds to the financial burden. This study provides the data on incidence rate, predisposing risk factors, and the causative microbial flora along with the information regarding catheter indications and CAUTI prevention. Therefore, the health-care professionals should have adequate active surveillance and by the proper management of the indwelling urine should be cultured regularly to diagnose and prevent CAUTI and its complications. The most important risk factors of CAUTI are improper indication and duration of catheterization. Although not all CAUTIs can be prevented, it is believed that the incidence can be reduced through active surveillance and by the proper management of the indwelling catheter. Most hospitals do not have strict guidelines for the prevention of CAUTI. Therefore, the health-care professionals should have adequate knowledge regarding catheter indications and CAUTI prevention.

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### AUTHORS CONTRIBUTION

Resmi Scaria and Merlin Babu contributed in writing the manuscript whereas Micah Job and Mobisha Monachan provided the particulars and details of the subjects.

### CONFLICT OF INTEREST

There is no conflict of interest between the authors.

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