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Research Article

Bacteriological Profile of Catheter Associated Urinary Tract Infection

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Abstract

Introduction: Catheter-associated urinary tract infection (CAUTI) is one of the most common causes of hospital-acquired infections. Among UTIs acquired in the hospital, approximately 75% are associated with a urinary catheter. CAUTI is associated with major morbidity and can lead to genitourinary complications.

Materials and Methods: 300 catheterized urine samples received in the bacteriological laboratory during the study period were processed as per the standard bacteriological procedures.

Results: Out of 300 samples from patients showing signs and symptoms of CAUTI included in our study a total of 76 strains were isolated, the isolates were identified based on culture characteristics, Gram's stain and biochemical reactions and were subjected to antimicrobial susceptibility testing.

Conclusion: In the present study, we found that Escherichia coli was the major organism for infection and was susceptible to Colistin followed by Meropenem, Imipenem and by other antibiotics, in that order.

Keywords: CAUTI; HAI Bacteriological Profile

Introduction

CDC (Centers for Disease Control and Prevention) defines Urinary tract infection (UTI) is an infection involving any part of the urinary tract including signs and symptoms such as dysuria, urinary urgency, and frequency, flank pain, fever (>38°C), suprapubic tenderness [1]. A urinary tract infection (UTI) is an infection in any part of your urinary system - kidneys, ureters, bladder or urethra. Most infections involve the lower urinary tracts are bladder and urethra. Catheter-associated urinary tract infection is one of the most common causes of hospital-acquired infections [2]. It is defined by the Centers for Disease Control and Prevention (CDC) as any urinary tract infection in a patient who had an indwelling catheter in place at the time of or within 48 hours before the onset of infection [3]. The urinary tract is the commonest site of nosocomial infections, accounts for more than 80% of infections [4]. Almost 40% of all healthcare-associated infections, are UTI out of these, 80% involve catheter-associated urinary tract infections [5]. Microbiological profile and antimicrobial sensitivity pattern of CAUTI vary considerably between regions and from time to time. Multiple risk factors like quality of aseptic technique, duration of catheterization, hand hygiene and care of catheter can affect the occurrence of CAUTI [3]. CAUTI can range from asymptomatic bacteremia urinary tract infection to symptomatic urinary tract infection [6]. Among organisms causing CAUTI, *Escherichia coli, Klebsiella, Enterococci, Enterobacter and Proteus* are common pathogens that colonize urinary catheters. *Pseudomonas aeruginosa, Staphylococcus aureus, Acinetobacter* are environmental organisms causing healthcare-associated CAUTI, due to inadequate aseptic precautions during insertions and maintenance of urinary catheters by health care workers [6]. It is associated with major morbidity and

can lead to genitourinary complications such as pyelonephritis, cystitis, prostatitis, epididymo-orchitis and other systemic complications such as vertebral osteomyelitis, septic arthritis, endocarditis, endophthalmitis and meningitis [4].

Materials and Methods

This study was conducted in the Department of Microbiology, School of Medical Science and Research, Sharda Hospital and Sharda University, Greater Noida. This study was conducted for a period of 6months (1 May - 31 October). 300 catheterized urine samples were received in the bacteriological laboratory during the study period. The specimens were processed as per the standard bacteriological procedures available [7]. These were immediately cultured upon arrival in the laboratory. In the case of undue delay, the samples were stored at 4°C.

Direct smear examination: Gram Staining is the first and foremost step for bacterial identification. It gave an idea of whether the bacteria were gram-positive or gram negative [8].

Urine culture: The culture media used were Cystine-Lactose-Electrolyte-Deficient Agar (CLED). The media was made and sterilized at 121°C for 15 minutes at a pressure of 15 psi in an autoclave as per manufacturer's instructions. After inoculation, the plates were incubated aerobically at 37°C for 24hrs for bacterial growth.

Incubation of culture media: For incubation Bacteriological Incubator was used, which helps to grow and maintain bacteriological cultures at 37°C [8].

Identification of bacterial pathogens: Preliminary identification of bacteria was based on the colony characteristics of the organism that is colonial morphology, changes in the physical enzyme activities of the organisms and Gram Staining. Isolated colonies were sub-cultured on nutrient agar for performing the biochemical tests. All isolates exhibiting ambiguous taxonomic classification were confirmed by the VITEK 2-compact system (BioMerieux, France) following the manufacturer's instructions.

Automated systems for bacterial identification: VITEK 2 is an automated system used for identification and antimicrobial susceptibility testing (AST) of bacteria and yeast [8]. Separate cards were available for gram-negative, gram-positive bacteria, fastidious bacteria and yeasts [8].

The results of identification were usually available within 4 - 6 hours and AST within 16 - 18 hours [8].

Following antibiotics were used:

- For Gram-positive organisms, susceptibility was tested against penicillin (10 units), azithromycin (15 µg), chloramphenicol (30 µg), linezolid (30 µg), tetracycline (30 µg), gentamicin (10 µg), nitrofurantoin (300 µg), erythromycin (15 µg), levofloxacin (5 µg), ciprofloxacin (5 µg) and clindamycin (2 µg).
- Gram-negative organisms were tested against ampicillin (10 µg), Amoxicillin/clavulanate (20/10 µg), ampicillin/sulbactam (10/10 µg), ceftazidime (30 µg), cefotaxime (30 µg), ceftriaxone (30 µg), cefepime (30 µg), gentamicin (10 µg), tobramycin (10 µg), amikacin (30 µg), levofloxacin (5 µg), aztreonam (30 µg), ticarcillin/clavulanic acid (75/10 µg), tetracycline (30 µg), azithromycin (15 µg), chloramphenicol (30 µg), ciprofloxacin (5 µg), cefuroxime (30 µg), meropenem (10 µg), nitrofurantoin (300 µg), piperacillin/tazobactam (100/10 µg) and imipenem (10 µg).
- *Pseudomonas* was tested against ceftazidime (30 µg), ciprofloxacin (5 µg), gentamicin (10 µg), amikacin (30 µg), piperacillin (100 µg), piperacillin/tazobactam (100/10 µg), aztreonam (30 µg), cefepime (30 µg), ciprofloxacin (5 µg), levofloxacin (5 µg), imipenem (10 µg), tobramycin (10 µg), meropenem (10 µg), nitrofurantoin (300 µg) and ticarcillin/clavulanic acid (75/10 µg).

Interpretation: After 24 hours each plate was examined and growth zones were measured to the nearest millimeter, using sliding caliber held at the back of the inverted media plate. The Petri dish was held a few inches above a black, non-reflecting background and illuminated with reflected light. The inhibition zone margins were taken as the area showing no obvious, visible growth that could be detected with the unaided eye. Faint growth of tiny colonies, detected only with a magnifying lens at the edge of the zone of inhibited growth, was ignored. The results were reported as sensitive or resistant to the agents that had been tested according to the CLSI interpretation criteria (2019).

Results

A total of 300 samples were included in our study from patients showing signs and symptoms of catheter-associated urinary tract infection. A total of 76 strains were isolated.

All the isolates were identified based on culture characteristics, Gram's stain and biochemical reactions. The isolates were subjected to antimicrobial susceptibility.

Total number of samples	300
Culture positive	76

Table 1: Distributions of culture-positive samples.

Demographic distribution of various samples collected

Out of 76 organisms, isolated 39 were from male patients and 37 were from female patients indicating higher rates of catheter-associated urinary tract infection in males than in females.

Distribution of pathogenic organisms in samples

A total number of 69 isolates were infected with bacterial infection and 7 isolates were infected with fungal infection.

Bacteriological profile of catheter associated urinary tract infection

The organisms isolated from urine samples included *Escherichia coli, Acinetobacter spp., Klebsiella spp., Citrobacter spp., Proteus spp., Staphylococcus aureus, Enterococcus spp.* and *Pseudomonas spp.*

Organisms	Number	Percentage
Escherichia coli	39	51.31
Acinetobacter spp.	6	7.89
Klebsiella spp.	2	2.63
Citrobacter spp.	7	9.21
Proteus spp.	3	3.94
Staphylococcus aureus	1	1.31
Enterococcus spp.	4	5.26
Pseudomonas spp.	7	9.21

Table 2: Bacteriological profile of catheter-associated UTI.

The type and number of isolates are shown below.

Antibiotic susceptibility pattern of CAUTI causing uropathogen

Escherichia coli

There were 4 classes of antibiotics tested for antibiotic susceptibility in Enterobacteriaceae. These included β- lactams (penicillins, monobactams, cephalosporins, and carbapenems), aminoglycosides (amikacin, tobramycin, and gentamicin), fluoroquinolones (levofloxacin) and tetracyclines. Amongst all the classes, carbapenems emerged as the most effective class of drugs against *E. coli* followed by fluoroquinolones and aminoglycosides. As an individual agent, Colistin was found to be most effective (100%), followed by nitrofurantoin (89%), meropenem (84%) and imipenem (79.48%). Ampicillin and Cefuroxime (74%) were the most resistant drugs followed by Cefepime (71%) and Norfloxacin (69%).

Antibiotics	Sensitive n (%)	Resistance n (%)
Ampicillin	10 (25.6%)	29 (74%)
Amikacin	20 (51.28%)	19 (48.71%)
Aztreonam	24 (61.54%)	15 (38.46%)
Azithromycin	27 (69.23%)	12 (30.76%)
Amoxicillin/clavulanic	27 (69.23%)	12 (30.76%)
Ampicillin/sulbactam	24 (64.10%)	16 (41.02%)
Cefotaxime	26 (66.66%)	13 (33.33%)
Chloramphenicol	26 (66.66%)	13 (33.33%)
Ceftriaxone	19 (48.71%)	20 (51.28%)
Ciprofloxacin	26 (66.66%)	13 (33.33%)
Ceftazidime	27 (69.23%)	12 (30.76%)
Cefuroxime	10 (25.6%)	29 (74.35%)
Cefepime	11 (28.20%)	28 (71.79%)
Gentamicin	25 (64.10%)	14 (35.89%)
Imipenem	31 (79.48%)	8 (20.51%)
Levofloxacin	15 (38.46%)	24 (61.54%)
Meropenem	33 (84.61%)	6 (15.38%)
Nitrofurantoin	35 (89.74%	4 (10.25%)
Norfloxacin	12 (30.76%)	27 (69.23%)
Ticarcillin/clavulanic	27 (69.23%)	12 (30.76%)
Tetracycline	26 (66.66%)	13 (33.33%)
Colistin	39 (100%)	0 (0%)
Tobramycin	24 (61.54%)	15 (38.46%)
Piperacillin/ tazobactam	23 (58.97%)	16 (41.02%)

Table 3: Antibiotic susceptibility pattern of *Escherichia coli* (n = 39).

Discussion

Indwelling urinary catheters are a routine in most urological patients. Various studies related to Catheter-Associated Urinary Tract Infections (CAUTI) have been conducted across the country, but the data remains limited. As with any medical innovation, the benefits of the catheters must be weighed against its potential adverse effects. The most common adverse effect being CAUTI. The present study highlighted the burden of CAUTI in the intensive care unit of tertiary care hospitals. In this study, out of 300 catheterized patients 76 were suspected of CAUTI and in these catheterized patients, males were more in number than the females. The occurrence of CAUTI was also more in males, that is, 39 out of 143 (51.31%) than that of female patients that are, 37 out of 156 (48.68%). In this presented study the maximum number of isolates is obtained during the

month of august that is 27 out of 76. *Escherichia coli* remains the common bacterial isolates for patients who develop symptoms of UTI in a short course catheterization, although it comprises fewer than one-third of isolates. In our study, the total no. of *Escherichia coli* isolates was 39 (51.3%) out of 69. Other *Enterobacteriaceae*, such as *Klebsiella* spp. (2.63%), *Proteus* spp. (3.94%), *Citrobacter* spp. (9.21%), *Acinetobacter* spp. (7.89%) and *Enterobacter* species, non-fermenters such as *Pseudomonas* spp. (9.21%), and gram-positive cocci that are *Staphylococcus aureus* (1.31%) and *Enterococcus* spp. (5.26%), were also isolated. *Escherichia coli* was found susceptible to Colistin (100%) followed by Nitrofurantoin (89%), Meropenem (84.6%), Imipenem (79.4%), Ciprofloxacin (66.66%). In another study by Akter T., *et al.* susceptibility of *Escherichia coli* was 89.19%, Azithromycin(89.19%), Ciprofloxacin (83.78%), which was higher than our findings and another study conducted by Bhuwan Khatri., *et al.* where found 52.4% susceptibility to Ciprofloxacin which was lower than our result [9].

Conclusion

The present study does not show any evident increase in urinary tract infections with a urinary catheter in place, irrespective of the length of time the catheter remains inserted. However, one striking feature noticed was the incidence was more in males as compared to females. Though there is no apparent reason for the upsurge in the male preponderance, it can be attributed, hypothetically, to dehydrating reasons associated with these on account of summer and the outdoor activity. In the present study, we found that *Escherichia coli* was the major reason for infection but the or-

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