

ORIGINAL ARTICLE

CATHETER ASSOCIATED URINARY TRACT INFECTION DUE TO PROLONGED CATHETERIZATION AND ITS CAUSATIVE UROPATHOGENS

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Background: The presence of a urinary catheter is the most important risk factor for bacteriuria and Catheter-associated urinary tract infection (CA-UTI). The objective of this study was to determine the frequency of catheter associated urinary tract infections and most common causative uropathogens due to prolonged catheterization. **Methods:** This descriptive, cross-sectional study was carried out in the Department of Microbiology, Abbas Institute of Medical Sciences, Muzaffarabad from January to December 2019. Total 270 patients of critical patient care areas and wards with age range 18–70 years were selected. Patients suffering from UTI prior to catheterization, suffering from complicated UTI, and already catheterized at the time of admission were excluded. Urine samples were collected from the distal end of urinary catheters under strict aseptic techniques. Samples were cultured and growing microbes identified on the basis of gram stain, colony morphology, and biochemical reactions. **Results:** Catheter associated urinary tract infections due to prolonged catheterization of patients for more than 48 hours were found in 143 (52.96%) patients. The frequency of common causative uropathogens was: *E. coli* in 67 (47.18%), *Klebsella* spp in 15 (10.56%), *Proteus* spp in 10 (7.04%), *Pseudomonas* spp in 8 (5.63%), *Staphylococci* in 14 (9.86%), *Enterococci* in 13 (9.15%) and other organisms in 15 (10.56%) patients. **Conclusion:** The frequency of catheter associated urinary tract infections with *E. coli* as the bacterial pathogen causing UTI due to prolonged catheterization is quite high.

Keywords: Catheter associated urinary tract infections, CA-UTI, *E. coli*, duration, catheterization

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INTRODUCTION

Urinary tract infections (UTI) are the most commonly acquired bacterial infections and they account for an estimated 25–40% of the nosocomial infections. The 70–80% of these infections are attributable to use of an indwelling urethral catheter.¹ As biofilm ultimately develops on indwelling catheters, the major determinant for development of bacteriuria is duration of catheterization.² The risk of urinary tract infection increases as the duration of catheterization increases. A patient with an indwelling urinary catheter has a 5% daily risk for development of urinary tract infection (UTI).³ Catheter associated UTI (CA-UTI) occurs when urethral catheters inoculate organisms in the bladder and cause colonization due to providing a medium for bacterial adhesion and mucosal irritation. Urinary catheter is the most important risk factor for bacteriuria.⁴ Catheter acquired urinary infection is a source for about 20% of episodes of healthcare acquired bacteraemia in acute care facilities, and over 50% in long term care facilities.² Catheter associated bacteriuria is the most common health care-associated infection worldwide and accounts for up to 40% of hospital-acquired infections.^{5,6} Most hospitalized patients are catheterized for only 2–4 days, but many are

catheterized for longer durations.⁷ About 5% to 10% of nursing home residents are managed with urethral catheterization, in some cases for years.⁸ The bacteria may gain entry into the bladder during insertion of the catheter, during manipulation of the catheter or drainage system, around the catheter, and after removal.⁹ The most frequently isolated uropathogen is *E. coli* spp (31.7%).¹⁰ Catheter associated urinary tract infections are associated with increased morbidity, mortality and adds 1–3 days of extra hospital stay.¹¹

Implementation of an evidence-based ‘UTI bundle’ focused on the avoidance of catheter insertion, maintenance of sterility, product standardization, and early catheter removal can significantly decrease catheter-associated UTIs.¹² The rationale of this study was to determine the prevalence of catheter associated UTI in our population and emphasize the need to improve infection control practices for proper management of catheterized patients in hospitals.

METHODOLOGY

This descriptive, cross-sectional study was carried out in the Department of Microbiology, Abbas

Institute of Medical Sciences, Muzaffarabad from January to December 2019. Non-probability, consecutive sampling technique was used. Patients admitted in critical patient care areas and wards with age range 18–70 years were enrolled in the study after informed consent. Patients with underlying renal pathology or chronic renal disease, antimicrobial therapy and already catheterized at the time of hospital admission were excluded from the study. A total 270 patients of critical patient care areas and wards were included.

Two sets of urine samples were taken from every patient. First sample was taken to rule out any previous UTI on day zero, i.e., the day when catheter was inserted. Second sample was taken after 48 hrs from patients suspected of having CA-UTI with development of symptoms like fever and suprapubic tenderness. Urine samples were collected from the distal end of urinary catheters under strict aseptic techniques with sterile syringes, transferred to sterile urine containers, and sent to laboratory immediately.

Wet preparation of urine was examined microscopically for pyuria. Specimens were inoculated on Cystine Lactose Electrolyte Deficient (CLED) media (Oxoid CM0301) with filter paper strips that carry known amount of urine (0.2 uL). Culture plates were inoculated aerobically at 37 °C for 18–24 hours. Next day, plates were checked for growth of any uropathogen. In case of significant growth, i.e., colonies >15, the isolate was identified on basis of colony morphology, Gram staining, and biochemical reactions like catalase, coagulase, DNase (in case of gram positive organisms) and oxidase test and Analytical profile index (API) 20E strips (bioMerieux.In) in case of gram negative organisms. Growth was observed and examined for 48 hrs. For the Quality Control, *E coli* ATCC 51153, *Staph aureus* ATCC 51153 and *Pseudomonas aeruginosa* ATCC 27858 bacterial strains were used. The Kirby-Bauer disc diffusion method was used to determine the antimicrobial susceptibility of isolates on Muller-Hinton agar using 0.5 McFarland standard, and disposable sterile swabs. Antimicrobial susceptibility and resistance was determined by isolate growth zone diameter according to Clinical and Laboratory Standards Institute (CLSI) guidelines.

Data was entered and analysed on SPSS-20. Mean±SD were calculated for quantitative variables (age and duration of catheterization). Frequency and percentages were calculated for qualitative variable like gender, CA-UTI and bacterial uropathogens. Effect modifiers like age, gender, duration of catheterization were controlled through stratification. Post stratification Chi-square test was applied and $p \leq 0.05$ was taken as significant.

RESULTS

In this study, a total of 270 patients were included. Age range in this study was from 18–70 years with mean age of 46.77 ± 10.32 years. Out of these 270 patients, 179 (66.30%) were male and 91 (33.70%) were females with male to female ratio of 2:1. Mean duration of catheterization was 9.61 ± 4.09 days. Frequency of catheter associated urinary tract infections due to prolonged catheterization of patients for more than 48 hours was found in 143 (52.96%) patients. The frequency of the different causative uropathogens due to catheterization is shown in Table-1. Stratification of catheter associated urinary tract infections with respect to gender is shown in Table-2.

Table-1: Frequency of common causative uropathogens due to catheterization (n=142)

| Causative uropathogens | Patients | Percentage |
|------------------------|----------|------------|
| <i>E. coli</i> | 67 | 47.18 |
| <i>Klebsiella spp</i> | 15 | 10.56 |
| <i>Proteus spp</i> | 10 | 7.04 |
| <i>Pseudomonas spp</i> | 8 | 5.63 |
| <i>Staphylococci</i> | 14 | 9.86 |
| <i>Enterococci spp</i> | 13 | 9.15 |
| Others | 15 | 10.56 |

Table-2: Gender-wise stratification of CA-UTI

| Gender | Yes | No | <i>p</i> |
|--------|-------------|------------|----------|
| Male | 100 (55.87) | 79 (44.13) | 0.180 |
| Female | 43 (47.25) | 48 (52.74) | |

DISCUSSION

Catheter Associated UTI is defined as a symptomatic patient with a urinary catheter having one or more of the following symptoms or signs, with no other recognized infection: fever (temperature >38 °C), chills, catheter obstruction, abnormal urine colour or suprapubic tenderness, with positive urine culture with no more than two pathogens isolated.¹³ Significant risk factors for CA-UTI include age, diabetes requiring insulin therapy, long hospitalization, and long duration of catheter insertion.¹⁴ The impact of a UTI on the individual can vary greatly, depending on the age, comorbidities, and socioeconomic status. Moreover, it leads to unnecessary use of antibiotics and antimicrobial resistance and longer hospital stays.¹⁵ CA-UTI is caused by instrumentation of the urinary tract and has been associated with increased morbidity, mortality, hospital cost, and length of stay.¹⁶

In this study, frequency of catheter associated urinary tract infections due to prolonged catheterization of patients for more than 48 hours was found in 143 (52.96%) patients. The most common causative uropathogens were Gram negative bacilli followed by gram-positive cocci. Our study was comparable with another study where Gram-negative

bacilli were the most common organisms (60%), followed by gram-positive cocci (36%) and then fungi (4%).¹⁷ In another study from Turkey, biofilm producer microorganisms such as *E. coli*, *Pseudomonas aeruginosa*, *Klebsiellapneumoniae*, *Proteus mirabilis* were significant cause of CA-UTI among catheterized patients.¹⁸ The findings in our study were in concordance with other studies that also reported *E.coli* as the most common prevalent organism.^{19,20} It is similar to Sayal *et al*¹⁹ who reported that predominantly Gram negative isolates are seen in patients with prolonged catheterization.

It was found that patients catheterized for prolonged periods had significantly higher incidence of CA-UTI than those with shorter duration of catheterization. Higher prevalence of UTI associated with prolonged use of catheterization was similar to findings of Bello *et al*²¹. In a study of CA-UTI in nursing home residents, carried out by Brauer *et al*, it was found that *Proteus mirabilis*, *Enterococcus* spp, and *E. coli* were the three most common organisms causing CA-UTI.²²

Another study showed CA-UTI in 68 out of 800 patients (8.5%) and the common organisms were: *Ecoli* (32.9%), *Pseudomonas* (15.1%), *Staph aureus* (12.3%), and *Candida albicans* (13.7%).²³ There may be many reasons for our rates to be on higher side, but the common reasons may be poor infection control practices and lack of policies for catheter insertion and maintenance. No strict adherence to bundle precautions to prevent UTI while insertion of urinary catheters was observed. Most of the staff is not trained for infection control practices. Moreover, there are no surveillance programs for CA-UTI and catheter use, and recommendations for quality indicators. Implementation of infection control practices, limiting placement and early removal of urinary catheters are powerful tools to improve rate of CA-UTI. Knowledge and attitude among nurses and doctors towards urinary catheterization and preventive measures related to catheter-associated urinary tract infection greatly affect the disease occurrence in patients.²⁴

CONCLUSION

Longer duration of catheterization is significantly associated with higher prevalence of CA-UTI. *E. coli* is the most common bacterial pathogen causing UTI. CA-UTI prevention guidelines for reducing use and duration of catheterization and its proper management can help to overcome CA-UTI to a great extent.

RECOMMENDATIONS

Causative organism should be identified before starting any antimicrobial therapy in catheterized

patients in order to decrease the resistance of uropathogens to antimicrobial agents.

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