https://doi.org/10.29309/TPMJ/2023.30.02.7069

The Professional Medical Journal
www.theprofesional.com
2023, Volume, 30 Issue, 02

ORIGINAL ARTICLE

Prevalence of uropathogens in catheter associated urinary tract infections and their antimicrobial susceptibility.

Muhammad Shahbaz Hussain[1], Umar Khalid Cheema[2], Shomaila Irim[3], Muhammad Sajjad[4], Mehvis Anwar[5], Shumaila Raees[6]

Article Citation: Hussain MS, Cheema UK, Irim S, Sajjad M, Anwar M, Raees S. Prevalence of uropathogens in catheter associated urinary tract infections and their antimicrobial susceptibility. Professional Med J 2023; 30(02):245-251. https://doi.org/10.29309/TPMJ/2023.30.02.7069

ABSTRACT… Objective: To assess the bacterial profile for catheter associated UTI and the antimicrobial sensitive to most commonly used antibiotics in Sheikh Zayed Hospital, Rahim Yar Khan. **Study Design:** Cross-sectional study. **Setting:** Urology Ward of Sheikh Zayed Medical College/Hospital Rahim Yar Khan. **Period:** 01 February, 2021 to 31 July, 2021. **Material & Methods:** The urine samples were collected from 100 patients. Clinical and microbiological data were analyzed from patients with CAUTI. **Results:** A total of 100 patients were included in the study in which 82 samples were positive for bacterial growth and 18 samples did not show growth. Out of 82 strains, E. coli (46) was the most frequently isolated pathogen followed by Klebsiella pneumonia (17), Pseudomonas (10), Proteus (4), Candida (3) and Staphylococci (2). **Conclusion:** Study concluded that most common cause of UTI was E. coli in catheter associated patients while the meropenem and colistin were the most sensitive drugs of choice.

Key words: Catheter, Prevalence, Susceptibility, Uropathogen, Urinary Tract Infection.

INTRODUCTION

Nosocomial infections (NIs) are the leading cause for morbidity as well as mortality throughout the globe.[1] Urinary tract is considered most frequent site of NIs.[2] The CAUTIs represent 40 percent of the whole NIs in hospital and hospice setups and establish almost 80% of nosocomial UTIs.[3-5]

As described by CDC, the CAUTI is any UTI among patients with indwelling catheter in position at the time of or in forty eight hours prior to start of infectivity with minimum one of the signs and symptoms namely fever (above 38°C), dysuria, urgency, costovertebral angle tenderness or pain, suprapubic tenderness and urine +ve culture of 10^5 or above colony-forming units per ml without >2 species of the microorganisms.[6] Presence of the indwelling catheter is requirement for CAUTI while risk of the CAUTIs differs from 3 percent to 7 percent daily. Though, utilizing catheter for >2 days could be an important factor regarding CAUTI.[7] The infectivity is noticed among 10 to 50 percent patients with temporary catheterization, however, if not treated, it can cause severe complications for example, septicemia, sepsis, pyelonephritis and bacteremia that accounts for considerable morbidity as well as mortality related to CAUTIs.[8]

The bacterial species for example, E.coli, Staphylococcus, Pseudomonas aeruginosa, Proteus vulgaris, Klebsiella, Proteaus mirabilis, fungal and enterococcal species can lead to CAUTIs.[9] E. coli is the most common isolated uropathogen responsible for 65 to 90 percent of UTIs.[10,11]

For bacteria, urinary catheters are comfortable route of admission following which they cause urinary tract infection and possible gram negative bacteraemia in hospitalized patients. The biofilms are called sessile polymicrobial groups that stick to the abiotic and bioticsurfaces and are enclosed in a self generated extracellular polymeric matrix.

1. MBBS, M.Phil (Microbiology), Professor Microbiology, Sheikh Zayed Hospital, Rahim Yar Khan
2. MBBS, M.Phil (Microbiology), Assistant Professor Pathology, Sheikh Zayed Hospital, Rahim Yar Khan
3. MBBS, M.Phil (Physiology), Master in Medical Education, Senior Medical Officer Physiology, Sheikh Zayed Hospital, Rahim Yar Khan
4. MBBS, Medical Officer Pathology, SZMC/SZH, RYK.
5. MBBS, MCPS, Demonstrator Pathology, SZMC/SZH, RYK.
6. MBBS, Senior Demonstrator Pathology, SZMC/SZH, RYK.

Correspondence Address:
Dr. Umar Khalid Cheema
Department of Pathology
Sheikh Zayed Hospital, Rahim Yar Khan.
ukcheema78@gmail.com

Article received on: 06/04/2022
Accepted for publication: 02/09/2022

Biofilms permits seepage of pathogen from the host defenses. It also boosts antimicrobial resistance because of resistant phenotype, gradual penetration and adjusted microenvironment. After attaching to the uroepithelium, biofilms can penetrate the renal tissue which may lead to the complications like pyelonephritis and prostatisis. Previous researches revels positive correlation between the duration of catheterization and biofilm formation.[12]

Antibiotics have been very effective in the management of UTI and for empirical treatment, broad-spectrum antibiotics are commonly prescribed.[13] The emergence of antibiotic resistance among urinary pathogens has been increasing worldwide and it becomes an important global public health problem especially among emerging countries.[14]

For urinary tract infection, a most favorable treatment requires knowledge regarding local epidemiology as well as antimicrobial susceptibility profiles. Resistance mechanisms have been developed by uropathogens to frequently prescribed antibiotics that limits treatment alternatives of successful therapies.[15] The current study aims to assess the bacterial profile for catheter associated UTI and antimicrobial sensitive to most commonly utilized antibiotics in Sheikh Zayed Hospital, Rahim Yar Khan.

MATERIAL & METHODS

It was a cross sectional study carried out among patients admitted in Urology Ward of Sheikh Zayed Medical College/Hospital Rahim Yar Khan. The study was conducted from February 01 to July 31, 2021. The urine samples were collected from 100 catheter associated patients. The criteria for the selection of patients was that catheter should have been passed for more than 72 hours. During six months all the urine samples of patients were collected and examined for bacterial pathogens.

After catheter insertion, urine samples were aseptically collected after 72 hour from the insertion time for baseline urine cultures and microscopic examinations. After that, urine cultures and examination were carried out daily. These subsequent urine samples were collected by aspiring urine from the rubber catheter with a sterile syringe with gauge 26 needle. 5 to 10 ml of urine were aspirated from the catheter and placed in a sterile container. Specimens of urine and catheter were placed immediately in the refrigerator. Generally the samples for gram stain and culture were processed during one hour of collection. Urine culture was prepared by inoculating 0.01ml of urine onto MacConkey agar and CLED agar with 5% sheep blood, incubated at 37°C, and examined at 24 and 48 h. Significant bacteriuria was considered when a patient had a colony count $>10^3$cfu/ml in any sample of the urine. Lower counts were accepted in catheter specimens if the organism(s) persisted and were isolated from successive specimens.[16] The organisms isolated were subjected to different biochemical and microscopic examinations for correct detection.[16] Among isolates the differences were analyzed. Standard biochemical tests were also carried out to discover the bacteria of interest.[17] Agar disc diffusion assay was utilized to ascertain the bacterial susceptibility to different antibiotics towards bacteria in vitro.[18] The zone diameters for individual antimicrobial agents were translated into susceptible, intermediate and resistant categories.[19]

The data was entered and analyzed by using SPSS version 24.0. Ethical approval was sought from Institutional Review Board (ERC47/2018).

RESULTS

Figure-1 describes that among 100 patients, 46(46.0%) were males and 54(54.0%) were females.

Table-I depicts that out of 100 specimens, 82 had growth while 18 specimens had no growth.

Table-II indicates different percentages of pathogens obtained from specimens and found that out of 82 specimens, E.coli was isolated from 46 (56.1%), followed by, Klebsiella from 17 (20.7%), Pseudomonas from 10 (12.2%), Proteus from 4 (4.9%), Candida from 3 (3.9%) and Staphylococcus from 2 (2.4%).

Table-III demonstrates that according to motility and urease tests, E.coli was found positive while according to gram staining, string and oxidase tests, E.coli was found negative. Klebshiella was found positive on string and urease tests while negative on remaining tests. Likewise Pseudomonas was found positive on motility, odxidase and urease tests while Proteus on motility, string and urease tests. Staphylococcus and Candida were found positive on gram staining only.

Table-IV exhibits that **Escherichia coli** was mostly sensitive (>85%) to Meropenem and Colistin while resistant (>60%) to Levofloxacin, Chloramphenicol and Trimethoprim.

Klebsiella pneumonia was mostly sensitive (>95%) to Meropenem and Colistin while resistant (>75%) to Levofloxacin, Moxifloxacin, Chloramphenicol and Trimethoprim.

Pseudomonas aeruginosa was mostly sensitive (>80%) to Meropenem and Colistin while resistant (>80%) to Levofloxacin and Trimethoprim.

Proteus was mostly sensitive (>75%) to Meropenem and Colistin while resistant (100%) to Ampicillin/Sulbactam, Piperacillin, Cefixime, Levofloxacin, Chloramphenicol and Trimethoprim. **Staphylococcus** was 100% sensitive to Colistin while 100% resistant to Ampicillin/Sulbactam, Piperacillin, Levofloxacin, Chloramphenicol and Trimethoprim.

Klebsiella	17 (20.7%)
Pseudomonas	10 (12.2%)
Proteus	04 (4.9%)
Staphylococcus	02 (2.4%)
Candida	03 (3.7%)
Total	82 (100%)

Growth	82
No Growth	18
Total Specimen	100

Table-I. Distribution of growth

Pathogen	No of Specimen	Percentage %
E.coli	46	56.1

Table-II. Distribution of pathogen

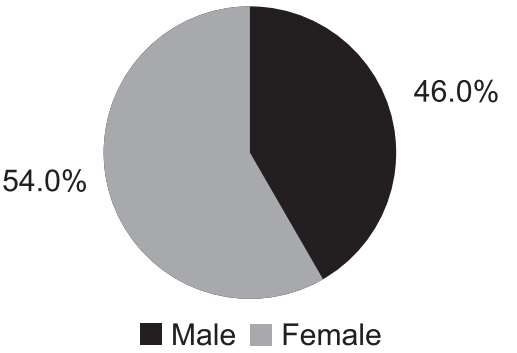

Figure-1. Distribution of gender

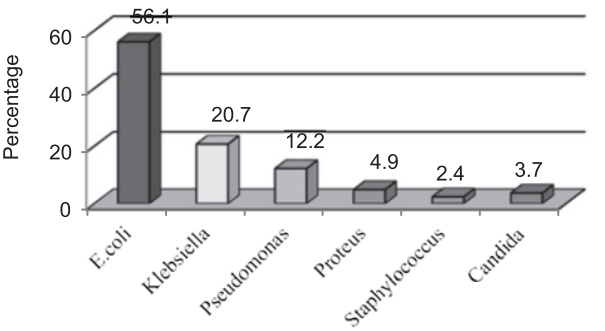

Figure-2: Distribution of pathogen

DISCUSSION

Globally, the nosocomial infections are the leading cause for morbidity as well as mortality while the most common nosocomial infections site is urinary tract.

Pathogens	Gram Staining	Motility	String Test	Oxidase Test	Urease Test
E.coli	Gram negative rod	Positive	Negative	Negative	Positive
Klebshiella	Gram negative rod	Negative	Positive	Negative	Positive/Negative
Pseudomonas	Gram negative rod	Positive	Negative	Positive	Positive/Negative
Proteus	Gram negative rod	Positive	Positive	Negative	Highly Positive
Staphylococcus	Gram positive cocci	Negative	Negative	Negative	Negative
Candida	Gram positive yeast	Negative	Negative	Negative	Negative

Table-III. Biochemical test to differentiate pathogens

Antibiotics	Escherichiacoli	Klebsiella Pneumoniae	Pseudomonas Aeruginosa	Proteus	Staphylococcus
	n=46	n=17	n=10	n=04	n=02
Ampicillin/Sulbactam	55% (25)	47% (8)	60% (6)	100% (4)	100% (2)
Ticarcillin/Clavulanic Acid	-	-	60% (6)	-	
Piperacillin	55% (25)	47% (8)	40% (4)	100% (4)	100% (2)
Cefuroxime	55% (25)	52% (9)	50% (5)	75% (3)	50% (1)
Cefuroxime Axetil	55% (25)	52% (9)	50% (5)	75% (3)	50% (1)
Cefixime	50% (23)	58% (10)	60% (6)	100% (3)	50% (1)
Ceftriaxone	50% (23)	58% (10)	40% (4)	50% (2)	50% (1)
Cefepime	50% (23)	52% (9)	40% (4)	50% (2)	50% (1)
Aztreonam	30 (14)	47% (8)	-	50% (2)	50% (1)
Meropenem	15% (7)	6% (1)	20% (2)	25% (1)	50% (1)
Levofloxacin	70% (32)	76% (13)	100% (10)	100% (4)	100% (2)
Moxifloxacin	60% (6)	76% (13)	40% (4)	75% (3)	50% (1)
Minocycline	45% (21)	58% (10)	60% (6)	50% (2)	50% (1)
Tetracycline	45% (21)	58% (10)	60% (6)	50% (2)	50% (1)
Tigecycline	45% (21)	58% (10)	60% (6)	50% (2)	50% (1)
Chloramphenicol	70% (32)	82% (14)	70% (7)	100% (4)	100% (2)
Colistin	0% (0)	0% (0)	0% (0)	0% (0)	0% (0)
Trimethoprim	70% (32)	82% (14)	80% (8)	100% (4)	100% (2)

Table-IV. Resistance pattern of organisms isolated

The current study was undertaken to assess the prevalence of uropathogens in catheter associated urinary tract infections and their antimicrobial susceptibility at Sheikh Zayed Hospital, Rahim Yar Khan. To obtain adequate results, 100 patients were included in the study and found that more than half of patients (54.0%) were females while 46.0% were males. The findings of our study are comparable with a recent study carried out by Khan and coworkers (2020) who also reported that among patients, majority (67.0%) was of females and only 33.0% patients were males.[4] Another study conducted by Seifu and Gebissa (2018) confirmed that female patients were in majority (69.3%).[10] But a most recent study performed by Oumer and associates (2021) exhibited different scenario that most of the patients were male (67.5%) and only 32.5 percent were females.[9] Similarly a study conducted in Poland by Michno and collaborators (2018) indicated that mainstream (61.7%) of the patients were males.[15]

Study revealed that out of samples taken from patients, the growth was observed in 82.0% specimens. The findings of a study performed by Folliero and teammates (2020) are much better than our study results who elucidated that only 31.0% specimens were found positive for pathogenic strains growth.[11]

Pathogens can lead to several diseases. The Escherichia coli is the most prevalent uropathogen responsible for UTIs among catheter associated patients. The results of our study confirmed that common catheter associated pathogen obtained from the samples was Escherichia coli (56.1%), followed by, Klebsiella (20.7%), Pseudomonas (12.2%), Proteus (4.9%), Candida (3.9%) and Staphylococcus (2.4%). The results of a study undertaken by Seifu and Gebissa (2018) also confirmed that most common isolated pathogen was E. coli (39.3%), followed by, Staphylococcus (20.2%), Klebsiella (8.4%) and Candida (2.7%).[10] Another study done by Muhammad and fellows (2020) asserted that most common pathogen was E.coli (68.9%), followed by, Klebsiella (8.9%), Staphylococcus (6.7%), and Proteus (2.1%).[13] Similar results were reported by Oumer and associates (2021) who stated that E.coli was most prevalent isolated pathogen (40.5%), followed by, Klebsiella (21.4%), Staphylococcus (7.1%), Pseudomonas (7.1%) and Proteus (2.4%).[9] Michno and comrades (2018) also described in

their study that E. coli was the most prevalent pathogen (61.7%), followed by, Proteus (10.0%), Staphylococcus (8.3%) and Klebsiella (3.3%),.[15]

During study biochemical tests were carried out to differentiate the pathogens and found that according to motility and urease tests, E.coli was found positive while according to gram staining, string and oxidase tests, E.coli was found negative. Klebsiella was found positive on string and urease tests while negative on remaining tests. Likewise Pseudomonas was found positive on motility, odxidase and urease tests while Proteus on motility, string and urease tests. Staphylococcus and Candida were found positive on gram staining only. The findings of a similar study performed by Bashir and colleagues (2020) highlighted that most widespread bacteria were the gram- negative namely E.coli, Proteus mirabilis, K.pneumoniae, Proteus vulgaris, and P.aeruginosa while gram+ve bacteria were S.aureus and S.saprophyticus.[7]

When the resistance pattern of organisms were evaluated, study indicated that Escherichia coli was mostly sensitive (>85%) to Meropenem and Colistin while resistant (>60%) to Levofloxacin, Chloramphenicol and Trimethoprim. Likewise Klebsiella pneumonia was sensitive (>95%) to Meropenem and Colistin while resistant (>75%) to Levofloxacin, Moxifloxacin, Chloramphenicol and Trimethoprim. Pseudomonas aeruginosa was found sensitive (>80%) to Meropenem and Colistin while resistant (>80%) to Levofloxacin and Trimethoprim. Proteus was mostly sensitive (>75%) to Meropenem and Colistin while resistant (100%) to Ampicillin/ Sulbactam, Piperacillin, Cefixime, Levofloxacin, Chloramphenicol and Trimethoprim. However, Staphylococcus was 100% sensitive to Colistin while 100% resistant to Ampicillin/Sulbactam, Piperacillin, Levofloxacin, Chloramphenicol and Trimethoprim. A study carried out by Mwangi et al. (2020) elucidated that Staphylococcus was 100% sensitive to Teicoplanin, Vancomycin & Linezolid and Klebsiella was sensitive to Meropenem & Amikacin while Escherichia coli was found sensitive to Meropenem, Nitrofurantoin and Amikacin.[20] A study conducted by Kazi and partners (2015) asserted that Pseudomonas was the most resistant uropathogen that showed an elevated resistance to several antibiotics including meropenem and imipenem.[1] A most recent study conducted by Ejerssa and companions (2021) reported that >70% of uropathogens were sensitive to gentamicin, chloramphenicol, amikacin and nitrofurantoin.[14] The findings of a study performed by Patel and coworkers (2021) highlighted that among the gram negative pathogens, most resistant drug was ciprofloxacin (95.12 percent), followed by cefipime (87.80 percent), piperacillin-tazobactem, meropenam, (85.37 percent).[12]

Increase in antibiotic resistance among uropathogens demonstrates that these are nosocomial infections and therefore complicated to treat. It could be much hazardous if the practices regarding infection prevention are not adequately followed during catheterized patients care. The risks of transmission of such multi-drug resistant can be enhanced if healthcare providers do not follow the preventive practices diligently.

CONCLUSION

Study concluded that most common cause of UTI was E.coli in catheter associated patients while the meropenem and colistin were the most sensitive drugs of choice. Further studies are required to be conducted on large scale to assess the prevalence of uropathogens in catheter associated UTIs and their antimicrobial susceptibility.

REFERENCES

1. Kazi MM, Harshe A, Sale H, Mane D, Yande M, Chabukswar S. **Catheter associated urinary tract infections (CAUTI) and antibiotic sensitivity pattern from confirmed cases of CAUTI in a tertiary care hospital: A prospective study.** Clin Microbiol. 2015; 4: 2.

2. Arina S, Shamsuzzaman SM. **Antibiotic sensitivity patterns of uropathogens isolated from catheterized patients in a tertiary care hospital in Dhaka, Bangladesh.** Urol Nephrol Open Access J. 2021; 9(3):61-6.

3. Adegun PT, Odimayo MS, Olaogun JG, Emmanuel EE. **Comparison of uropathogens and antibiotic susceptibility patterns in catheterized ambulant middle-aged and elderly Nigerian patients with bladder outlet obstruction.** Turk J Urol. 2019; 45(1): 48-55.

4. Khan AM, Ali Z, Salahuddin GS, Nowsherwan, Kamal M, Asghar M, et al. **Uropathogen isolates and their antibiotic sensitivity in patients with indwelling catheter associated urinary tract infections.** J Postgrad Med Inst. 2020; 34(1): 68-73.

5. Ramadan R, Omar N, Dawaba M, Moemen D. **Bacterial biofilm dependent catheter associated urinary tract infections: characterization, antibiotic resistance pattern and risk factors.** Egypt J Basic Appl Sci. 2021; 8(1): 64-74.

6. Job M, Monachan M, Scaria R, Babu M. **Comparative study of incidence rates and antibiogram of catheter-associated urinary tract infections in intensive care unit versus non-intensive care unit at a tertiary care teaching hospital.** Asian J Pharm Clin Res. 2021; 14(6): 167-72.

7. Bashir M, Umar AB, Bilyaminu M. **Determination of bacteria associated with urinary catheters from patients suffering from urinary tract infections.** Dr Sulaiman Al Habib Med J. 2020; 2(1): 20-3.

8. Al-Qahtani M, Safan A, Jassim G, Abadla S. **Efficacy of anti-microbial catheters in preventing catheter associated urinary tract infections in hospitalized patients: A review on recent updates.** J Infect Public Health. 2019; 12(6): 760-6.

9. Oumer Y, Dadi BR, Seid M, Biresaw G, Manilal A. **Catheter-associated urinary tract infection: Incidence, associated factors and drug resistance patterns of bacterial isolates in Southern Ethiopia.** Infect Drug Resist. 2021; 14: 2883-94.

10. Seifu WD, Gebissa AD. **Prevalence and antibiotic susceptibility of Uropathogens from cases of urinary tract infections (UTI) in Shashemene referral hospital, Ethiopia.** BMC Infect Dis. 2018; 18: 30.

11. Folliero V, Caputo P, Rocca MTD, Chianese A, Galdiero M, Iovene MR, et al. **Prevalence and antimicrobial susceptibility patterns of bacterial pathogens in urinary tract infections in University Hospital of Campania "Luigi Vanvitelli" between 2017 and 2018.** Antibiotics (Basel). 2020; 9(5): 215.

12. Patel C, Shah MB, Singh S, Modi C, Shah P. **Biofilm production and antimicrobial resistance in catheter associated urinary tract infection (CAUTI) pathogens isolated from ICU patients.** EJMCM. 2021; 8(3): 3143-52.

13. Muhammad A, Khan SN, Ali N, Rehman MU, Ali I. **Prevalence and antibiotic susceptibility pattern of uropathogens in outpatients at a tertiary care hospital.** New Microbe New Infect. 2020; 36: 100716.

14. Ejerssa AW, Gadisa DA, Orjino TA. **Prevalence of bacterial uropathogens and their antimicrobial susceptibility patterns among pregnant women in Eastern Ethiopia: Hospital-based cross-sectional study.** BMC Women's Health. 2021; 21: 291.

15. Michno M, Sydor A, Wałaszek M, Sułowicz W. **Microbiology and drug resistance of pathogens in patients hospitalized at the nephrology department in the South of Poland.** Pol J Microbiol. 2018; 67(4): 517-24.

16. Cheesbrough M. **District laboratory practice in tropical countries part 2.** UK: Cambridge University Press; 2000.

17. Cappuccino JG, Sherman N. **Microbiology-a laboratory manual.** California: Benjamin Cummings; 1996.

18. Bauer AW, Kirby WM, Sherris JC, Turck M. **Antibiotic susceptibility testing by a standardized simple disc method.** Am J Clin Pathol. 1966; 45: 493- 6.

19. Ferraro MJ, Craig WA, Dudley MN. **Performance standards for antimicrobial susceptibility testing.** Pennsylvania, USA: National Committee for Clinical Laboratory Standards (NCCLS); 2001.

20. Mwangi EG, Karanja SM, Wanzala P, Ngumi ZW. **Antimicrobial susceptibility patterns of isolates from catheterized patients at Kenyatta National Hospital Critical Care Unit.** Afr J Health Sci. 2020; 33(5): 1-16.

AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Muhammad Shahbaz Hussain	Principal investigator, Supervised.	
2	Umar Khalid Cheema	Statistical review and finalization.	
3	Shomaila Irim	Proof reading and statistical analysis.	
4	Muhammad Sajjad	Interpretation of data and drafting.	
5	Mehvis Anwar	Literature review and discussion.	
6	Shumaila Raees	Data collection & Statistical.