ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Incidence And Microbiological Profile Of Catheter Associated Urinary Tract Infections In A Tertiary Care Teaching Hospital.

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ABSTRACT

In recent years, healthcare associated infections (HAI) has emerged as the most common adverse events in delivery of healthcare across the world.Approximately half of HAI are associated with indwelling medical devices. Among various types of medical device associated infections, catheterassociated urinary tract infection (CA-UTI) is the commonest. As surveillance of HAI, so as to define the magnitude and nature of the problem, is the primary step towards reducing the risk of infection in vulnerable hospitalized patients, in the present study was conducted at a tertiary care academic hospital with an aim to study the rate of CA-UTI with special emphasis on its clinical and microbiological features. For the purpose of CA-UTI surveillance the definitions of CDC's National Healthcare Safety Network (NHSN) were used. urine sample was obtained from sampling port of indwelling urinary catheter with sterile syringe and needle from patient suspected to have CA-UTI. The urine specimens were inoculated on blood agar and MacConkey's agar and incubated at 35°C. Isolates were identified by standard microbiological protocol. A total of 378 (2.5%) patients developed CA-UTI. The overall rate of CA-UTI for 2 years was 5.1 per 1000 catheter associated days. The incidence of CA-UTIwas significantly high in age group above 55 years. *E. coli* (30.1%) followed by *Klebsiella* spp. (19.5%) and *Candida* spp. (10.9%) were common pathogens from isolated from CA-UTI. The cost of HAI is substantial, both in terms of morbidity and financial resources expended. To improve patient outcome and reduce health-care costs, strategies should be implemented to reduce the incidence of these infections. Surveillance is an effective tool that can be used to improve infection prevention and control practices. As the rate of medical device associated infections (MDAI) vary greatly as per type of healthcare setup and patients cared for, the surveillance data of particular institute cannot be generalized similarly the generalized data cannot reflect the situation of a particular institute. This study helped us to generate internal benchmarks for CA-UTI.

Keywords: Catheter associated urinary tract infection, healthcare associated infections, medical device associated infections, non *albicans Candida* species, surveillance.

https://doi.org/10.33887/rjpbcs/2022.13.5.6

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ISSN: 0975-8585

INTRODUCTION

Healthcare-associated infections (HAI) are one of the most common adverse, iatrogenic events experienced in patient care. These are acquired by the patients while receiving healthcare treatment for other ailments or conditions and were neither present nor incubating upon hospital admission [1]. At times, HAI may become evident even after discharge of patient from healthcare setup.

Globally, every year HAI affect hundreds of million patients. In developed nations, HAIs concern nearly5-15% of hospitalized patients and can lead to complications in 25-50% of patients admitted to intensive care units (ICU) [2]. In addition to added financial burden on the health-care system, HAI are usually associated serious illness, prolonged hospital stay, induce long-term term disabilities and add incrementally to cost expected of the patient's underlying diseases alone.[1]Various factors are identified for increased incidence of HAI, these include increased hospitalization, better adaptation of microorganisms to the hospital environment, advancement in medical technology along with injudicious use of antibiotics [3].

Approximately half of HAI are associated with indwelling medical devices [4]. Ventilator associated pneumonia (VAP), intravascular catheter-related blood stream infections (CR-BSI) and catheter associated urinary tract infection (CA-UTI) are major medical device-associated infections (MDAI) that pose the greatest threat to patient safety [5].

Among these MDAI, CA-UTI is the commonest. It may lead to complications like prostatitis, epididymitis, orchitis, cystitis, pyelonephritis, bacteremia, endocarditis, vertebral osteomyelitis, septic arthritis, endophthalmitis and meningitis [6]. As per the surveillance definition of CDC's National Healthcare Safety Network (NHSN), CA-UTI is a UTI where an indwelling urinary catheter was in place for > 2 calendar days on the date of event (DOE) [7].

Surveillance of HAI specially MDAI is the first and most important step towards reducing the risk of infection in vulnerable hospitalized patients [1]. Estimation of incidence of MDAI allows hospitals to compare their baseline data, rates and also to acknowledge exclusive problem that is needed to be reassessed.

Although, the rate of MDAI is well documented in developed countries, there are only few studies from Indian hospital. Most of these studies are from metropolitan cities like Mumbai, Delhi etc. The present study was conducted at a tertiary care teaching hospital of Ahmednagar with an aim to study the rate of CA-UTI with special emphasis on its clinical and microbiological features.

MATERIAL AND METHODS

The present descriptive cross-sectional study was conducted at Department of Microbiology of Dr. Vitthalrao Vikhe Patil Foundation's Medical College, Ahmednagar, Maharashtra. This medical college is attached to 960 bedded hospital that provides super-specialty healthcare services.

The study was conducted for a period of 2 year (January 2020 to December 2021). The study included all the patients above 18 years with indwelling catheter ≥48hr with baseline sterile urine culture prior to catheterization [8]. Patients with community acquired UTI without catheter, with significant growth on urinary culture prior to catheterization, patients catheterized for <48 hr and patients transferred from other hospitals with catheter were excluded from the study [9].

For the purpose of study, urine sample (following all aseptic technique) was obtained from sampling port of indwelling urinary catheter with sterile syringe and needle from patient suspected to have CAUTI. The patient was labeled as a case of CA-UTI, when he/she had an indwelling urinary catheter (IUC) in place for > 2 calendar days or if IUC was removed the day before the date of even and develops one or more of the following conditions: temperature (≥38◦C), urgency and suprapubic tenderness [1].

The urine sample was transferred to sterile container and transported to the laboratory without any delay. The urine sample was inoculated on blood agar and MacConkey's agar incubated at 35◦C for 24h. Additionally, a Gram-stained smear prepared from urine was also examined [1]. When urine culture showed growth with no more than two bacterial species and at least one of which was ≥ 10^5 colony

ISSN: 0975-8585

forming units (CFU) /mL, the organism was identified up to species level as per standard microbiological protocol.

CA-UTI rate was expressed as the number of CA-UTI per 1000 catheter days and was calculated using the following formula:

$$\left(\frac{\text{Number of patients developing CA-UTI}}{\text{Total number of catheter days}} \right) \text{X1000}$$

RESULTS

During the study period, a total of 110054 were admitted to various wards and critical care areas of the hospital. A total of 14895 (13.5%) patients, out of 110054 patients admitted to hospital, had indwelling urinary catheter.

Out of 14895 patients with indwelling catheter, 6199(41.6%) were males and 8696 (58.4%) were females. The total catheter days were 74928.A total of 378 (2.5%) patients developed CA-UTI. Therefore, as per the formula of CDC's NHSN for calculation of CA-UTI rate, the overall rate of CA-UTI for 2 years was 5.1 per 1000 catheter associated days. Out 378 patients with CA-UTI, a total of 84 (22.2%) were admitted to intensive care units (ICU) whereas 298 (78.8%) from general wards. The year wise rate of CA-UTI is shown in table 1.

Table 1: The year wise rate of catheter associated urinary tract infection.

Year	Total number of patients on urinary catheter	Total patient days	Number of patients developing CAUTI	Rate of CAUTI/1000 catheter days
2020	7518	37380	167	4.5
2021	7377	37548	211	5.6
Total	**14895**	**74928**	**378**	**5.1**

The rate of CA-UTI for the year 2020 was 4.9 per 1000 catheter associated days. The month wise distribution of the year 2020 is shown in figure. The rate of CA-UTI was highest in the month of September (8.7 per 1000 catheter associated days) followed by the month of October (8 per 1000 catheter associated days) and November (7.6 per 1000 catheter associated days) whereas low rate was seen in the month of February (2.5 per 1000 catheter associated days).

Figure 1: Month wise distribution of catheter associated urinary tract infection rate of Year 2020.

ISSN: 0975-8585

The overall rate of CA-UTI in the year 2021 was 5.6 per 1000 catheter associated days. As shown in figure 2, highest rate of CA-UTI was seen in month of July (6.8 per 1000 catheter associated days) whereas lowest rate was noted in the month of May (2.5per 1000 catheter associated days).

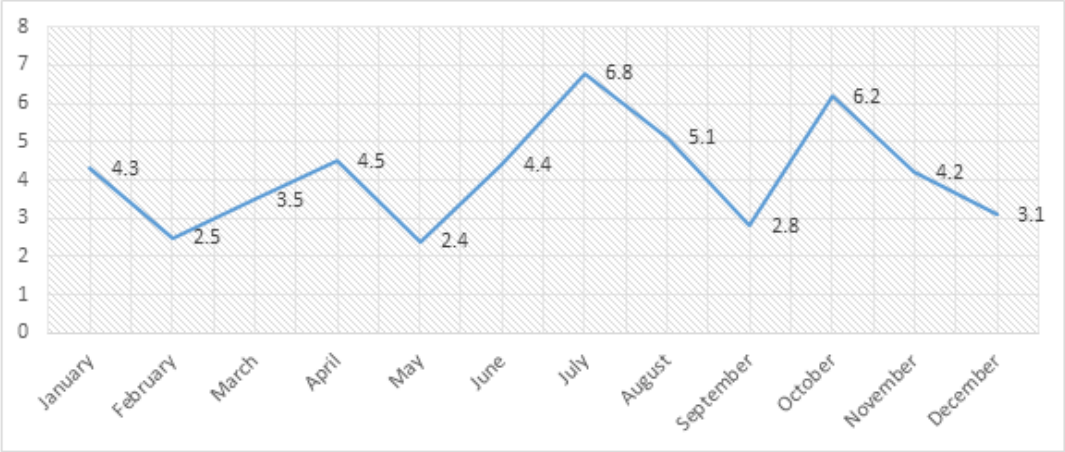

Figure 2: Month wise distribution of catheter associated urinary tract infection rate of Year 2021.

Out of 378 patients s of CA-UTI, 176 (46.6%) were males whereas 202 (53.4%) were females. Although female predominance was seen there was no significant difference observed between gender and development of CA-UTI (Chi square test, *P* value>0.05).

The age wise distribution of CA-UTI patients is shown in figure 3. The incidence of CA-UTI was significantly high in age group above 55 years (Fisher's exact test *P* value <0.05).

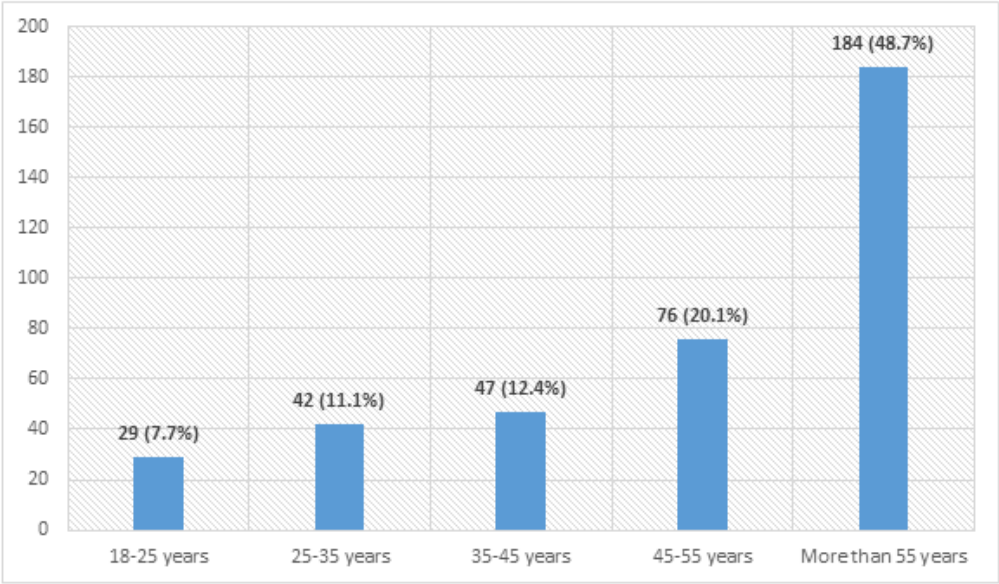

Figure 3: Age wise distribution of patients with catheter associated urinary tract infection.

A total of 392 microorganisms were isolated from 378 CA-UTI patients. Out of these 383 (97.7%) were single isolates whereas 09 (2.3%) were mixed culture. Out of 392 isolates, a total of 349 (89.1%) were bacterial isolates whereas *Candida* spp. was isolated from 43 (10.9%) urine samples collected from suspected cases of CA-UTI. The isolates from CA-UTI patients are shown in table2. *E. coli* (30.1%) followed by *Klebsiella* spp. (19.5%) and *Candida* spp. (10.9%) were common pathogens from isolated from CA-UTI

ISSN: 0975-8585

Table 2: Microorganism isolated from patients with catheter associated urinary tract infection.

Microorganisms	Number (%)
E.coli	118 (30.1)
Klebsiella spp.	76 (19.3)
Candida spp.	43 (10.9)
Enterococcus spp.	42 (10.7)
Pseudomonas spp.	34 (8.7)
Citrobacter spp.	31 (7.9)
Enterobacter spp.	26(6.6)
Staphylococcus aureus	22(5.6)
Total	392

Out of 43 *Candida* spp., isolated from cases of CA-UTI, a total 32 (74.4%) were identified as non *albicans Candida* (NAC) spp. whereas *C. albicans* were isolated from only 11 (25.6%) cases. The species distribution of *Candida* isolates is shown in figure 4. *C. tropicalis* was the predominant *Candida* spp. isolated from CA-UTI cases.

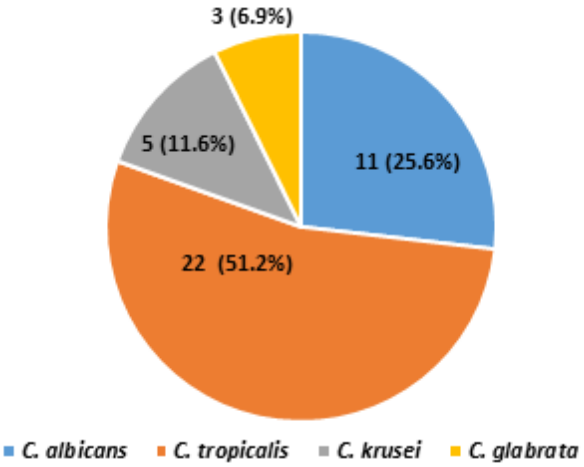

Figure 4: *Candida* species isolated from patients with catheter associated urinary tract infection.

DISCUSSION

In recent years, HAI has become a major public health problem worldwide, with an impact on morbidity, mortality, expected treatment cost and outcome, and quality life of patient admitted in a health-care setup. By and large many HAI can be prevented through effective infection prevention and control (IPC) measures.

Surveillance is an effective tool that can be used to improve IPC practices and decrease HAI. Various researchers have reported that health care setups with effective and efficient surveillance and robust IPC programs have reduced HAI [1, 5]. As per Bonita *et al*. (2006) health surveillance is defined as "the ongoing systematic collection, analysis, and interpretation of health data for planning, implementing and evaluating public health activities."[10].

In modern medicine, medical devices are integral parts of delivery of quality health-care to the masses. However, at times these indwelling medical devices may act as a source of infection. MDAI are often more treatment resistant and associated with fatal complications [1].

Urinary catheter is the commonest indwelling medical device in patients admitted to hospital. In the present, a total 14895 (13.5%) patients out 110054 patients admitted to the hospital had indwelling urinary catheters. The total catheter days were 74928. As per researchers like McGuckin (2012) and Lo *et al* (2014), nearly 12-16% of adult inpatients will have indwelling urinary catheter at some time during their hospitalization [11, 12]. The risk of CA-UTI increases with each day of indwelling urinary catheter.

A total of 378 patients, out of 14895 with indwelling urinary catheter developed CA-UTI. The overall rate of CA-UTI was 3.5% or 5.1cases per 1000 catheter days. The rates of CA-UTI significantly vary as per the study duration, the country (developed/developing), the economic status of the country (high/middle/lower), the type of heath care setup, and healthcare unit (general wards/critical care unit) and type of patient population studied [8, 13].

Out of these 378 CA-UTI patients, a total of 84 (22.2%) were admitted to intensive care units (ICU) whereas 298 (78.8%) from general wards. In consistent to our observation, Zahran *et al* [19] reported CA-UTI to be more common in patients admitted to general wards compared those admitted in ICUs. In general wards, the incidence of CA-UTI may be high due to large number of patients and less nurse-to-patient ratio compared to ICU setup. The infection prevention and control protocols are more strictly followed in critical care areas like ICUs compared to general wards [5].

Although, not statistically significant, CA-UTI was more common in female patients compared to males. Anatomical structure of the female urinary tract facilitates easier access to the perennial flora to the urinary bladder along the indwelling catheter.[1]However, CA-UTI can occur in either of sexes in the presence of specific predisposing factors and non or poor compliance with catheter insertion and maintenance bundle.

Age of patient with indwelling urinary catheters appear to play an important role in development of CA-UTI. In the current study, incidence of CA-UTI was significantly high in patients with age group > 55 years. Similar observation was reported by researchers like Hussain *et al* [14], Trautner *et al,* [15] and Chao *et al* [16]. Various risk factors like waning of immune function, exposure to nosocomial pathogens and increasing number of co-morbid conditions increases the risk of infections in elderly population.

In the present study, *E. coli* (30.1%) followed by *Klebsiella* spp. (19.5%) and *Candida* spp. (10.9%) were common pathogens from isolated from CA-UTI. Similar observation was noted by other Indian researchers like Singh *et al*. (2010) and Deorukhkar *et al*. (2016) [1, 5]. Although the type of pathogen varies as per healthcare setup, the microorganisms isolated from HAI cases are usually the nosocomial pathogens prevalent in the hospital environment.[1,5] Therefore healthcare workers (HCW) should strictly adhere to IPC measures like hand hygiene, standard precautions, disinfection policy and care bundles.

In recent years, fungi in general and *Candida* in particular are increasingly implicated in HAI. *Candida* spp., now ranks 3rdamong various leading cause of catheter-associated infections [1, 17]. *Candida* spp. is capable to adhere, colonize and form biofilm on almost all medical devices in current use [1].

A total of 43 (10.9%) *Candida* spp. were isolated from CA-UTI. In clinical practice, candiduria is rarely noted as a community acquired infection in a healthy individual with structurally normal urinary tract [1]. Indwelling urinary catheters, diabetes mellitus, advanced age, female sex, use of immunosuppressive agents and broad-spectrum antibiotic therapy are important risk factors for candiduria [1].

Among *Candida* spp., predominance of NAC spp. (74.4%) over *C. albicans*(25.6%) was noted. In accordance to our observation, recent studies on candiduria have reported predominance of NAC spp [1]. NAC spp. are not only well adapted to the urinary tract but also are more difficult to eradicate compared than *C. albicans.C. tropicalis* (51.2%) was the predominant *Candida* spp. isolated from CA-UTI cases [1].

In recent years, *C. tropicalis* has emerged as the most cause of nosocomial blood stream and urinary tract infections, especially in Indian hospitals. *C. tropicalis* can be acquired both endogenously and exogenously [18]. Endogenous spread usually occurs in pre-colonized patients where translocation and spread yeasts through the gastrointestinal system to distant anatomical sites under altered conditions whereas exogenous spread occur via hands of HCW and contaminated medical devices [18].

CONCLUSION

The cost of HAI is substantial, both in terms of morbidity and financial resources expended. To improve patient outcome and reduce health-care costs, strategies should be implemented to reduce the incidence of these infections. Surveillance is an effective tool that can be used to improve infection

prevention and control practices. The primary aim of surveillance of HAI is to establish benchmark for a particular type of HAI in a particular health care setup. Once these baseline rates are known, the surveillance can continue and further trends can be effectively monitored. As the rate of medical device associated infections (MDAI) vary greatly as per type of healthcare setup and patients cared for, the surveillance data of particular institute cannot be generalized similarly the generalized data cannot reflect the situation of a particular institute. This study helped us to generate internal benchmarks for CA-UTI.

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