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Original Research

Bacteriological Profile and Antibiotic Sensitivity Patterns of Catheter Associated Urinary Tract Infection Isolates in a North- Indian Tertiary Care Hospital

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ABSTRACT:
Background: Catheter associated urinary tract infection (CAUTI) usually resulting from wide spread inappropriate urinary catheterization is a major concern due to its nosocomial potential and association with antibiotic resistance both of which make its management difficult, consequently increasing morbidity, mortality, hospital stay, and economic burden. This study was therefore undertaken to find bacteriological profile and antibiotic sensitivity pattern of the isolates of catheter associated urinary tract infections (CAUTI). **Materials and method:** A total of 115 non-repetitive urine samples were collected aseptically from all catheterised patients in various Intensive Care units (ICUs) of SGRD Charitable Hospital as per standard protocol. Semi-quantitative bacterial cultures were performed without delay by inoculating samples on Blood agar and MacConkey agar and incubating them aerobically at 37^0C overnight. Isolate identification and antibiotic sensitivity testing was done by both conventional bacteriological techniques and automated Vitek-2 as per CLSI guidelines. **Results:** Of the 115 samples we processed CAUTI was diagnosed in 100 (86.9%). Overall incidence of CAUTI was 30.94. The average age of the patient was 55$\pm$15 years. CAUTI developed more frequently in (95.7%) female patients compared to male patients (80.9%). The most common uropathogen was *E.coli* 42/100 (42%) followed by *Klebsiella pneumoniae* 30/100 (30%), *Acinetobacter baumanii* and *Enterococcus faecium* 4/100 (4%) each, *Klebsiella oxytoca*, *Staph.hemolyticus* and *Pseudomonas aeruginosa* 2 (2%) each and *Enterobacter cloacae* 1 (1%). However, yeast like organisms 13/100 (13%), were a conspicous observation denoting that immunocompromised status of ICU patients may increase susceptibility to infection. Also high microbial resistance was found in the first two organisms in listed above in the new treatment options. **Conclusion**: Stringent infection control interventions including hand hygiene, closed drainage system aseptic method of insertion and catheter care along with daily need assessment with evidence-based observation can go a long way to keep CAUTI rates in check.

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INTRODUCTION

CAUTI is a UTI where an indwelling urinary catheter was in place for >2 calendar days on the date of event.[1] Approximately12%-16%of adult hospital in patients will have an indwelling urinary catheter (IUC) at some time during their hospitalization, and each day the indwelling urinary catheter remains, a patient has a 3%-7% increased risk of acquiring a catheter-associated urinary tract infection (CAUTI).[2] CAUTI can lead to such complications as prostatitis, epididymitis, and orchitis in males, and cystitis pyelonephritis, gram-negative bacteremia, endocarditis, vertebral osteomyelitis, septic arthritis, endophthalmitis, and meningitis in either gender. Complications associated with CAUTI cause discomfort to the patient, prolonged hospital stay, and increased cost andmortality.[3] However, reduction of the rate and duration of unnecessary catheterization may have an impact in reduction of HA CAUTI.

Bacteria may enter the bladder through contamination of the tip during insertion with the flora of the distal urethra or from bacteria ascending the outside or the

inside of the catheter. Residual urine in the bladder of catheterised patients increases the risk of bacteriuria. During the process of infection, bacteria need first to adhere to the epithelial cells of the urinary tract and/or the surface of the catheter. They will then develop into biofilms on the catheter surface which are resistant to the immune system and antibiotics. Catheters by themselves may cause immediate physical damage to the bladder epithelium; they may be toxic and also cause inflammation. Bacteria can also damage the epithelium and cause inflammation and the combination of both may be synergistic in producing symptoms in the patient.[4]

The development of bacteriuria is mainly attributed to the duration of catheterization in the inpatient that in turn increases the length of hospital stay, cost and morbidity. So it is mandatory to know the prevailing bacterial strains and its antimicrobial susceptibility pattern to start targeted therapy to prevent such sequel. Additionally, a major concern is the growing antibiotic resistance of the uropathogens isolated that makes management difficult, consequently increasing morbidity, mortality, hospital stay and economic burden. Knowledge of antibiotic resistance trends is important for improving evidence based recommendations for empirical treatment of CAUTI.

This study was therefore undertaken to find bacteriological profile and antibiotic sensitivity pattern of the isolates of catheter associated urinary tract infections (CAUTI) in SGRD Hospital.

MATERIAL AND METHODS

A total of 115 patients catheterized for more than 48 hours and admitted in various ICUs of SGRD Charitable Hospital were studied for development of CAUTI. Patients who didn't give consent or catheterized prior to admission or having any sub acute/chronic urinary tract infections prior to admission were excluded.

Upon enrollment, and thereafter on days $3^{rd}/5^{th}/ 7^{th}$ and removal / change of first catheter approximately 3ml of urine was aspirated from the sampling port of the catheter with a sterile syringe, first disinfecting the port with 10% povidone-iodine. The catheter tubing was then clamped just above the port to allow collection of freshly voided urine. The collected urine was then transported in a sterile, wide mouthed, screw capped universal container. Diagnosis of CAUTI was made as per the Centers for Disease Control and Prevention (CDC) guidelines published in 2009.[1] Urine samples were transported immediately in a sterile container to Bacteriology section of Microbiology department of SGRD hospital. In case of delay in processing beyond 2 hours they were refrigerated overnight. Uncentrifuged urine samples were subjected to microscopic examination of wet mount and gram staining for the presence of pus cells and or organisms. With a calibrated platinum loop of 3.26 mm internal diameter, 0.001ml urine was inoculated on Blood agar and MacConkey agar media for semi-quantitative analysis.

INCIDENCE OF CAUTI WAS CALCULATED AS FOLLOWS

$$\frac{\text{Total number of CAUTIs in one month} \times 1000}{\text{Total catheter days*}} = \text{Number of CAUTIs per 1000 catheter days}$$

*Number of patients catheterized in that month × Total number of days of that month

RESULTS

Table 1: Association of age group with culture results

Age Group	Positive		Negative		Total	
	Number	%	Number	%	Number	%
<=40	15	78.90%	4	21.10%	19	100.00%
41-60	57	91.90%	5	8.10%	62	100.00%
61-80	23	82.10%	5	17.90%	28	100.00%
>80	5	83.30%	1	16.70%	6	100.00%
Total	100	87.00%	15	13.00%	115	100.00%
P value=.381						

Table 1 show that no significant association was present between culture results and age group as depicted

Table 2: Association of gender with culture results

Gender	Positive		Negative		Total	
	Number	%	Number	%	Number	%
Male	55	80.9%	13	19.1%	68	100.00%
Female	45	95.7%	2	4.3%	47	100.00%
Total	100	87.00%	15	13.00%	115	100.00%
P value=.020						

In this study, 55/68(80.9%) males and 45/47(95.7%) females were diagnosed with CAUTI. A significant association (p=.012) was seen in gender and culture positivity was found. (Table 2)

Table 3: Distribution of positive cultures according to day of sampling

Day	CAUTI Present	
	No. of patients	% age
Day 0	0	0
Day 3	14	12.2
Day 5	25	21.7
Day 7	61	53.0
Culture negative	15	13
Total	115	100

Table 3 shows that 14(12.2%), 25 (21.7%) and 61 (53%) of 115 samples were positive on Day 3, 5 and 7 respectively indicating that CAUTI was commonest after a week of catheterization.

Table4 shows similar results by both conventional and automated (vitek-2) methods. But 2 additional were detected as *E.coli*, beyond 42 detected by conventional technique.

Table 4: Comparative analysis of organisms isolated by conventional and automated vitek-2 method

	Conventional Method		Automated vitek-2 method	
Bacteria	**No. of isolates**	**Percentage (%)**	**No. of patients**	**Percentage (%)**
E.coli	42	42	44	44
Klebsiella pneumoniae	30	30	28	28
Yeast like organisms	13	13	13	13
Acinetobacter baumanii	4	4	4	4
Enterococcus faecium	4	4	4	4
Klebsiella oxytoca	2	2	2	2
Pseudomonas aeruginosa	2	2	2	2
Staph.hemolyticus	2	2	2	2
Enterobacter cloacae	1	1	1	1
Total	100	100.0	100	100.0

Table 5: Antibiotic resistance profile of gram negative bacteria

	Sensitive strains		Resistant strains		Intermediate	
Ampicillin	2 (2.4)	2 (2.4)	79 (97.5)	79 (97.5)	00 (00)	00 (00)
Amoxycillin	5 (6.1)	5 (6.1)	73 (90.1)	73 (90.1)	3 (3.7)	3 (3.7)
Piperacillin/tazobactam	9 (11.1)	10 (12.3)	71 (87.6)	70 (86.4)	00 (00)	00 (00)
Cefoperazone/sulbactam	10 (12.3)	11 (13.5)	64 (79)	64 (79)	7 (8.6)	6 (7.4)
Imipenem	16 (19.7)	15 (18.5)	55 (67.9)	57 (70.3)	10 (12.3)	9 (11.1)
Meropenem	14 (17.2)	16 (19.7)	64 (79)	61 (75.3)	3 (3.7)	3 (3.7)
Amikacin	37 (45.6)	37 (45.6)	40 (49.3)	39 (48.1)	4 (4.9)	4 (4.9)
Gentamicin	30 (37)	30 (37)	46 (56.7)	46 (56.7)	5 (6.1)	5 (6.1)
Ciprofloxacin	6 (7.4)		73 (90.1)		2 (2.4)	
Tigecycline	56 (69.1)	55 (67.9)	23 (28.3)	21 (25.9)	2 (2.4)	2 (2.4)
Nitrofurontoin	31 (38.2)	31 (38.2)	47 (58)	47 (58)	3 (3.7)	3 (3.7)

It was observed 2, 5, 37, 30 and 31 among 81 gram negative bacterial isolates were sensitive to ampicillin, amoxicillin, amikacin, gentamicin and nitrofurontoin respectively in both conventional and automated vitek-2 method.

Sensitivity was shown by 9 and 10 isolates to piperacillin/ tazobactam and cefoperazone/ sulbactam respectively by conventional method however 1 more in each case shown to be sensitive by automated vitek-2 method.

While 16 and 56 isolates were sensitive to imipenem and tigecycline respectively by conventional method, one less was shown to be sensitive by automated vitek-2 for both mentioned antibiotics. On the contrary sensitivity to meropenem was shown by 14 isolates by conventional method and 16 by automated

vitek-2 method.

It was observed that all isolates of *Acinetobacter baumani, Enterobacter cloacae, Klebsiella pneumoniae* and *Pseudomonas aeruginosa* were resistant to ampicillin, amoxycillin and piperacillin/tazobactam.

We found that 34 (81%), 33 (80.5%), 28(66.7%), 27 (64.3%), 29(69%), 14(33.3%), 22(52.4%), 36(85.7%), 3(7.1%) and 11(26.2%), of 42 *E.coli* strains were resistant to Ampicillin and Amoxicillin, Piperacillin/Tazobactam, Cefoperazone/Sulbactam, Imipenem, Meropenem, Amikacin, Gentamicin, Ciprofloxacin, Tigecycline, Nitrofurontoin respectively. As many as 29 (96.7%), 19 (63.3%), 26 (86.7%), 17(56.7%), 15(50%), 16 (53.3%), 28(93.3%) of 30 *Klebsiella pneumoniae* were resistant to Piperacillin/Tazobactam, Cefoperazone/Sulbactam and Ciprofloxacin, Imipenem, Meropenem, Amikacin, Gentamicin, Tigecycline and Nitrofurontoin respectively.

Table 6: Incidence of CAUTI

Month	Incidence of CAUTI	% positivity of ICU catheter samples
January 2020	25.8	80
February 2020	28.5	40
March 2020	28.2	87.5
April 2020	20	60
May 2020	29	90
June 2020	28.5	85.7
July 2020	32.2	100
August 2020	32.2	100
September 2020	33.33	100
October 2020	21.5	66.66
November 2020	25	75
December 2020	32.25	100
January 2021	28.22	77.7
February 2021	35.70	100
March 2021	32.25	100
April 2021	33.33	100
May 2021	32.25	100
June 2021	33.33	100

Table 7: Association between day of sampling and type of bacterial isolate

Day of sampling VS Bacterial isolate	Day 3		Day 5		Day 7		Total		P value
	N	%	N	%	N	%	N	%	
Acinetobacter baumanii	1	7.1	1	4	2	3.3	4	4	
E.coli	3	21.4	10	40	29	47.5	42	42	
Enterobacter cloacae	0	0	0	0	1	1.6	1	1	
Enterococcus faecium	1	7.1	1	4	2	3.3	4	4	
Klebsiella oxytoca	0	0	0	0	2	3.3	2	2	
Klebsiella pneumoniae	2	14.3	8	32	20	32.8	30	30	
Pseudomonas aeruginosa	0	0	2	8	0	0	2	2	
Staph.hemolyticus	1	7.1	1	4	0	0	2	2	
Yeast like organisms	6	42.9	2	8	5	8.2	13	13	.045
Total % within Day of Growth	14	100	25	100	61	100	100	100	

DISCUSSION

CAUTI continues to be the most common health care associated infection worldwide and result from widespread misuse of urinary catheterization. The overall incidence rate observed in the present study was 30.94%, similar to the study conducted by Dund et al.[5] in 2013 which reported an the incidence rate of 32%. It was also in concordance to the studies conducted by Bagchi et al.[6] and Patil et al.[7.] that reported the incidence rate to be 29.09% and 27.70% respectively. However results in present study were in sharp contrast to the studies conducted by Chih-Cheng Lu et al.[8] Taiwan in 2000 and Danchaivijitr S et al.[48] who found overall incidence of CAUTI 57% and 73.3% respectively. In the study by Kulkarni et al.[9] in MGM MCH, Aurangabad the incidence was found to be lower at 21.47%. However in a study by Kaji et al.[10] the overall incidence of 4.59 per 1000 catheter days was much lower than the incidence observed in the current study. In present study the incidence rate was more as ours is a tertiary care hospital and patients are mostly admitted in critical conditions thereby increasing the incidence of debilitating diseases.

In present study, maximum patients were present in the age group 41 to 60 years (53.9 %) followed by 61-

80 years (24.3%), ≤40 (16.5%) and >80 years (5.2%) making the average age of the patient 55±15 years. Similar results were shown by Patil et al.[7], Kulkarni et al.[9] and Leelakrishna et al.[11] reported 54.5 years, 46.48±17.82 and 51.61 years respectively as the mean age of patients with CAUTI. Conversely, Chih-Cheng Lu, et al.[8] conducted a study in a tertiary care hospital in Taiwan and observed the mean age of the patients to be 75.9 years which was noticeably greater than present study.

The present study found no significant association between age and culture results implying that age was not a risk factor for development of CAUTI. Similarly, study conducted by Verma et al.[12] showed no significant correlation between age and growth of bacteria. However, Anggietal.[13] in 2019 concluded a significant relationship between CAUTI infection with age, with a value of p= 0.028 (p < 0.05), with the most research subjects being in the age group of 21 to ≥ 60 years. The subjects who aged ≤ 50 years had two times more risk than a subjects who aged >50years. Similarly, Leelakrishna and Karthik.[11] also observed that patients >50years were at more risk of developing CAUTI then those below 50 years of age (p=.001).

In present study 68 (59.1%) of 115 patients were males and 47 (40.9%) patients were females almost same as in the study done by Bhayani et al.[14] in 2019 comprising more male patients (63%) compared to female patients (37%). Leelakrishna and Karthik.[11]also observed more no. of males (67.1%) in their study.

This study also noted that CAUTI developed more frequently (95.7%) in female patients compared to in male patients (80.9%). A significant association was seen in gender and culture result (p=.012).In a study by Vincitorio et al.[15] 483 patients, the number of females were more being 297 (61.5%) and also had more prevalence of CAUTI. Conversely in present study the number of male patients was more although it was females who had more prevalence of CAUTI. Similarly study conducted by Mishra et al.[16] had more females 25(67.6%).Verma et al.[12] in their study had more number of females, 38.04% and 21% of them developed CAUTI. Leelakrishna and Karthik.[11] reported that 64.4% males and 35.6% females to be affected with CAUTI. The difference was statistically non significant in the latter two studies in contrast to current study. Our finding is in strong agreement with the findings of other researchers that females have a stronger predilection for CAUTI compared to males. [12]

Sensitivity of gram negative organisms in present study to tigecycline, amikacin and nitrofurontoin is 69.1%, 45.6% and 38.2% respectively making them the most effective antibiotics.

It was observed that 3 and 1 of *Acinetobacter baumani*, were sensitive to tigecycline and nitrofurontoin respectively. In contrast, Michael Osthoff et al.[17] in his study showed 84 % sensitivity to nitrofurantoin**.** Sujatha et al.[18] in her study found that most of the Gram negative bacilli were sensitive to nitrofurantoin (97%) and amikacin (85%). The above mentioned results are opposite to current study where very less isolates were sensitive to these drugs.

Whereas, all isolates of Acinetobacter *baumani, Enterobacter cloacae, Klebsiella pneumoniae* and *Pseudomonas aeruginosa* were resistant to ampicillin, amoxycillin and piperacillin/tazobactam.

None of the isolates of *Enterobacter cloacae* and *Klebsiella oxytoca* was sensitive to any of the drugs used making the last two mentioned organisms pan resistant strains.

Similar results were obtained by Verma et al.[12] who showed that most of the Gram negative bacilli were resistant to commonly used antibiotics. Earlier studies have suggested that selective pressure from the use of antimicrobial agents is a major determinant for the emergence of resistant strains.

Peng et al.[19] in their study showed that some common pathogen groups of gram-negative bacteria, including *E.coli*, *Klebsiella spp*, *Acinetobacter spp*, and *Pseudomonas spp*, were generally resistant to ampicillin, ciprofloxacin, cefazolin, and cotrimoxazole. The present study also showed similar results where majority of the bacteria were resistant to most of antibiotics.

method for bacterial identification and antibiotic susceptibility. By decreasing the time required for accurate identification of common uropathogens and determination of their antibiotic susceptibility resulting in better clinical outcome as well as financial saving for the hospital.

CONCLUSION

Due to pooling of large number of referrals from other centers to our hospital, the development of CAUTI was common in our critically ill patients making incidence of CAUTI high further, most of the isolates were MDRO's. It can be managed through extra emphasis placed on good catheter care management, reducing the duration of catheterization and avoiding indiscriminate use of antibiotics, that may contribute to emergence of drug resistant strains in the environment. Active infection control team and efficient institutional infection control surveillance policy for non-compliance, strict adherence to preventive bundle practices and constant monitoring can go a long way in bringing down the incidence rate of CAUTI.Vitek-2 could be very useful as reference

REFERENCES

1. Hooton TM, Bradley SF, Cardenas DD, Colgan R, Geerlings SE, Rice JC, et al.; Infectious Diseases Society of America. Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. Clin Infect Dis. 2010 Mar- 1;50(5):625-63.
2. Lo E, Nicolle LE, Coffin SE, Gould C, Maragakis LL, MeddingsJ,et al.Strategies to prevent catheter-associated urinary tract infections in acute care

hospitals: 2014 update. Infect Control HospEpidemiol. 2014 May;35(5):464-79.
3. Scott RD. The direct medical costs of healthcare-associated infections in US hospitals and the benefits ofprevention.
4. Barford J, Coates A. The pathogenesis of catheter-associated urinary tract infection. Journal of Infection Prevention. 2009;10(2):50-56.
5. Dund JV, Durani K, Ninama RD, et al. Profile of UTI in indwelling urinary catheterized patients in tertiary care hospitals, Jamnagar, Gujarat. Int J Health Sci Res., 2015; 5(9):181-188.
6. Bagchi I, Jaitly NK, Thombare VR Microbiological Evaluation of Catheter Associated Urinary Tract Infection in a Tertiary Care Hospital. PJSR.2015:8(2):23-29.
7. Patil HV, Patil VC. Clinical, bacteriology profile, and antibiotic sensitivity pattern of Catheter associated Urinary tract infection at tertiary care hospital. Int J Health SciRes. 2018;8(1):25-35.
8. Chih-Cheng Lu, et al .The Incidence of Urinary Tract Infection in patient with a Chronic Indwelling Urethral Foley's Catheter. Incont Pelvic Floor Dysfunction, 2007; 2:67-8.
9. Kulkarni DS, Talib DS, Naik DM, Kale DA. Profile of urinary tract infection in indwelling catheterized patients. IOSR-JDMS. 2014 Apr;13(4):132-8.
10. KaziMM, Harshe A, Sale H, Mane D, Minal Y, 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. ClinMicrobiol: Open Access. 2015 Apr28.
11. Leelakrishna P, Karthik RB. A study of risk factors for catheter associated urinary tract infection. Int J Adv Med2018;5:334-9.
12. Verma S, Naik SA, Deepak TS. Etiology and risk factors of catheter associated urinary tract infections in ICU patients. Int J Med Microbiol Trop Dis.2017;3:65-70.
13. Anggi A, Wijaya DW, Ramayani OR. Risk Factors for Catheter- Associated Urinary Tract Infection and Uropathogen Bacterial Profile in the Intensive Care Unit in Hospitals in Medan, Indonesia. Open Access Maced J Med Sci. 2019 Oct14;7(20):3488-92.
14. Bhayani P, Rawekar R, Bawankule S, Kumar S, Acharya S, Gaidhane A, et al. Profile of urinary tract infection in a rural tertiary care hospital: Two-year cross-sectional study. J DattaMegheInst Med SciUniv 2019;14:22-6.
15. Vincitorio D, Barbadoro P, Pennacchietti L, Pellegrini I, David S, Ponzio E, Prospero E. Risk factors for catheter-associated urinary tract infection in Italian elderly. Am J Infect Control. 2014 Aug;42(8):898-901.
16. Mishra D, Rao KB. Catheter associated urinary tract infection in an acute care setting of a tertiary care centre in South India. Int J Res Med Sci2019;7:2182-6.
17. Osthoff M, McGuinness SL, Wagen AZ, Eisen DP. Urinary tract infections due to extended-spectrum beta-lactamase-producing Gram- negative bacteria: identification of risk factors and outcome predictors in an Australian tertiary referral hospital. Int J Infect Dis. 2015 May 1;34:79-83.
18. Sujatha R and Pal. Antibiotic Resistance Pattern of The Hospital And Community Acquried Isolates Of Uropathogen In A Teritary Care Centre at Kanpur. Rama UnivJMed Sci 2015. 2015;1(1):10–7.
19. Peng D, Li X, Liu P, Luo M, Chen S, Su K, Zhang Z, He Q, Qiu J, Li Y. Epidemiology of pathogens and antimicrobial resistanceof catheter- associated urinary tract infections in intensivecare units: A systematic review and meta-analysis. Am J Infect Control. 2018 Dec;46(12):e81- e90.