ORIGINAL RESEARCH

Catheter-Associated Urinary Tract Infection: Incidence Rate And Antibiotic Sensitivity Pattern Of Bacterial Isolates In Patients Admitted In I.C.U Of Tertiary Health Care Hospital Of Jammu Province

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Received: 24 November, 2022 Accepted: 26 December, 2022

INTRODUCTION

Health care-associated infections (HCAIs) are infections that occur while receiving health care developed in a hospital or other health care facility[1]. HAIs are associated with increase in the cost of treatment, adverse patient outcomes, social impact, morbidity and mortality. DAIs continues to be one of the major threats to the patient safety, particularly in m of low- and middle-income countries[2,3,4,5]. There are four major types of healthcare associated infections which were commonly encountered. Catheter associated urinary tract infections (CAUTI), Central line associated blood stream infections (CLABSI), Ventilator associated pneumonia (VAP) and surgical site infection. Among these first three are known as device associated infections (DAIs). Around, 15-25% of hospitalized patients require urinary catheterization. The risk of developing CA-bacteriuria increases with time; with an average risk of 3-10% per catheter days to 25% at the end of one week and to nearly all cases in one month[6].

For the diagnosis of CAUTI, a patient with a urinary catheter in place must meet one of two criteria: one or more of the given signs and symptoms with no other recognized causes; such as fever (temperature $\geq$ 38 degree Celsius), urgency, suprapubic tenderness, and urine culture positive for $\geq$105 cfu/mL, with no more than two microorganisms isolated; and positive dipstick analysis for leukocyte esterase or nitrate and pyuria ($\geq$10 leukocytes/mL) with no other recognized cause. Catheter-associated urinary tract infections (CAUTIs) have accounted for as much as 40% of all nosocomial infections in the United States, affecting an estimated 800,000 patients per year. The incidence of nosocomial UTI among the 25% of hospitalized patients, who have a urinary catheter, is approximately 5% per day, with virtually all patients developing bacteriuria by 30 days of catheterization[7]. One of the recent study found that most catheter-associated bacteriuria was asymptomatic[8]. But silent catheter-associated UTIs may represent a large pool of antibiotic-resistant pathogens[9] and drive a great deal of generally unnecessary antibiotic therapy. These infections increase the length of stay, hospital cost, and mortality.[10]According to Centre for disease control and prevention-National Healthcare Safety Network-2013 report, the mean incidence of CAUTI per 1000 catheterized days was 0-5.3% in critical care units and 0-3.1% in inpatient wards[11]. In India the incidence of CAUTI is 1.63-2.1 per 1000 catheter days[12, 13]. Broad range of bacteria can cause CAUTI. In short term catheterized patients it is monomicrobial such as gram negative bacilli like Escherichia coli, Klebsiella, Serratia, Citrobacter, and Enterobacter, Pseudomonas and Acinetobacter and gram positive cocci like Coagulase negative staphylococcus and Enterococcus. In long term catheterized patients it is polymicrobial. In addition to the pathogens of short term catheterization, it is caused by Proteus, Providencia and Morganella.[6]The significant risk factors for CAUTI include age, uncontrolled diabetes and long hospital stay[14]. Other risk factors are female gender, impaired immunity and length of duration ofcatheterization[15.]

METHODS

STUDY DESIGN, SETTING AND POPULATION

A facility-based cross-sectional study was conducted from November 2019 to October 2020 at Government medical college and hospital, Jammu. In study Inclusion criterias are: (a) I.C.U patients with indwelling urinary catheter for more than 48 h,(b) patients with at least two of the following signs and symptoms of UTIs: fever, suprapubic tenderness, costovertebral angle pain or tenderness, urinary urgency, urinary frequency and dysuria, (c)patients who give informed consent. Exclusion criteria are: (a) OPD patients, (b)patients without indwelling medical devices (Urinary catheters), (c)patients showing clinical signs of infection on or before admission or transfer to the ICUs, (d) refusal of consent.

After taking informed consent, detailed history including the name, age, sex, underlying clinical condition, date of admission to the ICU, any history of previous antibiotic intake, the treatment being administered in the ICU, and clinical outcome of each patient . Laboratory samples for CAUTI were taken depending on the clinical suspicion from the patients admitted in I.C.U for more than 48 hrs. A freshly voided clean catch midstream urine sample (10–20 mL) was collected with a wide mouth sterile container with screw cap before catheter insertion. In patients with short-term (<7 days) catheterization, urine specimens were obtained by sampling through the catheter port using aseptic technique (disinfecting with 70% alcohol) or, if a port is not present, by puncturing the catheter tubing with a needle and syringe after clamping (catheter urine is taken in this case because risk of contamination is low). In patients with long-term (> 7 days) indwelling catheters, urine sample was collected after catheter was replaced from the freshly placed catheter.

All specimens will be collected as per standard aseptic protocol and transported to the laboratory as early as possible. Gram staining was done from all specimens and examined to determine the presence, type of cells, relative number of microorganisms and their morphologies. All the samples were inoculated on Blood agar and MacConkey agar and incubated on Blood agar and MacConkey agar at 37°C overnight. Cases of significant growth were subjected to gram staining, antibiotic sensitivity test (Kirby-Bauer Disk Diffusion Method) and biochemical tests for identification. Identification of organism was carried out as per established Departmental guidelines. Organism was reported as sensitive, intermediate or resistant based on the standard zone size. The following antibiotic discs with their respective concentrations were used: penicillin (10 µg), ampicillin (10 µg), gentamicin (10 µg), ciprofloxacin (5 µg), tetracycline (30 µg), erythromycin (15 µg), vancomycin (30 µg), chloramphenicol (30 µg), norfloxacin (10 µg), nitrofurantoin (300 µg), cefoxitin (30 µg), and ceftriaxone (30 µg) for Grampositive bacteria and ampicillin (10 µg), piperacillin (100 µg), cefoxitin (30 µg), cefepime (30 µg), ceftriaxone (5 µg), gentamicin (10 µg), ciprofloxacin (5 µg), tetracycline (30 µg), meropenem (10 µg), amikacin (30 µg), norfloxacin (10 µg), nitrofurantoin (300 µg) and ceftazidime (30 µg) for Gram-negative bacteria.

RESULTS

A total of 448 patients were included in the study.

Table 1: The age distribution of patients

S.NO.	Age(yrs)	Total no. of patients
1	≤50	301(67%)
2	51–64	71(16%)
3	65–79	58(13%)
4	≥80	18(4%)

Table 2: The gender distribution of patients

Gender	Number
Females	119
Males	329

Table 3: Distribution of patient on the basis diagnosis

Clinical diagnosis	No. of patients(n=448)
CAUTI	33(7.40%)

Table 4: Showing age distribution of CAUTI

Age(years)	CAUTI
≤50	25
51–64	7
65–79	0
≥80	1

The most common age group affected was ≤50 years.

Table 5: CAUTI incidence rate among patients admitted in ICU

Total no. of patients on urinary catheter	448
Total no. of catheter days	3189
No. of CAUTI	33
CAUTI incidence rate: No. of CAUTI/no. of indwelling catheter days × 1000	10.35

Table 6: Showing distribution of age in CAUTI

Diagnosis	Male	Female
CAUTI	23	10

Table 7: Showing type and total number of organisms isolate in CAUTI

Organism	Number of organism
Escherichia coli	10
Enterococcus sp.	6
Klebsiella sp.	4
Staphylococcus aureus	3
Pseudomonas sp.	5
Acinetobacter sp.	4
Citrobacter sp.	1
Total	33

Among gram negative bacilli, *Escherichia coli* (10.31%) was the common organism isolated followed by and *Pseudomonas sp*.(5.15%) followed by *Klebsiella sp*. And *Acinetobacter sp*.(4.12%). The least common organism isolated was *Citrobacter sp.* (1.3%). Among gram positive cocci, *Enterococcus sp.* (6.18%) was the common organism isolated followed by *Staphylococcus aureus*(3.9%). Among 33 organisms five were multidrug resistant. *(Escherichia coli, Klebsiella sp*., *Pseudomonas sp*. and 2 *Acinetobacter sp.*).

Table 8: Showing AST of Klebsiellae species

Antibiotics												
AMC	**AMK**	**CTX**	**CXM**	**CIP**	**ETP**	**FEP**	**GEN**	**MEM**	**SXT**	**TZP**	**IMP**	**DOX**
R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	S	R	R	S	R	R	R	R	R
R	R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	R	R	R	R	R	R	R	R	R

Only 25% were sensitive to ciprofloxacin and gentamicin. Rest all were resistant.

Table 9: Showing AST of Escherichia coli

Antibiotics											
AMP	**AMC**	**AMK**	**CTX**	**CIP**	**ETP**	**FEP**	**MEM**	**FOS**	**SXT**	**TZP**	**IMP**
S	S	R	S	R	R	R	R	S	R	R	S
S	S	R	R	R	S	R	R	S	R	R	S
R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	S	S	S	S	S	R	S	S
R	R	R	R	R	R	R	R	S	R	R	R
R	S	S	S	R	S	R	R	S	R	R	S
S	S	R	S	R	S	R	R	S	R	R	S
S	S	R	R	R	S	R	R	S	R	R	S
R	R	R	R	R	R	R	R	R	R	R	R
R	R	R	R	S	S	S	S	S	S	S	S

60% were resistant to Ampicillin, 50% resistant to Amoxyclavulinic acid and 90% were resistant to Amikacin, 70% were resistant to Cefotaxime, 80% were resistant to Ciprofloxacin, Feropenem, piperacillin- tazobactam and meropenem, 40% resistant to Ertapenem, 20% resistant to trimethoprim- sulfamethoxazole and Fosfomycin, 30% were resistant to Imipenem.

Table 10: Showing AST of Citrobacter species

Antibiotics										
AMK	**CTX**	**CAZ**	**CIP**	**GEN**	**MEM**	**SXT**	**TZP**	**IMP**	**NET**	**MNO**
S	S	R	S	S	R	S	S	S	R	S

Table 11: Showing AST of Acinetobacter species

Antibiotics									
AMK	**CTX**	**CAZ**	**CIP**	**GEN**	**MEM**	**SXT**	**TZP**	**IMP**	**MNO**
S	R	R	R	R	R	R	R	R	S
S	S	S	S	S	R	S	S	S	S
S	R	R	R	R	R	R	R	R	S
S	S	S	S	S	R	S	S	S	S

50% of Acinetobacter sp. were sensitive to Cefotaxime, Ceftazidime, Ciprofloxacin, Gentamycin, trimethoprim- sulfamethoxazole, piperacillin- tazobactam, Imipenem, 100% were sensitive to Amikacin and Minocycline, 100% of the species were resistant to Meropenem.

Table 12: Showing AST of Pseudomonas species

Antibiotics								
AMK	**ATM**	**CAZ**	**CIP**	**GEN**	**MEM**	**TZP**	**IMP**	**NET**
S	S	S	R	S	R	R	R	R
R	R	R	R	R	R	R	R	R
S	S	R	R	S	R	S	R	R
S	S	S	R	S	R	R	R	R
R	R	R	R	R	R	R	R	R

40% resistant to Amikacin, Aztreonam and Gentamycin, 60% resistant to Ceftazidime, 80% resistant to piperacillin- tazobactam, 100% resistant to Ciprofloxacin, Meropenem, Netilmycin and Imipenem.

Table 13: Showing AST of Staphylococcus aureus

Antibiotics						
CIP	**ERY**	**GEN**	**TEC**	**LNZ**	**DOX**	**VAN**
S	R	S	S	S	S	S
S	S	S	S	S	S	S
S	R	S	S	S	S	S

Only 67% were resistant to Erythromycin. Rest of the species were sensitive.

Table 14: Showing AST of Enterococcus species

Antibiotics						
AMP	**CIP**	**FOS**	**GEN**	**TEC**	**LNZ**	**VAN**
R	R	S	R	R	S	R
S	S	S	S	S	S	S
R	R	R	R	S	S	S
R	R	R	S	R	R	R
R	R	S	R	R	S	R
S	S	S	S	S	S	S

16% resistant to Linezolid, 33% resistant to Fosfomycin, 50% resistant to Gentamycin, Teicoplanin and Vancomycin and 67% were resistant to Ampicillin, Ciprofloxacin.

DISCUSSIONS

During the period covered by our study, a total of 448 patients were included. They were within the age range of 1 – 80 years. Most common age group included in study were <50 years, males were more in number than females. This findings were also depicted in the studies of **Soundaram GVG *et al*., 2020 and Yoshida T et al, 2019**[16,17]. All patients admitted in ICU during our study were on catheterization. Similar to the study of **Soundaram GVG *et al*., 2020**[16]**.** The urinary catheter days were 3189.
These findings were correlated with the studies of **Ravi PR, Joshi MC., 2018**[18] **and Soundaram GVG *et al*., 2020**[16]**.** As total of 33 out of 448 patients developed CAUTI respectively**.** After completion of the study, the CAUTI rate was calculated. The formula for CAUTI Rate used was: **CAUTI incidence rate:** No. of CAUTI/no. of indwelling catheter days × 1000.This formula was also used in the studies of **Clarke k *et al.,* 2012**[19]**, Lai C *et al.,* 2017**[20]**, and Soundaram GVG *et al*., 2020**[16]**.** The CAUTI rate found was 10.35 per 1000 catheter days .Inthe present study the most common organisms causing CAUTI were Gram negative bacilli than Gram positive cocci. Similar to the study done by **Titsworth WL *et al.,* 2012**[21] **and Lai C *et al,*. 2017**[20]**.** Among gram negative bacilli, *Escherichia coli* (10.31%) was

the common organism isolated followed by *Pseudomonas sp*. (5.15%) and followed by *Klebsiella sp*. and *Acinetobacter sp*.(4.12%). The least common organism isolated was *Citrobacter sp.* (1.3%). Among gram positive cocci, *Enterococcus sp.* (6.18%) was the common organism isolated followed by *Staphylococcus aureus* (3.9%).

In this study the most common organism causing CAUTI is *Escherichia coli.* This finding correlates with the studies done by **Davis KF *et al.* 2014**[22]. The majority of CAUTIs were caused by *Enterobacteriaceaespp* and *Pseudomonas aeruginosa.* The remaining infections were due to *Staphylococcus aureus*, *Enterococcus spp.* Nearly all CAUTIs were due to a single organism. In both phases, *E. coli* was the common organism isolated followed by *P. aeruginosa.* These findings resembles with the findings of the studies done by **Soundaram GVG**[16]*et al*, **2020 and Davis KF *et al.* 2014**[22].

Regarding susceptibility of Staphylococcus aureus, linezolid, Vancomycin, Gentamycin showed good response but in case of Enterococcus, only linezolid was sensitive (84%). For Pseudomonas sp., high sensitivity was shown in case of ampicillin, aztreonam and gentamycin (120microgram). Acinetobacter sp. was 100% sensitive to Amikacin and Minocycline. Lactose fermenters like Klebsiellae sp. 25% were sensitive to ciprofloxacin and gentamicin and Escherichia coli showed good sensitivity to trimethoprim- sulfamethoxazole and Fosfomycin and Imipenem. The only isolated species of Citrobacter was sensitive to every antibiotic except meropenem, netimycin and ceftazidime. This finding is similar to the study of **Saleem M *et al*, 2022**[23], where they also observed that all the Gram-negative isolates showed great variation in sensitivity patterns.

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