Spectrum of Catheter associated Urinary Tract Infections in the Obstetric Patients in a Tertiary Care Hospital

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ABSTRACT

Introduction: Catheter-associated Urinary tract infection (CA-UTI) is one of the prevalent health care–associated infections globally as a consequence of inappropriate use of urinary catheterization in health care facilities. Study aimed to determine the prevalent microbes and their antibiogram of CA-UTI among Obstetric inpatients.

Material and Methods: This hospital based cross-sectional study was carried out from November 2015 to October 2016. A total of 84 urine specimens from catheterized females were cultured using standard loop technique. The isolated bacteria were identified by colony morphology, staining, motility and standard biochemical tests. Antibiotic susceptibility was performed by Kirby Bauer method. Data was analyzed by SPSS and Microsoft office 2007.

Results: The incidence of CA-UTI was found to be 34 (40.47%). The mean age was 29.26 years. Monomicrobial infections were seen in 26(76.47%) patients, while 8(23.52%) patients showed polymicrobial infection. Ten patients (29.41%), had urethral catheter in place for 1-3 days, 15(44.11%) for 4-6 days and 9(26.47%) for 7-9 days. The most number of positive cases were seen among caesarian sections, patients with eclampsia and preeclampsia. *Escherichia coli* 10(23.8%), were the most common isolate followed by *Klebsiella species* 09 (21.4%), *Staphylococcus aureus* 06(14.3%), *Candida albicans* 06(14.3%), *Pseudomonas aeruginosa* 05(11.9%), *Coagulase negative Staphylococci (CoNS)* 04(9.5%), *Proteus mirabilis* 02(4.8%). Notable antibiotic resistance against Gram Negative bacteria were observed for Penicillins, Fluoroquinolones and Cephalosporins, while for Gram positive bacteria were Penicillins, oxacillin and Nitrofurantoin.

Conclusion: Accurate etiology of the CA-UTI and its antibiotic resistance due to resistant strains is necessary for therapeutic management of the catheterized patients especially in pregnancy keeping in view about its complication.

Keywords: CA-UTI, Pregnancy, Escherichia coli, resistance

INTRODUCTION

Nowadays, indwelling catheters forms an integral component of patient care and the prevalence rate for short-term catheterization among hospitalized patients in the UK is 15–25%, including 9% in nursing homes and approximately 4% in the community.[1] The use of indwelling urinary catheter is a routine part of the majority of cesarean deliveries performed. Indications for using a catheter include providing relief when there is urinary retention, monitoring of the urine output for critically ailing persons, managing urine outflow during surgery, before and after the cesarean sections, prior to and following hysterectomies, patients with genital injury.

However, indwelling catheters are allied with infection, maternal discomfort, deferred ambulation, and reasonable cost. A major crisis with catheters is that they have a propensity to contribute to urinary tract infections (UTI). Contagion of the urinary tract can be in two ways: the transurethral way for peri-urethral microbes, and the intra- urethral or endoluminal way for the patient's endogenous flora in (majority of cases), health care workers or other patients.[2] The perimeatus, the intersection between the catheter, the collection bag and the collector drainage site are points of entry for the microbes.[3] Infection occurs because bacteria can travel up the catheter to the bladder, where the urine can become infected. The etiology of Catheter associated UTI includes *Escherichia coli, Staphylococcus aureus, Klebsiella species, Proteus species, enterococci, Pseudomonas aeruginosa* and *Candida*. Majority of these microbes are part of the patients' endogenous bowel commensal flora but they can also be acquired by cross contamination from other patients or hospital personnel as iatrogenic infections or by exposure to contaminated solutions or non-sterile equipment. In general, pregnant females are considered immunocompromised hosts for UTI because of the physiologic changes associated with pregnancy. These changes augment the risk of serious infectious complications from symptomatic or asymptomatic urinary infections even in healthy pregnant women. A range of bacterial species and yeast colonizes the catheters and has the important virulence factor that is to form biofilm which induces serious complications in the form of drug resistance. So keeping in view the use of catheters especially during pregnancy and the inclining likelihood of colonization of catheter, this study aimed at determining the prevalent microorganisms and their antibiogram from the specimen of indwelling urinary catheterized patients admitted in wards of Obstetrics and Gynaecology (OBG) of our hospital.

MATERIAL AND METHODS

It was a hospital based cross sectional study carried out from November 2015 to October 2016 in Department of Obstetrics and Gynaecology and Department of Microbiology of Rohilkhand College and Hospital, Bareilly. The study was carried out after the approval of the Institutional ethical committee.

Sample: The study was carried out among 84 catheterized

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patients of the 424 patients admitted in OBG ward of our hospital, from November, 2015 to October 2016.

Inclusion criteria

- Obstetric patients
- Catheterized females who have no signs of UTI during the time of admission.

Exclusion criteria

- Females with UTI at the time of admission.
- Females with Gynaecological problems.

Data collection: Age, patient's identification number were collected from Medical Record Department. Detailed physical and clinical examinations of patients were carried out to evaluate the condition and the patient was asked about any history of previous instrumentation or UTI.

Sample collection: Midstream urine within 48 hours of removal of catheter or using standard sampling technique the catheter specimens were collected in case of catheterized patients after clamping the catheter for 30 minutes in a universal container and transporting it immediately to the microbiology laboratory.[4]

Sample Processing: The urine samples were processed immediately after collection. The centrifuged urine specimens were examined under low dry power (10X) and high dry power (40X) of bright field microscope to find out the presence of pus cells, erythrocytes, casts, crystals and bacterial cells were recorded. The protein and sugar level were also recorded using urine strip test (Urostix, Baeyer) The specimens were cultured, using a standard wire loop of 4mm, on CLED, Mac Conkey and Blood agar (Himedia, Mumbai). The seeded plates were incubated at 37˚C for 18-24 hours.

Bacterial identification: The isolates were identified by colony morphology, Gram staining, motility testing and necessary biochemical tests such as catalase, coagulase (for Staphylococci), oxidase, Triple Sugar Iron test, Hugh and Leifson OF test, Nitrate reduction test, Sugar fermentation test, IMViC test, Amino acid degradation tests and other necessary tests.[5]

Antibiotic susceptibility testing: By adopting Kirby Bauer method and CLSI guidelines.[6] The 1st line antibiotics (Himedia, Mumbai) used for Gram negative isolates were ampicillin (AMP), nitrofurantoin (NIT), gentamycin (GEN), ciprofloxacin (CIP), cefuroxime (CRM), cotrimoxazole (COT). The 2nd line and 3rd line antibiotics used were amikacin (AK), ceftazidime (CAZ), imipenem (IMP), colistin (CL), and tigecycline (TGC). The 1st line antibiotics intended for Gram positive isolates were Penicillin (P), oxacillin (OX), cefoxitin (CX), nitrofurantoin (NIT), gentamycin (GEN). The 2nd and 3rd line antibiotics were teicoplanin (TEI), ciprofloxacin (CIP), ofloxacin (OF), vancomycin (VA), Leinezolid (LZ). The diameter of Zones of inhibition were measured using ruler and interpreted according to the interpretation Chart provided by the manufacturer (Himedia). *Escherichia coli* American Type Culture Collection (ATCC) 25922 and *Staphylococcus aureus* ATCC 25923 were used as control strains.

Criteria for consideration of Catheter associated UTI (CA-UTI)

CA-UTI in patients with indwelling urethral, indwelling suprapubic, or intermittent catheterization is defined by the presence of signs or symptoms companionable with UTI with no other recognized source of infection along with $\geq 10^3$ colony forming units (cfu)/mL of one or more than one bacterial species in a solitary catheter urine sample or in a midstream voided urine sample from a patient whose urethral, suprapubic catheter has been removed within the previous 48 hours.[7]

STATISTICAL ANALYSIS

Statistical Package for the Social Sciences (SPSS) version 21 and Microsoft office 2007 were used for data tabulation and analysis. Proportions and percentages were used as statistical measures.

RESULT

Of the total 84 catheterized patients, 34 (40.47%) had significant bacteriuria, that is $\geq 10^3$ cfu/ml according to the International Clinical Practice Guidelines from the Infectious Diseases Society of America guidelines 2009.[7] The mean age of the catheterized females with diagnosed CA-UTI was 29.26 years and the median was 30.5 years. Monomicrobial infection (one bacteria) were seen in 26 (76.47%) patients, while 8 (23.52%) patients showed polymicrobial (two isolates) infection resulting in 42 isolates as depicted in Table 1.

The length of catheterization related to significant Urinary Tract Infections as depicted in Figure 1. Ten patients (29.41%) had urethral catheter in place for 1-3 days, 15 (44.11%) had for 4-6 days whereas 9 (26.47%) had the catheter for 7-9 days.

The indications for use of catheter in the patients are described in Table 2. The most number of positive cases of CA-UTI is seen among caesarian section patients (67.64%)

A total of 42 bacterial and fungal isolates were recovered from the 34 patients with significant bacteriuria among 84 catheterized patients. *Escherichia coli* 10 (23.8%), were the most common isolate followed by *Klebsiella species* 09 (21.4%), *Staphylococcus aureus* 06 (14.3%), *Candida albicans* 06 (14.3%), *Pseudomonas aeruginosa* 05 (11.9%) *Coagulase negative staphylococci (CoNS)* 04 (9.5%), *Proteus mirabilis* 02 (4.8%) (Table 3).

The most susceptible antibiotics for Gram negative isolates were colistin (87.5%) followed by Tigecycline (81.25%), Imipenem (62.5%), nitrofurantoin (50%), Amikacin (50%), cotrimoxazole (43.75%), gentamicin (46.87%), ceftazidime (34.37%) cefuroxime (31.25%), ciprofloxacin (28.75%) and ampicillin (12.5%) (Figure 2).

Amongst the Gram positive isolates, the most susceptible antibiotics were Linezolid (100 %), followed by Teicoplanin (90%) Cefoxitin (70%), Ciprofloxacin (50%), Vancomycin (30%) and the total resistant was for Penicillin (100%) (Figure 3).

DISCUSSION

CA-bacteriuria is the most widespread healthcare associated infection in developed as well as in developing countries. It accounts for about 40% of hospital related infections and most of the patients with nosocomial bacteriuria are from US hospitals (developed country) each year.[8] The incidence of significant bacteriuria in pregnant women is roughly the same as that in non-pregnant women; though, repeated bacteriuria is more common during pregnancy.

Age Group	Total Number of catheterized patients (n)	Number of catheterized patients with diagnosed CA-UTI		
		Monomicrobial infection	Polymicrobial Infection	Total (N) (N/n*100)
15-20 years	14	03	01	04 (28.57%)
21-25 years	18	04	01	05 (27.77%)
26-30 years	26	06	02	08 (30.76%)
31-35 years	24	08	02	10 (41.66%)
36-40 years	10	05	02	07 (70%)
Total	84	26	08	34 (40.47%)

Table-1: The distribution of the diagnosed CA-UTI and the type of infection.

Sl no	Indications for use of catheter	Total number of cases	Total number of Positive cases
1	Caesarian section	46 (54.76%)	23 (67.64%)
2	Eclampsia	12 (14.28%)	03 (8.82%)
3	Severe Preeclampsia	08 (9.52%)	03 (8.82%)
4	Rupture uterus	03 (3.57%)	01 (2.94%)
5	Antepartum haemorrhage	09 (10.71%)	02 (5.88%)
6	Ectopic Pregnancy	06 (7.14%)	02 (5.88%)
	Total	84 (100%)	34 (100%)

Table-2: Indications for use of catheter among the patients.

Sl no	Bacterial isolates	Number (%)
1	*Escherichia coli*	10 (23.8%)
2	Klebsiella species	09 (21.4%)
3	*Staphylococcus aureus*	06 (14.3%)
4	Candida albicans	06 (14.3%)
5	Pseudomonas aeruginosa	05 (11.9%)
6	CoNS	04 (9.5%)
7	*Proteus mirabilis*	02 (4.8%)
8	Total	42 (100%)

Table-3: Bacterial and Fungal isolates from urinary catheterized patients.

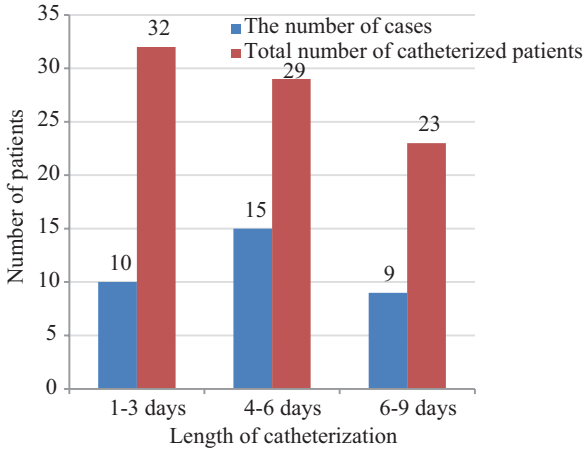

Figure-1: Relationship of Length of catheterization and development of significant bacteriuria among patients.

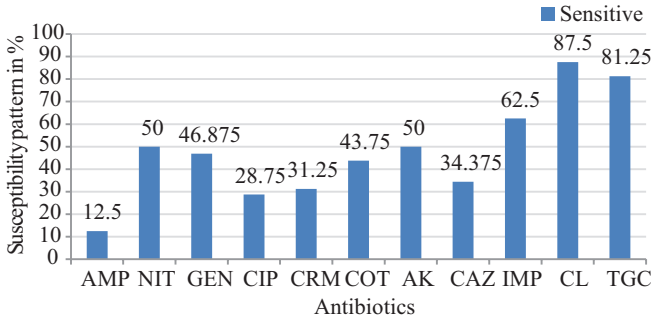

Figure-2: Antibiotic susceptibility pattern of Gram Negative isolates

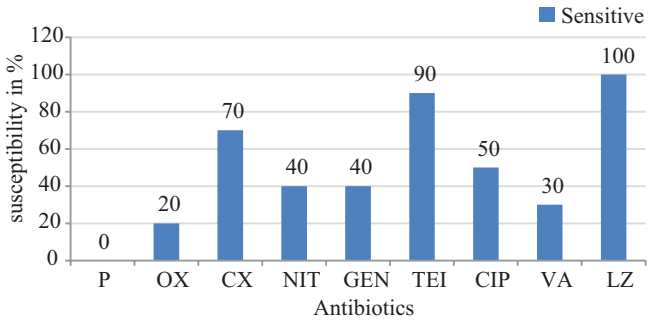

Figure-3: Antibiotic susceptibility pattern of Gram positive isolates

The incidence rate of CA-UTI in our set up according to the study is 40.7% among catheterized obstetrics patients. A quite similar overall incidence of 38.75% in 8341 CSUs was reported by Wazait HD in their five year study from UK.[9] A slight lower incidence rate of 36.3% and 27.0 % has been reported in the two Indian studies by Gupta V et al and Khosariya Mahim et al respectively.[10,11] Our study shows slight higher rate that may be due to the study being conducted in obstetrics patients as the pregnant females are more prone to UTI due to physiological and biochemical changes. This may be due to nonadherence to catheter insertion indications, introduction and maintenance techniques, discontinuation strategies, and indications for replacement of catheter. The other major reason includes prolonged catheterization as a major risk factor for the development of CA-UTI in our study. However, there are different studies which also point the high incidence of CA-UTI in catheterized patients.[12,13]

The mean age in our study was found to be 29.26 years. The maximum number of significant UTI is observed in the age group of 21-37 years as they are obstetrics patients. Hence we could not show the significant relationship between the age and acquisition of CA-UTI. Our study has determined various indications for the use of indwelling catheter in obstetrics patients, out of which caesarian section is the most common factor followed by eclampsia and severe pre-eclampsia. While the other indications included Rupture uterus, Antepartum haemorrhage Ectopic Pregnancy. The use of catheter has been in caesarian section has been extensively studied and reported by Joseph F. Lang et al in USA in 2001.[14] The commonest etiological agent isolated in our study was *Escherichia coli*, followed by *Klebsiella spp, Staphylococcus aureus, Candida albicans, Pseudomonas aeruginosa,* CoNS and *Proteus mirabilis*. Similar pattern of isolation of the pathogen causing CA-UTIs in catheterized patients was stated in previous studies.[15,16] Many of

these pathogens especially *E. coli* and *Klebsiella species* are part of the patients' intestinal flora but the others like *Staphylococcus aureus*, CoNS and *Candida albicans* are the normal flora of the genital area. Some like *Pseudomonas aeruginosa*, S.*aureus* may have been acquired by cross-contamination from other patients or health care personnels or by exposure to contaminated solutions or non-sterile equipment.

Our study shows that the most sensitive antibiotics for Gram negative isolates were colistin followed by Tigecycline, ciprofloxacin, Imipenem, while cephalosporins like ceftazidime and cefuroxime and fluoroquinolones shows resistance of more than 50%. The resistant to Ampicillin is the most. The rise in resistance of cephalosporins and fluoroquinolones are comparable with the study of Taiwo SS et al from Nigeria.[17] In a longitudinal study by Acharya VN, et al[18] there has been a gradual and definite increase of microbial resistance to many routinely used antibiotics with less than 25% isolates are sensitive. Among the Gram negative isolates there may be high number of Extended Spectrum Beta Lactamases, or Metallo Beta Lactamases producing organisms as indicated by the resistance pattern. Amongst the Gram positive isolates, the most susceptible antibiotics were Linezolid, followed by Teicoplanin and Cefoxitin. There was total resistant for Penicillin. The resistance against the oxacillin and vancomycin indicates the rise in drug resistant pathogens like Methicillin Resistant *Staphylococcus aureus (MRSA)* and Vancomycin Resistant *Staphylococcus aureus (VRSA)*.

CONCLUSION

Based on the findings of the study we conclude that accurate etiology of the CA-UTI and its antibiotic resistance is necessary to commence the therapeutic management of the catheterized patients especially in pregnancy keeping in view about its complication. We found *E.coli*, *Klebsiella, Pseudomonas aeruginosa* as prime pathogens among Gram negative isolates and *Staphylococcus aureus* and *Coagulase Negative* among Gram positive isolates. So we recommend use of catheters in appropriate indications for inserting indwelling urinary catheters, we should also educate staff about such indications, duration of catheters, maintenance and removal of catheters.

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