

## Clinico-Microbial Analysis of Catheter Associated Urinary Tract Infection

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Received: 20-03-2023 / Revised: 16-04-2023 / Accepted: 11-05-2023

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Conflict of interest: Nil

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### Abstract

**Background:** The present study aimed to find out the factors responsible for catheter associated urinary tract infection (CA-UTI) and most effective antibiotic for empirical treatment of CA-UTI. Catheter-associated urinary tract infection (CA-UTI) is the most common nosocomial infection. The etiological agents of which may be varied depending on exposure of antibiotics. Advancing age, diabetes mellitus, duration of catheterization are the risk factors. Complications include prostatitis, epididymitis, pyelonephritis, and septicemia in high-risk patients, adding to hospitalization and morbidity. With this background the present study was undertaken.

**Material & Method:** In this institutional based cross-sectional study, consecutive urine samples of 371 catheterized patients admitted in the hospital were included. They were processed by standard microbiological procedures. Isolated organisms were speciated, and antibiotic susceptibility performed as per standard guidelines.

**Result:** The prevalence of catheter associated UTI was 40.43%. Out of 371 cases, 150 were culture positive in which *Escherichia coli* (46/165) was the predominant isolate followed by *Klebsiella* spp. (39/165), *Pseudomonas* spp. (35/165), *Enterococcus* spp. (19) and *Staphylococcus aureus* (7/165), and *Candida glabrata* (4/165). Nitrofurantoin and Piperacillin +Tazobactam were the most effective first line antibiotics.

**Conclusion:** Development of CAUTI is common in ICU patients. Emphasis should be placed on good catheter management and reducing the duration of catheterization rather than prophylaxis in order to reduce the incidence. Culture and susceptibility testing play a vital role in the management if UTI occurs.

**Keywords:** Antibiotic Resistance, Intensive Care Unit, Catheter-Associated; Urinary Tract; Healthcare Associated Infections.

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## Introduction

Catheter-associated urinary tract infection (CA-UTI) is the most common hospital acquired infection. The etiological agents of CA-UTI may vary depending on environmental conditions. The predisposing factors include old age, co morbidities like diabetes mellitus, and duration of catheterization. If not treated CA-UTI may cause some complications like prostatitis, epididymitis, cystitis, pyelonephritis, and septicemia [1]. Many of these organisms causing CA-UTI are part of patient's endogenous intestinal normal flora but they can also be acquired from the hospital environment [2]. The exogenous hospital environmental micro-organisms are responsible for almost 20-30 percent of nosocomial infection in medical or surgical Intensive Care Unit (ICU) [3,4]. Various hospital-based studies have reported three folds increase in mortality due to nosocomial UTI [5,6]. Catheter-associated UTI (CA-UTI), increases hospital stay, mortality rate and also cost of the treatment [7,8]. There are various indications of indwelling urinary catheterization in the management of critically ill patients. Various micro-organisms are introduced into the urethra while the catheter is inserted through the sheath of exudates surrounding the catheter either from the tube or collection bag. Bacteriuria and candiduria develop in up to 25 percent of patients requiring urinary catheter for more than 7 days [9]. CA-UTIs can be avoidable if recommended infection-prevention practices are implemented [10]. Guidelines for the prevention of catheter-associated UTIs recommend appropriate use, aseptic insertion, proper maintenance, and timely removal of indwelling urinary catheters, as well as use of established practices such as hand hygiene [11-13]. All health care personals should abide by standard guideline to reduce the incidence of

CAUTI, thus contributing to the improved safety of patients and lower the costs of treatment [14]. With this background, we are willing to undertake present study to provide an insight regarding the prevalence of CA-UTI and its etiologic agents in hospitalized patients at Rama Medical College Hospital, Kanpur. This study will serve as a guide to the clinical practitioner in the selection of specific antimicrobial agents for prophylaxis and empiric therapy of CA-UTI. It will also provide a scope for determining any non-compliance with the preventive recommendations, implementation of the antibiotic policy and improvising the infection control policy.

## Aim

To find out etiological agents associated with UTI in catheterized patients and their antibiotic susceptibility pattern.

## Material & Methods

The study was carried in Department of Microbiology at Rama Medical College Hospital & Research Centre Kanpur. Total 371 patients with indwelling urethral catheter inserted under aseptic condition for various Medical and surgical conditions were studied. Samples were collected over a period of 1-year from July 2022 to April 2023 from patients admitted to the intensive care unit (ICU), and from the patients who were on urinary catheter insertion for >48 hours were included in this study. [15]

The patients were screened for inclusion and exclusion criteria. The criteria being considered are as follows:

**Inclusion criteria:** Patient's above 15 years of age indwelling catheterized & admitted to various wards and ICUs were included.

**Exclusion criteria:** Patients on steroidal and second line antibiotic therapy will be excluded.

Demographic data, clinical/ treatment history, number of days with the catheter were collected from the patients in whom CAUTI is suspected.

The urine samples were collected following aseptic procedure and subjected to wet mount for evaluating the presence of pus cells, epithelial cells, RBCs and microorganisms. Semi-quantitative culture of urine samples was done by calibrated loop method on CLED agar (cystine–lactose–electrolyte - deficient agar and incubated in aerobic conditions at 37°C for 24 hours. The bacterial colony count >10<sup>5</sup> colony forming units (CFU)/mL with no more than two species of microorganisms were considered as positive for CAUTI and cultures showing growth of more than two types of bacteria were considered contaminated. The antimicrobial sensitivity testing for all the isolates were done on Muller Hinton agar (Himedia, Mumbai) by Kirby-Bauer disc diffusion method McFarland 0.5 standard. The antibiotic susceptibility test result was interpreted as per CLSI 2022 guidelines. Data was recorded on a predesigned study questionnaire and managed on an Excel spreadsheet.

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#### **Ethical consideration:**

Ethical clearance was obtained from ethical committee.

#### **Result**

Out of 371 cases, 150(40.43%) cases were culture positive. Catheter associated UTI was more in females 79(52.66%) belonging to the 26-35 years of age group

followed by 15-25 years of age (table no.3). In male's-catheter associated UTI were common in 66-75 years of age group followed by 56-65 years (table no.4). *Escherichia coli* was the most common isolated organism in female patients whereas *Klebsiella* spp. was most commonly isolated in the male patient (graph no. 2).

Out of 150 positive cases, *Escherichia coli* (46) was predominant followed by *Klebsiella* spp. (39), *Pseudomonas aeruginosa* (35), *Enterococcus faecalis* (19), *Staphylococcus aureus* (7), *Candida* spp. (4) (graph no. 1)

Among *E. coli* isolates, piperacillin–tazobactam, polymyxins showed 100% sensitivity, gentamycin (93.47%), imipenem (93.47%), meropenem (93.47%), nitrofurantoin (95.65%), and tigecycline (91.30%). *Klebsiella* spp. shows 100% sensitivity to polymyxin, colistin, imipenem, meropenem, piperacillin-tazobactam followed by amikacin (92.30%), gentamycin (94.87%), nitrofurantoin (97.43%).

*Pseudomonas aeruginosa* is 100% sensitive to amikacin, polymyxin, colistin, followed by gentamycin (97.14%), meropenem (94.28%), imipenem (94.28%), norfloxacin (97.14%), nitrofurantoin (97.14%), piperacillin-tazobactam (97.14%) (graph no. 3).

In case of *Enterococcus faecalis* vancomycin, high-level gentamycin, high-level streptomycin showed 100% sensitivity followed by teicoplanin (94.73%), linezolid (89.47%), norfloxacin (89.47%), nitrofurantoin (84.21%).

In case of *Staphylococcus aureus* linezolid, vancomycin, showed 100% sensitivity followed by gentamycin (85.71%), amikacin(85.71%), nitrofurantoin (85.71%) (graph no. 4).

**Table 1: Gender distribution of suspected cases of CA-UTI**

Gender	No. of suspected cases	Percentage
Male	163	43.93%
Female	208	56.06%

**Table 2: Distribution of culture positive and culture negative samples**

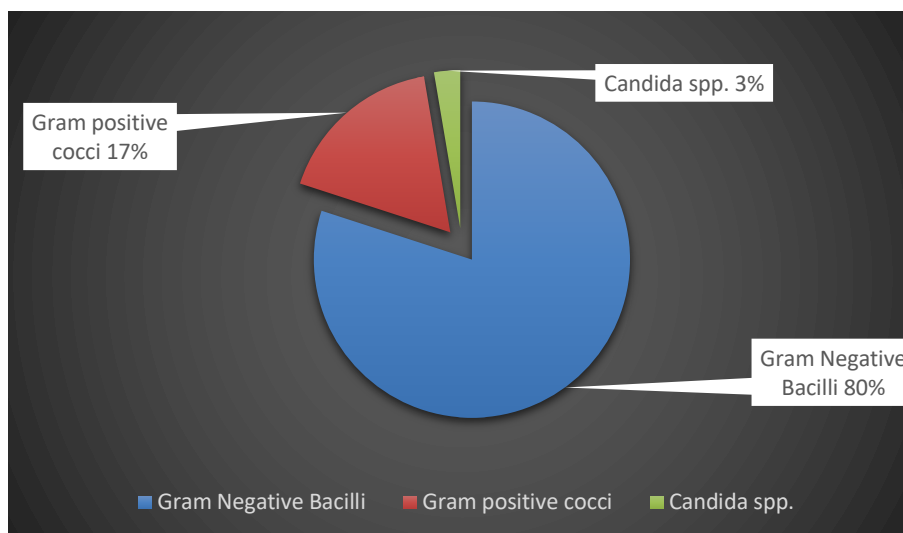
No. of positive culture cases	150 (40.43%)
No. of negative culture cases	221 (59.56%)
Total no. of sample	371 (100%)

**Table 3: Age wise distribution of culture positive samples of Female patients**

Age group (in years)	Total No. of positive sample of Female patients(n=208)
15 – 25	22(27.84%)
26 – 35	<b>35(44.30%)</b>
36 – 45	9(11.39%)
46 – 55	5(6.32%)
56 – 65	3(3.79%)
66 – 75	4(5.07%)
ABOVE 75	1(1.28%)

**Table 4: Showing age wise distribution of positive samples of Male patients**

Age group (in years)	Total No. of positive sample of Male patients
15 – 25	3(4.22%)
26 – 35	5(7.04%)
36 – 45	2(2.82%)
46 – 55	9(12.68%)
56 – 65	17(23.94%)
66 – 75	<b>32(45.07%)</b>
ABOVE 75	3(4.23%)



**Figure 1: Distribution of culture positive organisms isolated in CAUT**

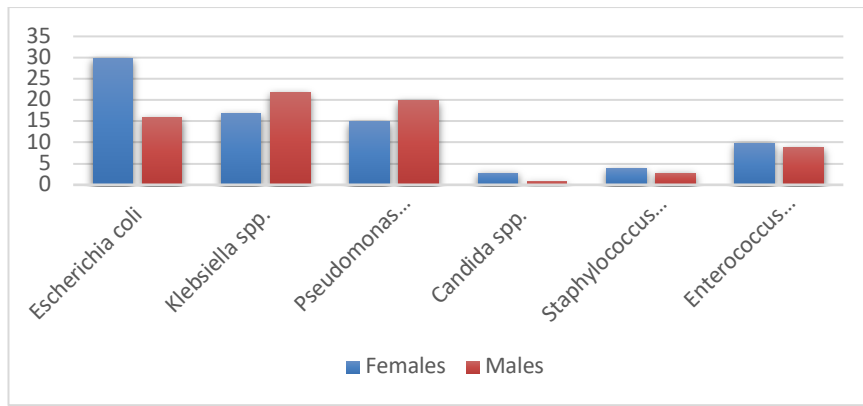


Figure 2: Gender wise distribution of isolated Organism obtained in CAUTI

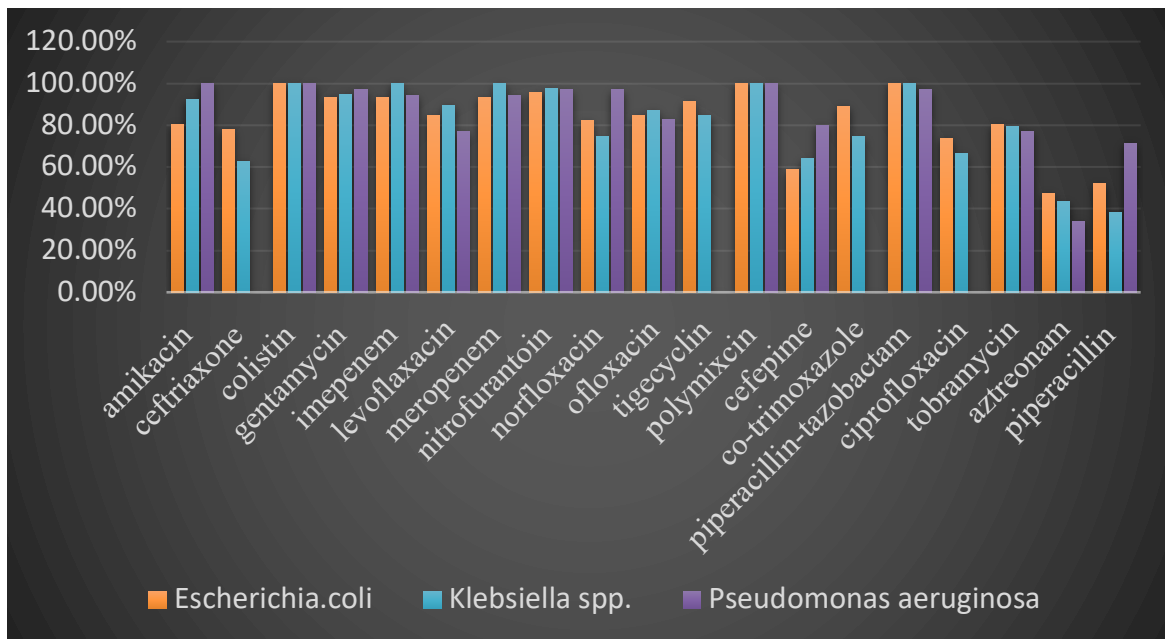


Figure 3: Antibiotic Susceptibility Pattern of Gram – Negative Bacilli

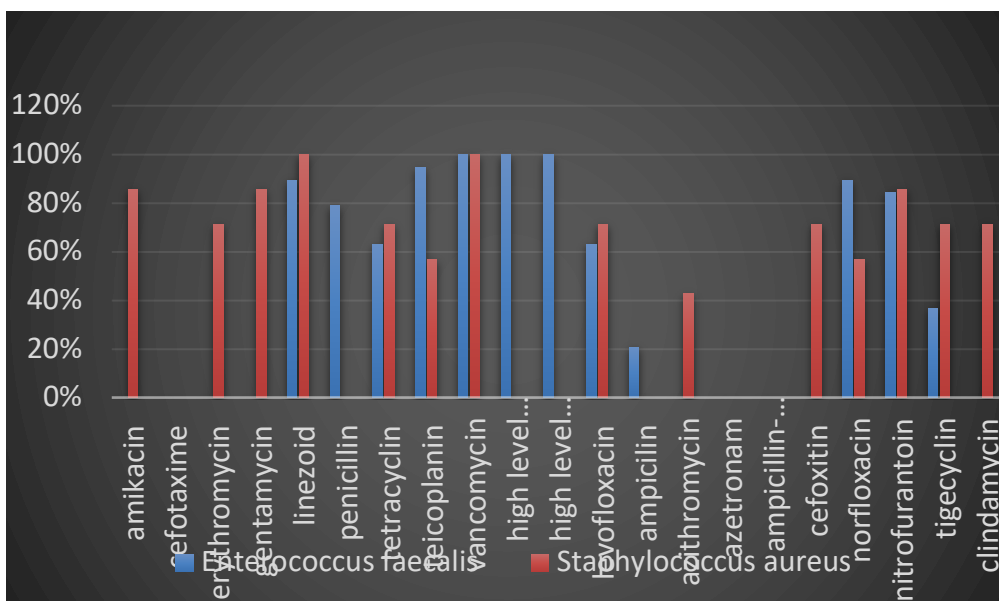


Figure 4: Antibiotic Susceptibility Pattern of Gram-Positive Cocci

## Discussion

CAUTI is the common health acquired infection among ICU patients. Risk factors associated with the development of CAUTI include prolonged duration of urinary catheterization, lengthy hospital stay, prior systemic antimicrobial therapy and co-morbid condition in critical care patients [18]. The impact of CAUTI varies among patients based on their age, immune status and socio-economic status. Common sign and symptoms include fever, dysuria rigors [19] lower abdomen pain, urgency, frequency, micturition, burning, anorexia.

In the present study females (52.66%) were more affected than males. The finding is in accordance with Karkee Prahamsa et al [20] (51.47%) and in contrast with Vinoth M et al[21] in which males were affected than females (48%).

In the present study, prevalence of CA-UTI was 40.43%, this finding is comparable to the study conducted by Sreedevi Hanumantha et al[19] in which CA-UTI was 42.2% contrasting to Muhammad Mukhitkazi et al(22) (2.46%), Priya Datta et al(10.75%) and Karkee Prahamsa et al[20](12.5%).

The common isolates obtained in the present study are *Escherichia coli*, *Klebsiella* spp., *Pseudomonas aeruginosa*, *Enterococcus faecalis*, *Staphylococcus aureus*, *Candida glabrata*.

Which is are comparable to Muhammad Mukhitkazi et al[22] (*Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Enterococcus faecalis*, *Candida* species). & Karkee Prahamsa et al[20], (*Escherichia coli*, *Klebsiella pneumoniae*, *Enterococcus* species). & Priya Datta et al[23] (*Pseudomonas aeruginosa*, *Enterococcus faecalis*) and contrasting to Sreedevi Hanumantha et al[19], who isolates *Citrobacter* species as the commonest isolate.

## Conclusion

In this study we concluded that CA-UTI is more common in long term catheterized patients and in patients having comorbidities like diabetes mellitus. Proper catheter care played an effective role in prevention of CA-UTI as CA-UTI was observed less in high catheter care compliance rate. CA-UTI was more in males in comparison to females in the present study which may be due to co – morbidities associated to male.

## Limitations Of The Study:

In present study we could not recorded the clinical outcome of the treatment due to lack of time. In most of the cases CA-UTI was highly suspected but culture was negative. In such condition we could take the help of some sepsis biomarkers like CRP and PCT but it could increase the cost of the study.

**Acknowledgement:** We deeply acknowledge Principal Sir Dr. (COL) B.K Prasad, Dr. Sujatha Ma'am (HOD & Professor) Department of Microbiology) & Guide Dr. Desh Nidhi Singh (Professor of Department of Microbiology) RMCH & RC, Kanpur UP INDIA to provide facilities for this research.

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