Original Research Article

Bacteriological Profile of Catheter Associated Urinary Tract Infection and its Antimicrobial Susceptibility Pattern in a Tertiary Care Hospital

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Received: 25-09-2021 / Revised: 30-10-2021 / Accepted: 13-12-2021

Abstract

Introduction: Among nosocomial infections catheter associated urinary infection (CAUTI) is one of the most common infection. Uropathogens isolated from CAUTI are more multi-drug resistant than from community acquired urinary tract infection (UTI). Hence the aim of this study is to isolate uro-pathogens from CAUTI and find out antibiotic sensitivity pattern among the isolates. **Material and Methods:** This is a prospective and observational study conducted at tertiary care teaching hospital over a period of One year. Urine samples were collected from patients who were catheterized, according to CDC guidelines using sterile needle from tubing of catheter under aseptic precautions. The samples were processed in the Department of Microbiology, as per standard protocols. Uropathogens were isolated, identified and subjected to antibiotic sensitivity testing. **Results:** The present study shows the pathogens causing CAUTIs and their antibiotic susceptibility pattern. Of 200 urine samples cultured from patients with CAUTI 50 (25%) yielded growth of single organism and 150 (75%) showed no evidence of growth. Escherichia. coli 38% was the predominant pathogen followed by Klebsiella pneumoniae 30%, Pseudomonas aeruginosa 10% Staphylococcus aureus 6.0%. **Conclusion:** The result showed that the most predominant bacterial isolate causing CAUTI was E. coli. Overall, the percentage of sensitivity of Gram-negative bacteria to all antibiotics tested was relatively low, except for Amikacin, Meropenem and Imipenem which were relatively high. Gram positive cocci showed high susceptibility to Linezolid, Tigecycline and Vancomycin.

Keywords: CAUTI, Uropathogens, Sensitivity pattern.

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Introduction

CDC (Centers for Disease Control and Prevention) defines Urinary tract infection (UTI) is an infection involving any part of the urinary tract with 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 urinary system - kidneys, ureters, bladder or urethra. Most infections involve the lower urinary tracts, 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 catheter associated urinary tract infection (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 [6]. CAUTI can range from asymptomatic bacteremia urinary tract infection to symptomatic urinary tract infection [7]. 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 [8]. 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 [9-11].

Catheter-associated (CA) bacteriuria is the most common health care–associated infection worldwide and is a result of the widespread use of urinary catheterization, much of which is inappropriate, in hospitals and long-term care facilities (LTCFs). Considerable personnel time and other costs are expended by health care institutions to reduce the rate of CA infections, especially those that occur in patients with symptoms or signs referable to the urinary tract (CA urinary tract infection [CA-UTI]). In these guidelines, we provide background information on the epidemiology and pathogenesis of CA infections and evidence-based recommendations for their diagnosis, prevention and management.

Material and Methods

This is a prospective and observational study conducted at tertiary care teaching hospital over a period of One year. Urine samples were collected from patients who were catheterized, according to CDC

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guidelines using sterile needle from tubing of catheter under aseptic precautions.

Inclusion criteria: All patients who were catheterized for atleast 48 hours were included in the study.

Exclusion criteria: 1.Patients who were earlier treated with UTI were excluded.2.Patients already suffering from cystitis and prostatic enlargement.3.Patients on suprapubic catheter, nephrostomy tube and condom catheter were excluded.

Data related to socio-demographic characteristics (gender, age, residence), History included, date of admission to the hospital, date of insertion of indwelling catheter, number of days with the catheter, and clinical data such as Hematuria/dark Flank pain, urgency frequency, dysuria, abdominal discomfort and urinary incontinence and treatment data were collected by direct interview of the study participants in combination with a review of medical records. All the questionnaires were checked for accuracy and completeness. Urine samples were collected from clinically suspected cases of CAUTI in a sterile wide mouthed universal container taking aseptic precautions with a sterile disposable syringe after cleaning and clamping the catheter tube. Then the collected urine specimens were transported to Department of Microbiology Laboratory of Shri B M Patil Medical College Hospital & Research Centre, Vijayapur Urine specimens collected from catheterised patients were processed in the laboratory within 2 h of collection and specimens that are not processed within 2 h were kept refrigerated at 4 °C until analyzed.Using calibrated inoculating loop 0.001 mL of uncentrifuged, uniformly mixed, midstream urine samples were aseptically inoculated onto mannitol salt agar, blood agar and MacConkey agar.

After overnight incubation at 37 °C for 24–48 h colonies were counted to check significant growth. Colony counts yielding bacterial growth of **10^5/mL** of urine were regarded as significant for bacteriuria. All positive urine cultures with significant bacteriuria were further identified by their colony characteristics, Gram-stain, and pattern of biochemical profiles using standard procedures. *Enterobacteriaceae* were identified by H_2S production and carbohydrate utilization tests in TSI agar, motility test, urease test, oxidase, indole test, and citrate tests. The Gram-positive bacteria were identified using catalase and coagulase tests.Antimicrobial susceptibility test was performed using a modified Kirby- Bauer disc diffusion method according to Clinical and Laboratory Standards Institute (CLSI) guidelines. The following antibiotics were used: Ampicillin (AMP; 10 µg), Amikacin (AK, 30 µg), Amoxy–clav (AMC; 20/10 µg), Aztreonam (AT; 30 µg), Ceftriaxone (CTR; 30 µg), Cefotaxime(CTX; 30 µg), Ceftazidime (CAZ; 30 µg) , Gentamicin (GEN; 10 µg), Nitrofurantoin (NIT; 300 µg), Co-trimozaxole (COT; 25/125 µg), Ciprofloxacin (CIP; 5 µg), Norfloxacin (Nx; 10 µg) Piperacillin+Tazobactum (PIT; 100/10 µg) , Ceftazidime+Clavulanic acid (CAC; 30/10 µg), Imipenem (IPM; 10 µg), Meropenem (MRP; 10 µg) . Isolates were classified as sensitive, intermediate and resistant according to the standardized table supplied by CLSI 2016. Staphylococcal ATCC 25923, Escherichia coli ATCC 25922 and Pseudomonas aeruginosa 25873 were used as control strains

Statistical analysis: Data were edited, cleaned, entered and analyzed using statistical package for social science (SPSS) version 22. All characteristics were summarized descriptively. For continuous variables, the summary statistics of mean ± standard deviation (SD) were used. For categorical data, the number and percentage were used in the data summaries and diagrammatic presentation.

Result

Among 890 patients on catheter in ICU, 200 (22.4%) patients developed clinical signs or symptoms of UTI. Of 200 urine samples cultured, 50 (25%) yielded growth of single organism and 150 (75%) showed no evidence of growth.In table 1, of the 200 samples, 127 were males and 73 females which correspond to 63.5% of male and 36.5% female.

Table 1: Distribution of Gender

Sex	No. of patients	Percentage
Male	**73**	**36.5**
Female	**127**	**63.5**
Total	**200**	**100**

Table 2: Distribution of different age groups of patients

Age in years	No. of patients	Percentage
1-20	48	24.0
21-40	61	30.5
41-60	72	36.0
>61	19	9.5
Total	200	100

Table 3: Gender based distribution of various uropathogens in culture positive samples

Name of the organism	Male, n (%)	Female, n (%)	Overall, n (%)
Escherichia coli	5 (10.0)	14 (28.0)	19 (38)
Klebsiella pneumoniae	7 (14.0)	8 (16.0)	15 (30)
Pseudomonas aeruginosa	2 (4.0)	3 (6.0)	5 (10)
Acinetobacter spp.	1 (2.0)	1 (2.0)	2 (4.0)
Enterococcus faecalis	-	2 (4.0)	2 (4.0)
Proteus spp.	1(2.0)	1 (2.0)	2(4.0)
Staphylococcus aureus	1 (2.0)	2 (4.0)	3 (6.0)
Citrobacter spp.	-	2 (4.0)	2 (4.0)
Total	23(36.5%)	27 (63.5%)	50 (100%)

In table 3, the present study shows the pathogens causing UTIs and their antibiotic susceptibility pattern. Out of 50 total isolates 45were Gram negative bacilli and 5 were Gram positive bacteria Escherichia. coli 38% was the predominant pathogen followed by Klebsiella pneumoniae 30% Pseudomonas aeruginosa 10% Staphylococcus aureus 6.0%.

Table 4: Antibiotic Susceptibility pattern of Enterobacteriaceae

Antibiotic drugs	**Escherichia coli N (%)**	**Klebsiella pneumoniae N (%)**
Amikacin	10(52.63%)	8 (53.33%)
Ampicillin	3 (15.78%)	2 (13.33%)
Amoxy–clav	5(26.31%)	3 (20.0%)
Aztreonam	4(21.05%)	3 (20.0%)
Cefotaxime	4 (21.05%)	4 (26.66%)
Ceftrioxane	5 (26.31%)	5 (33.33%)
Cefatzidime	6 (31.57%)	4 (26.66%)
Ciprofloxacin	5 (26.31%)	5 (33.33%)
Cotrimoxazole	7 (36.8%)	4 (26.66%)
Gentamicin	6 (31.57%)	5 (33.33%)
Imipenem	12 (63.15%)	10 (66.66%)
Meropenem	11 (57.89%)	11 (73.33%)
Nitrofurantoin	6 (31.57%)	5 (33.33%)
Norfloxacin	6 (31.57%)	4 (26.66%)
Ceftazidime+Clavulanic acid	5 (26.31%)	6 (40%)
Piperacillin + tazobactam	9 (47.36%)	7(46.66%)

In table 4, high susceptibility of E. coli is seen to amikacin (52.63%), meropenem (57.89%) and imipenem (63.15%). Susceptibility of E. coli to Piperacillin + tazobactam was 47.36% in this investigation.

Klebsiella pneumoniae also showed a high susceptibility to amikacin (53.33%), imipenem (66.66%) and meropenem (73.33%).

Table 5: Antibiotic Susceptibility Pattern of Non - Fermenters

Antibiotics	Pseudomonas N(%)	Acinetobacter N(%)
Amikacin	3(60%)	1(50%)
Gentamycin	2(40%)	0
Ciprofloxacin	1 (20%)	1(50%)
Imipenem	4(80%)	1(50%)
Meropenem	3(60%)	1(50%)
Ceftazidime	1(20%)	0
Ceftazidime+Clavulanic acid	2(40%)	1(50%)
Piperacillin-tazobactam	2(40%)	1(50%)
Colistin	4(80%)	2(100%)

Among the non fermenters Pseudomonas aeruginosa(Table 5) showed high susceptibility to Amikacin (60%), Meropenem (60%), Imipenem (80%) and Colistin (80%). Acinetobacter spp showed 100% susceptibility to colistin.

Table 6:Antibiotic Sensitivity Pattern of Gram Positive Cocci

Antibiotics	Enterococcus spp N(%)	Staphylococcus spp N(%)
Ciprofloxacin	0	1(33.33%)
Nitrofurantoin	1(50%)	2(66.66%)
Cotrimoxazole	1(50%)	1(33.33%)
Cefuroxime	1(50%)	1(33.33%)
Amoxy–clav	1(50%)	1(33.33%)
Gentamycin	1(50%)	1(33.33%)
Norfloxacin	1(50%)	1(33.33%)
Linezolid	2(100%)	3 (100%)
Penicillin	0	0
Tetracycline	1(50%)	1(33.33%)
Tigecycline	2(100%)	3(100%)
Vancomycin	2(100%)	3(100%)

Among the gram positive cocci (Table 6), Enterococcus spp showed 100% susceptibility to Tigecycline & Vancomycin. Staphylococcus aureus also showed 100% susceptibility to Linezolid, Tigecycline & Vancomycin.

Discussion

Indwelling urinary catheters are a routine in most in-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 a tertiary care hospitals. The occurrence of CAUTI was more in females, that is, 127 out of 200 (63.5%) than that of male patients that are, 73 out of 200 (36.5%).

Though UTI can be caused by both Gram-negative and Gram-positive bacteria, Gram-negative bacteria are the most common cause of the infection, because the agents are the normal constituent of the normal intestinal microbiota [12]. Acquisition of UTI starts with periurethral contamination by uropathogens inhabiting in the gut, followed by colonization of the urethra and successive migration of the pathogen to the bladder [13].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 shows the pathogens causing CAUTIs and their antibiotic susceptibility pattern. Escherichia. coli 38% was the predominant pathogen followed by Klebsiella pneumoniae 30% Pseudomonas aeruginosa 10% Staphylococcus aureus 6.0%, This predominance might be due to their unique structures such as flagella and pili, which help for their attachment to the uroepithelium and increases risk for infection [14].Enterobacteriaceae showed high resistance to commonly used antimicrobials like Gentamycin, Ceftriaxone, Ofloxacin, ciprofloxacin and but showed high susceptibility to Amikacin, imepenem, Meropenem. In our study, both the pseudomonas as well as Acinetobacter were multidrug resistant. They were resistant to commonly used antibiotics like Ciprofloxacin, Gentamicin, Ceftazidime, Ceftazidime+Clavulanic acid and Piperacillin-Tazobactam. Pseudomonas is highly sensitive to Amikacin(60%), Meropenem(60%), Imipenem(100%), Colistin (100%) whereas Acinetobacter is maximally sensitive to Colistin (100%). Enterococcus and staphylococcus showed high susceptibility to Tigecycline, Vancomycin and Linezolid.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. found 52.4% susceptibility to Ciprofloxacin which was also higher than our result [15]. Similar percentage of Citrobacter species, E. coli species, and Klebsiella species was documented in Nigeria, 10.7%. 16] A study in Bangladesh reported the same prevalence of E. coli, 63.3% of the total Gram-negative bacterial isolates [17]. bout 14/19 (73%) of the E. coli isolate and 8/15 (53.33%) of and Klebsiella pneumoniae were isolated from females. This might be due to poor hygienic conditions, the proximity of anal and urethral openings, and relatively wide urethra [18]. All Gram-negative bacterial isolates were resistant to Majority of the drugs. The reason may be due to the continuous use of these drugs for many years, easily availability, self-prescription, the tendency of patients using relatively cheaper antibiotics for all types of infection, and misuse. This might be due to the unavailability of this drug in the area. Another reason might be due to the gradual increase of drug resistance/ selective pressure of bacteria to the drug /mutation, or the difference in antibiotic practices in the study area. The reason for the effectiveness of this drug might be, due to the nature of having multiple mechanisms and site of actions of the drug with a non-specific blockage of protein synthesis limited access to the drug, and narrow-spectrum nature of the drug. However, about 71.4% resistance rate was documented in Hawasa [19]. Higher resistance to this antibiotic is perhaps due to its wrongly usage as an empirical therapy. Although antimicrobial resistance comes primarily as a result of selective pressure on susceptible microbes by the use of therapeutic agents, there are also further multiple factors for the spread of resistance. Using broad-spectrum agents, easy availability of antimicrobials in non-controlled pharmacy, sub-standard/poor drug quality, treatment termination, and over-prescription due to a poor diagnostic set-up or fear of loss of followup are among common factors enhancing antimicrobial resistance [20]. The emergence of resistant strains among uropathogens are alarmingly increasing with different resistance patterns. Acquisition of resistance might be either mutational (changing the target site of a bacteria within its genetic material) or acquisition of new genetic material from other bacteria. [21]In this study, associated factors were also determined. Infections can be attributed to two common enhancing factors: ascending of identical urethral microbiota, particularly uropathogenic E. coli to the bladder and/or untreated chronic/persistent bladder infection resulted from either ascending or bloodstream infections [22]. This fact is supported by a study done in Denmark, and it depicted that 77% of recurrent UTIs have resulted from infection with identical uropathogenic E. coli strains [23]. Adhesion structures like P and type 1 pili may help E. coli for progression to the bladder [24]. Having facultative intracellular multiplication in uroepithelial cells helps E. coli to escape from being killed by humoral immunity and antimicrobial agents. This multiplication takes place to a certain extent and forms loose colonies and escapes out to the lumen of the bladder.However, some of the bacterial colonies remain intracellularly and can be a reservoir for persistent infection [25].

Conclusion

The result showed that the most predominant bacterial isolate was E. coli followed by Kbelsiella pneumoniae. Overall, the percentage of sensitivity of Gram-negative bacteria to all antibiotics tested was relatively low, except for amikacin, meropenem and imipenem which were relatively high. Gram positive cocci showed high susceptiblity to Linezolid, Tigecycline and Vancomycin.

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Conflict of Interest: Nil
Source of support:Nil