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BACTERIOLOGICAL PROFILE OF CATHETER ASSOCIATED URINARY TRACT INFECTION (CAUTI) AND ITS ANTIBIOGRAM IN PATIENTS ADMITTED IN A TERTIARY CARE HOSPITAL IN KOLKATA, WEST BENGAL, INDIA

Microbiology

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ABSTRACT

Objective: Aim of the present study is to determine the bacteriological profile of catheter associated urinary tract infections and its antibiotic sensitivity pattern in patients admitted in Intensive Care Unit of a tertiary care hospital in Kolkata. **Materials And Methods:** The present study is a prospective study done in a tertiary care hospital in Kolkata. The study was done for a period of 1 year and included 288 patients who were admitted in ICU and required urinary catheterization. The urine from catheter was collected from each patient and subjected to culture and antibiotic susceptibility testing. **Results:** Our study shows that CAUTI is more in female population around the age group of 60-90 years. Prolonged catheterization is a risk factor for development of CAUTI. Laboratory investigation shows that Klebsiella pneumoniae is the commonest organism accounting for CAUTI 46%. Other organisms isolated are Escherichia coli 18%, Pseudomonas spp. 15%, Proteus spp. 9%, Staphylococcus aureus 9% and Acinetobacter spp. 3%. **Conclusion:** CAUTI remains a challenge to the infection control team and is also a great burden to patient safety. Alarmingly high degree of antibiotic resistance requires urgent evaluation. Adherence to infection control program and proper enforcement and periodic review of antibiotic policy well definitely reduces CAUTI thereby decreasing patient morbidity.

KEYWORDS

CAUTI, UTI, HAI, Infection control, catheterization, antibiotic policy, antibiotic resistance.

INTRODUCTION

Urinary tract infection is an infection involving any part of the urinary system including urethra, bladder, ureters and kidney. Among UTI s acquired in the hospital, approximately 75% are associated with a urinary catheter, which is a tube inserted into the bladder through the urethra to drain urine.

About 15-25% of hospitalized patients receive urinary catheters during their hospital stay. The most important risk factor for developing CAUTI is prolonged use of the urinary catheter [1] Therefore, catheters should only be used for appropriate indications and should be removed as soon as they are no longer needed.

CAUTI is considered to be the most common HAI worldwide, accounting for up to 40% of nosocomial infections [2] About 70-80% of healthcare associated UTI are attributed to the presence of an indwelling urinary catheter.

Catheter associated urinary tract infections are infections occurring in patients where indwelling catheter is placed for more than 2 calendar days (Day 1 being the day of placement). A broad range of bacteria can cause CAUTI, most of which are multidrug resistant and can lead to serious complications. Furthermore, abiotic surfaces such as catheter form excellent substates for microorganisms to adhere and establish biofilm growth [3]. Once a mature biofilm has formed, it is highly recalcitrant to treatment of antibiotics as well as immune response components. This can lead to serious complications.

This study well emphasizes the need to implement and monitor effective infection control programmes to reduce the risk of CAUTI.

MATERIALS AND METHODS:

Setting: Present prospective, longitudinal study was done in a tertiary care hospital in Kolkata.

Duration: The study was done for a period of one year from 1st April 2023 to 31st March 2024. During this study period, 288 patients were selected who were admitted in ICU and required urinary catheterization.

Sampling Methods: Convenience sampling was used in this study.

Sample Size Calculation:

The sample size was calculated after studying the prevalence of risk factors from various studies and taking their average, which was 50%. The sample size was estimated at 5% level of significance with an allowable error of 10%, using the following formula:

$n = (z\alpha)^2 p\,q / L^2$

Where,

n= Sample size, p= Prevalance, q= (p-1), L= Allowable error, Z Alpha = Z 0.05 = 1.96

So,

p = 44% = 0.44
q = 56% = 0.56
L = 10% = 0.1
So, n is (1.96 x 1.96 x 0.44 x 0.56) / (0.1 x 0.1) = 94.6

Since we have not done simple random sampling to minimize bias, we will take Design Effect (DEFF) as 3.

So, sample size = 94.6 x 3 which is 285.

We have taken 288 samples in our study, in case there is any contamination in some samples.

Inclusion Criteria:

1. Adult patients who were admitted in ICU and required catheterization.
2. Among those patients, the ones who developed symptoms of UTI after 48 hours of catheterization.

Exclusion Criteria:

1. Patients who were not admitted in ICU.
2. Patients who were already suffering from urinary tract infection prior to admission.

Collection And Processing Of Samples:

Clinical history of the patients comprising of signs and symptoms like fever, flank pain, burning sensation during micturition was taken.

Catheter urine was collected aseptically and sent to the laboratory in a sterile container. Processing of urine samples were carried out within 15 minutes of collection without any delay. Urine samples were centrifuged and the deposits were used for wet mount preparations. They were examined microscopically for the presence of pus cells, RBC s, bacteria and yeast cells.

The samples were inoculated on Hi-chrome media using semi-quantitative technique and were incubated overnight at 37^{0}C.

The plates with significant colony count were further processed based on colony morphology, Gram staining and standard biochemical tests for species level identification of bacteria.

Antibiotic sensitivity of the isolates was carried out according to standard CLSI guidelines. About 4-5 colonies of similar type were picked up and inoculated on Mueller Hinton agar for putting up antibiotic sensitivity testing by Kirby Bauer disc diffusion method.

The drugs used were Ampicillin, Cefoxitin, Cefuroxime, Cefotaxime, Ceftriaxone, Cefoperazone, Cefepime, Amoxycillin-Clavulanic acid, Piperacillin-Tazobactam, Cefoperazone-Sulbactam, Ciprofloxacin, Norfloxacin, Nalidixic acid, Nitrofurantoin, Meropenem, Imepenem, Ertapenem, Amikacin, Gentamicin, Tobramicin, Linezolid, Vancomycin, Doxycycline, Cotrimoxazole, Aztreonem, Ceftazidime-Avibactam and Colistin.

Reporting was done based on the diameter of zone of inhibition. For Vancomycin, Ceftazidime-Avibacatam and Colistin, E Strip was used.

Data Collection:
The data was collected and analysed using Microsoft Excel sheet and other statistical softwares.

RESULTS:

Table 1:

Organism	Percentage of distribution
Klebsiella pneumoniae	46%
Escherichia coli	18%
Pseudomonas aeruginosa	15%
Acinetobacter spp	3%
Proteus mirabilis	9%
Staphylococcus aureus	9%

Percentage of distribution of uropathogens among the 66 cases of CAUTI shows that Klebsiella pneumoniae is the most common isolate followed by Escherichica coli and Pseudomonas aeruginosa.

Table 2:

Age	Number of patients
0-20	0
21-30	6
31-40	6
41-50	12
51-60	0
61-70	12
71-80	12
81-90	1
91-100	6

Age distribution among the 66 laboratory confirmed CAUTI showed that majority of the patients belonged to 41-50 years and 61-80 years of age group.

Table 3:

Gender	Number of patients
Male	17
Female	31

The gender distribution among the total 288 patients with catheter, admitted in ICU showed a female preponderance.

Table 4:

Symptomatic Male Catheterised	Male (Lab confirmed CAUTI)	Symptomatic Female Catheterised	Female (Lab confirmed CAUTI)
36	24	42	42

Gender distribution among both symptomatic catheterised and laboratory confirmed CAUTI revealed that there was a complete correlation in female patients

Table 5:

Day 3	36%
Day 4	55%
Day 5	9%

Distribution of Day of Event in the study population showed that majority percentage of the cases had DOE as Day 4.

Table 6:

Antibiotic	Percentage of sensitivity (%)
Ampicillin	6.66%
Cephalosporin	0.33%
Nitrofurantoin	16.66%
Aminoglycoside	26.66%
Carbapenem	90%
Fluoroquinolones	96.66%
Ceftazidime-Avibactam	100%

Antibiotic sensitivity pattern showed that Klebsiella is mostly resistant to all the antibiotics but have a good sensitivity for Carbapenems and 100% sensitivity to Ceftazidime-Avibactam

Table 7:

Antibiotic	Percentage of sensitivity (%)
Ampicillin	8.33%
Cephalosporin	33.33%
Nitrofurantoin	41.66%
Aminoglycoside	75%
Carbapenem	100%
Fluoroquinolones	58.33%
Ceftazidime-Avibactam	100%

The AST pattern of Escherichia coli showed that it is 100 % sensitive to Carbapenems and Ceftazidime-Avibactam

Table 8:

Antibiotic	Percentage of sensitivity (%)
Ampicillin	0%
Cephalosporin	0%
Nitrofurantoin	0%
Aminoglycoside	0%
Carbapenem	0%
Fluoroquinolones	0%
Ceftazidime-Avibactam	50%

Acinetobacter species that were isolated from the urine samples showed pan drug resistance. Even sensitivity towards Ceftazidime-Avibactam was lower than other isolated gram negative bacteria.

Table 9:

Antibiotic	Percentage of sensitivity (%)
Linezolid	100%
Vancomycin	100%
Nitrofurantoin	16.66%
Teicoplanin	83.33%
Penicillin	0%
Fluoroquinolones	33.33%
Tetracycline	33.33%

Staphylococcus aureus isolated from these urine samples were found to be sensitive to Linezolid and Vancomycin completely. Rather Sensitivity towards Penicillin was found to be nil.

DISCUSSION:
Catheter associated urinary tract infections are the most common nosocomial infections. They are the common cause for secondary bloodstream infections. 3-10% of the patients in the long term care facilities are managed with chronic indwelling catheters.[4,5] Risk factors for CAUTI include age, female gender, diabetes and prolonged catheterisation time.[6]

Our study shows that CAUTI is significantly more in females around the age group of 60-90 years. In general women have a higher risk of UTI s than men, probably due to short distance of urethra from the rectum.[7]

Presence of Diabetes mellitus is a significant comorbidity associated with CAUTI.[8] Other significant comorbidities that are found to be associated with CAUTI are hypertension followed by chronic kidney disease.

Prolonged catheterization adds to the risk factor of CAUTI.[9] The duration of catheterisation is the most important factor in the development of infection.

CAUTI in the Intensive Care Units are associated with increased lengths of stay in hospitals, higher expenditure on healthcare and antibiotic over use. [10,11]

Laboratory investigation in our study showed that Klebsiella pneumoniae was the predominant organism isolated. This is in accordance with a study done by Saleem et al. where Klebsiella pneumoniae was the predominant isolate.[12]

Among the gram-positive organisms, the percentage of Staphylococcus aureus isolated was 9%. This is also in accordance with the study done by Vinoth et al. where the percentage of Staphylococcus aureus was 6%.[13]

Klebsiella isolated was found to be resistant to most drugs, only being sensitive to Ceftazidime-Avibactam and Carbapenems.

In a study done by Mario et al. Ceftazidime-Avibacatam was an important option for treating Klebsilella infections even when used alone.[14]

Acinetobacter species isolated were highly drug resistant, some being pan resistant.[15]

In this study, Staphylococcus aureus isolated was also found to be drug resistant, mostly being sensitive to Vancomycin and Linezolid.[16]

The cornerstone of the treatment of CAUTI is antibiotics. However, the abiotic surface of the catheter is subject to biofilm formation and thus often resistant to the penetration of antibiotics.

Furthermore, prolonged antibiotic treatment alters the normal flora and helps in the colonisation by resistant organisms.

Pili, adhesive virulence associated factors that contribute to antibiotic evasion also helps in colonisation of bacteria.[17]

In CAUTI, the infection may be initiated upon bacterial adherence to the catheter with formation of a biofilm.[18]

Biofilms allow bacterial evasion of antibiotics and persistence of infection.[19]

Biofilms act as nidus for microbial seeding of the urinary tract and are important in the pathogenesis of CAUTI.

This rise in extreme drug-resistant strains has been accompanied by an alarming rise in the mortality of resulting infections.

Furthermore, the increasing number of CAUTI in critical care units is mainly because of not adopting meticulous aseptic precaution during catheter insertion, infrequent change of catheter and improper catheter care.[20]

There are multiple interventions that reduce the risk of CAUTI.[21]

The duration of catheterisation is the most important factor in the development of infection. Thus, the most important intervention is to minimize the use of indwelling catheters and remove them as soon as it is medically feasible.

CONCLUSION:

Catheter associated urinary tract infection is one of the most common and serious hospital acquired infection. Prolonged indwelling catheter along with other comorbidities like Diabetes mellitus, hypertension, etc contribute to the increased morbidity. Organisms causing CAUTI are generally highly resistant to antibiotics, hence difficult to treat.

Rampant antibiotic abuse, if can be controlled by proper antimicrobial stewardship, then the development and proliferation of resistant organisms can be eliminated.

Adherence to infection control programme, regular monitoring of antibiotic susceptibility, evaluation and enforcement and periodic review of the antibiotic policy of the hospital, encouragement of rational antibiotic usage well reduce the rates of acquiring nosocomial infections and development of bacterial resistance.

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