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Original Article

The Epidemiology and Microbiological pattern of Catheter Associated Urinary Tract Infection in a Tertiary Care Hospital- A Surveillance Study

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Abstract
Background: *Among the Health care associated infections, Urinary tract infections are the most common, accounting for up to 40% of infections reported by acute care hospitals. Also, 70 - 80% of urinary tract infections are associated with the presence of an indwelling urinary catheter. So, a periodical surveillance system is essential to establish effective infection control and prevention program.*

Aims
1. *To determine the rate of Catheter Associated Urinary Tract Infection (CAUTI),*
2. *To isolate and identify the antibiotic sensitivity pattern of the isolates.*

Setting: *This study was undertaken in patients admitted in the Intensive Medical Care Unit (IMCU) for ≥48 hrs and on Foley's catheter.*

Methodology: *In a catheterized patient, urine sample were collected aseptically. Total 168 catheterized patients were included for a period of six months. Standard proforma was used to collect all the demographic details. Colony count of* 10^5 *was taken as significant. p value of <0.05 is considered significant.*

Results: *The mean age of patients was 37 ± 19 years. A total number of 41(24.40%) patients were culture positive. Bacterial cause was identified in 17 (41 %) and in 24 (59 %) patients Candida species were isolated. The most common bacteria isolated was Escherichia coli. The rate of Extended-spectrum β-Lactamase production was 78%. In the present study, the rate of development of CAUTI was higher with longer duration of catheterization. p value 0.033946.*

Conclusions: *In an IMCU setting, the catheterized patients are highly susceptible to infection. As the rate of development of CAUTI is significantly associated with the duration of catheterization emphasis should be made on reducing the duration of catheterization.*

Keywords: *Escherichia coli, infection control and prevention, Intensive Medical Care Unit, Health care associated infections.*

Introduction

Health Care Associated Infections (HCAI) are a major public health problem for patient safety and its impact can result in prolonged hospital stay, long-term disability, increased resistance of microorganisms to antimicrobial agents, a massive additional financial burden for the health care system, high costs for patients and their families, and increased mortality [1].[2].

The WHO Report on the burden of endemic HCAI worldwide, states that the incidence of Intensive Care Unit (ICU) acquired infection among adult patients in low- and middle-income countries ranged from 4.4% up to 88.9%. [3] As per a systematic review, pooled overall HCAI density in adult ICU was 47.9 episodes per 1000 patient-days which are at least three times as high as densities reported in developed countries. [2]

Among the HCAI, Urinary tract infections are the most common, accounting for up to 40% of infections reported by acute care hospitals [4, 5]. Also, 70 - 80% of urinary tract infections are associated with the presence of an indwelling urinary catheter. [6]

Antibiotic resistance in Gram-negative uropathogens is a major global concern, bacterial resistance particularly in relation to Catheter-Associated Urinary Tract Infections (CAUTI)has major implications [7]leading to increased hospital cost and increased morbidity [8] and mortality. [5].[9]

Up to 69% of CAUTIs are considered to be avoidable, provided that recommended infection-prevention practices are implemented. [10]

A periodical surveillance system for health-care-associated infection which is virtually nonexistent in most low- and middle-income countries is essential to record the size of this infection burden and the effect of interventions. Moreover, many studies have stated that by itself, surveillance can lead to reduction in health-care-associated infection. [2].[11]

On this background this study was undertaken to determine the epidemiology and rate of CAUTIs, risk factors, microbiological profileand their antimicrobial susceptibilities.

Material and methods

This surveillance study was undertaken in an Intensive Medical Care Unit of a tertiary care hospital. Total 168catheterized patients were included for a period of six months from April 2016 to September 2016. Standard proforma was used to collect all the demographic details like name of the patient, age, sex, diagnosis also details regarding catheterization indication, type, date and days of catheterization were noted.

Patients who got admitted and stayed in the IMCU for ≥48 hrs and catheterized on Foley's catheter were included in this study. Patient with symptoms of UTI prior to the catheterization and on suprapubic and condom drainage were excluded. The study was approved by the institutional Ethics Committee and an informed written consent was obtained from the patients before the collection of the samples.

In a catheterized patient, urine sample (3 mL) were collected as per the guidelines for culture and sensitivity with aseptic precautions using a sterile needle and syringe from the distal edge of catheter tube into a sterile universal container [12] and was transported immediately to the laboratory. For those patients who were admitted more than a week, the repeat samples were collected in the second week. With the calibrated loop urine was cultured on CLED media for quantitative analysis to assess the microbial counts. Colony count of 10^5 was taken as significant while confirmation as CAUTI. The identification of pathogen was done by standard biochemical tests. Isolate suggestive of the yeast were subcultured on Sabouraud's dextrose agar and further identification was done by demonstration of germ tube; sugar fermentation and CHROME agar. Antimicrobial susceptibility testing was done by Kirby-Bauer disk-diffusion method on Muller-Hinton agar as recommended by CLSI guidelines.[13]

All the gram negative isolates were subjected to Extended Spectrum Beta-lactamase (ESBL) screening test using ceftazidime (30µg) and cefepime (30µg) by Phenotypic screening method and carbapenemase screening test using imipenem (10µg) and meropenem (10µg) discs. The isolates which were positive in the screening test were subjected to respective confirmatory tests using appropriate antibiotic discs. The phenotypic confirmation for ESBL production was done by testing the strain against ceftazidime (30µg) and ceftazidime/clavulanic acid (30µg/10µg) *Himedia, were placed at a distance of 20mm centre to centre on the Mueller-Hinton agar plate, incubated at 37ºC for 20-24 hours. The test isolate was considered to produce ESBL if the zone of inhibition around the ceftazidime-clavulanic acid disc was ≥5mm that the zone around ceftazidime disc alone.[14]

Isolates resistant to carbapenems was further processed by modified Hodge test to detect carbapenemase production. A lawn culture of 1:10 dilution 0.5 McFarland standard suspension of E.coli ATCC 25922 was done on to a Mueller Hinton Agar plate and allowed to dry for 3-5 minutes. A 10µg meropenem disc is placed in the center of the test area. In a straight line, the test organism was streaked from the edge of the disc to the edge of the plate and incubated at 37°C for 16-20 hours. Enhanced growth (Clover-leaf indentation) was considered as positive for carbapenemase production.[15]

Statistical analysis

Categorical data are presented as proportions. Normally distributed continuous data are presented as mean with standard deviation. Non-normally distributed continuous data are presented as median with range. Chi square test was used to analyse the strength of association of longer duration of catheterization and the risk of developing CAUTI. McNemar test was used to analyse development/outcome of CAUTI with the duration of catheterization.p value of <0.05 is considered significant.

Results

A total of 168 patients were included in the study. The mean age of patients was 37 ± 19 years. Male to Female ratio was 1:1.15.

Majority n = 36 (21%) of them were in the age group of 31 – 40 years, followed by the age group 12 -20,and 21 -30 years (18%). [Table 1]

A total number of 41(24.40%) patients out of 168 were culture positive with significant colony count. Bacterial cause was identified in 17 (41 %) of patients and in 24 (59 %) patients *Candida* species were isolated.

Out of 17 patients 3 patients had 2 bacterial isolates each with significant count. So, 20 bacterial pathogens were isolated from 17 patients. [Table 2]

Candida non albicans was the predominant organism isolated in 19 (79.2%) patients while *Candida albicans* was isolated only in 5 (20.8%) patients. Among *Candida nonalbicans*,

C. tropicalis 09 (47%) was the predominant species followed by *C. glabrata* 05 (26%) *C. krusei* 03 (15.7%) and *C.parapsilosis* 2 (10.5%).

A total urinary catheterization day calculated for 168 patients was 1848 days.The descriptive analysis of catheter days is given in Table: 3. CAUTI rate was calculated as 22%.

Among patients who were culture negative on 1st week, 70% turned to be culture positive on repeat culture. On the other hand among patients who were culture positive on the 1st week, 85.7% continued to be culture positive on the repeat samples. It was not statistically significant (McNemar test p value 0.07) which could be because of the low sample size.

Table 4 discusses the Antibiotic Susceptibility Pattern of bacterial isolates causing CAUTI. Seven uropathogens including 3 *Enterococcus* spp isolated from CAUTI cases were found to be multidrug resistant. The rate Extended-Spectrum β-Lactamase (ESBL) production was 78%. Carbapenemase-producing *Klebsiella pneumoniae* 2 have been isolated.

Table: 1 Age and sex distribution of participants. (n=168)

S.no	Age (Years)	Male	Female	Total
1	12 – 20	13	17	30
2	21 – 30	11	19	30
3	31- 40	19	17	36
4	41-50	13	12	25
5	51-60	11	9	20
6	>61	11	16	27
Total		78	90	168

Table: 2 Spectrum of microorganisms isolated from CAUTI

ORGANISMS	NUMBER
Klebsiella oxytoca	4
Klebsiella pneumoniae	4
Acinetobacter sp	2
E.coli	5
Pseudomonas sp	1
P. mirabilis	1
Enterococcus sp	3
Candida non albicans	19
Candida albicans	5
Total	44

Table: 3 Descriptive analysis of catheter days

Days of urinary catheterisation	No of patients	No of UTI detected	Total No of Device Days	Infection rates (%)	Mean duration of catheter use
≤3	29	3	84	1.7	2.8
4 - 7	56	11	344	6.5	6.15
>7	83	27	1420	16.07	17.10
Total	168	41	1848	24.40	11

Table: 4 Antibiotic Susceptibility Pattern of Pathogen Causing CAUTI

Name of the antibiotic	Antibiotic Susceptibility(%) of Gram negative bacteria	Antibiotic Susceptibility(%) of Enterococcus
Amikacin	41	0
Gentamicin	35.2	0
Cefotaxime	23.5	-
Cephaperazone Sulbactum	82.35	-
Norfloxacin	47	0
Imipenem	82.35	-
Nitrofurantoin	7.6	33.3
Amoxicillin	-	0
Vancomycin	-	100
Penicillin	-	0

Discussion

The diagnosis of CAUTI was done as per the CDC guidelines. The patient was labelled as a case of CAUTI, when a catheterized patient developed one or more of the following conditions after 48 hours admission to IMCU: fever (>38.0°C), urgency, suprapubic tenderness, dysuria, turbidurine and burning micturition.[16]

Duration of catheterization is the most important determinant of bacteriuria. When an indwelling catheter is in situ the daily risk of acquisition of bacteriuria is 3–7%.[17]

CAUTI is usually deemed present if there are at least 10^5 colony-forming units (cfu)/mL of 1 or 2 micro-organisms identified by urine culture

CAUTI incidence density is defined as the Number of CAUTI episodes per 1000 patient-days or device-days and in this study the CAUTI rate was calculated as 22 per 1000 catheter days. Another prospective observational study describes the rates of nosocomial urinary tract infection as (24%) which is very similar to this study.[18]

The most common (54.5%) etiological agents of CAUTI were *Candida spp.*[19]

The predominance of *Candida non albicans* spp (19) over *C. albicans* (5) was noted. This is similar to other study.[20]

Compared to bacterial CAUTI patients, *Candida* CAUTI patients had more intensive healthcare exposure, longer durations of indwelling urinary catheters, and more frequently had co-infections at the time of CAUTI diagnosis.

Gram-negative bacilli represented the most common (85%) CAUTI isolates among bacteria. A recently-published review of microbiological patterns of HCAI from 28 studies conducted in developing countries 3 reported gram-negative rods as the most common nosocomial isolates, both in mixed patient populations and in high-risk patients. [2]

The most common organisms isolated were *Escherichia coli* (29.4%), *Klebsiella pneumoniae* (23.5%), *Acinetobacter* sp (11.7%), and *Enterococcus* species (15%). The microbiological profile in our study is similar to other studies.[21]. [22]. [23]

Among organism causing CAUTI extended spectrum beta lactamase (ESBL) resistance seen in nearly 78% of isolates. In a study the prevalence of ESBL producers among *K. pneumoniae* and *E. coli* isolates was 56% (14/25) and 78.6% (11/14), respectively.[24]

Carbapenemase-producing *E. coli* 2 and *Klebsiella pneumoniae*1 have been isolated.

In the WHO Global priority list of Antibiotic resistant bacteria to guide research, discovery and development of new antibiotics, the organisms causing CAUTI are grouped under priority 1 critical list. In that list, 9 out of 12 families are of the "gram-negative" type. Top of the list is *Escherichia coli* the leading cause of urinary tract infections.[25]

Prolonged catheterization is one of the significant risk factors for the development of CAUTI.[26]. [27].

In the present study, the rate of development of CAUTI was higher as the duration of catheterization increased. p value 0.033946, Chi square value 6.766. [Table 3]

Conclusion

In an IMCU setting, the urinary tract of catheterized patients is highly susceptible to infection by multi drug resistant pathogens. This infection is associated with varied microbiological etiology. This infection along with the underlying comorbid condition increases hospitalization, medication and morbidity. As the rate of development of CAUTI is significantly associated with the duration of catheterization emphasis should be made on reducing the duration of catheterization. Hospital-wide infection control and prevention program and appropriate catheter care bundles can be developed and implemented from evidence-based surveillance study.

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