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RESEARCH ARTICLE

BACTERIOLOGICAL PROFILE OF CATHETER ASSOCIATED URINARY TRACT INFECTION (CAUTI) AMONG IN-PATIENTS OF A TERTIARY CARE MEDICAL COLLEGE HOSPITAL IN COIMBATORE

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ABSTRACT

Background: Urinary tract infections (UTIs) are the second most common cause of Hospital Acquired infections (HAI) or Nosocomial infections. Indwelling Urinary Catheter associated urinary tract infections among hospital settings had become a potential source for drug resistance thereby increasing the morbidity and mortality especially in elder people and has now gained paramount importance in patient outcome. Purpose: To detect the prevalence of Catheter Associated Urinary tract Infection and to evaluate the bacterial etiology of Catheter Associated Urinary tract Infection.
Methods: A total of 260 catheterized urine samples were subjected to culture and sensitivity by standard loop technique and the colonies were identified along with the susceptibility patterns and the results noted.
Results: Out of 260 catheterized patients, 193 (74.23%) belonged to age group 18-80 years and 67 (25.77%) belonged to 0-17 years age group. Urine culture was positive in 52 out of total 260 samples (20%) which represent the prevalence of CAUTI. Culture positivity among age group 18-80 was 38 out of 193 (19.69%) and cultures were negative in 155 out of 193 patients (80.31%). Culture positivity among age group 0-17 years was 14 out of 67 (20.90%) patients and cultures were negative in 53 out of 67 patients (79.10%). The predominant organisms were found to be Escherichia coli (44.74%) in age group 18-80 followed by Klebsiella pneumoniae and Proteus vulgaris (10.53% each). Likewise the predominant organisms in 0-17 years age group was found to be Escherichia coli (42.86%) followed by Klebsiella pneumoniae (21.42%).
Conclusions: Prolonged Catheterization is an important risk factor for iatrogenic CAUTI. Escherichia coli are the most common pathogen causing CAUTI. Early diagnosis followed appropriate and timely therapeutic management is a gold standard to control these emerging high level drug resistant bugs producing ESBLs, Carbapenemase and etc. This can be achieved by having a dedicated infection control and a properly functioning institutional Hospital Infection Control Committee (HICC) team to monitor hospital surveillance to control nosocomial infection.

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INTRODUCTION

Urinary tract infection (UTI) accounts for 15% of the infections reported by acute care hospitals. Each year more than 13,000 deaths are associated with UTI (Klevens and Edward, 2007) and are the second most common cause of Hospital Acquired infections (HAI) or Nosocomial infections. Indwelling Urinary Catheter (IUC) related urinary tract infections among hospital settings had become a potential cause for morbidity and mortality especially in elder people and has now gained paramount importance in patient outcome.

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Bacteriuria develops in at least 10-15% of hospitalized patients with indwelling urethral catheters. *Escherichia coli* are the most common community acquired pathogen responsible for approximately 75-90% of cases followed by other gram negative bacilli and gram positive cocci (Hooton, 2012; Warren, 1997). Catheter Associated Urinary Tract Infection (CAUTI) accounts for 34% of hospital acquired or health care associated infections (HAI) in United States. CAUTI in patients with indwelling urethral, indwelling supra-pubic, or intermittent catheterization is defined by the presence of symptoms or signs compatible with UTI with no other identified source of infection along with 10^3 colony forming units (CFU)/mL of 1 bacterial species in a single catheter urine specimen or in a midstream voided urine specimen from a

patient whose urethral, supra-pubic, or condom catheter has been removed within the previous 48 hours Emergence of multidrug resistant bugs had worsened the situation especially in the developing countries like India (Saint *et al*., 2009; Elvy *et al*., 2009; Maki, 2001). Risk factors (Maki, 2001; Nguyen-Van-Tam *et al*., 1999; Graves *et al*., 2007; Tissot *et al*., 2001) associated with an increased risk of catheter associated UTI includes female sex, older age, meatal colonization, impaired immunity, prolonged catheterization, severe underlying illness like diabetes mellitus, renal dysfunction, neurological or orthopedic problems necessitating prolonged catheterization, disconnection of the catheter and drainage tube, other types of faulty catheter care and lack of systematic antimicrobial therapy. The calculated risk of infection is almost 3-10% per day of catheterization. CAUTI rates are higher for Non-Intensive Care Units compared to Intensive care units (ICU), while the former accounts for 72% of CAUTI in the community hospitals which confirms that this population is a potential target for dedicated surveillance and prevention efforts (Tambyah *et al*., 1999; Fink, 2012; Lewis, 2013). Fluoroquinolones offer broad-spectrum UTI pathogen cover with a few side effects and are suitable for treatment of complicated UTI (http://www.cdc.gov/hicpac/index.html. Accessed 21 January 2010; Magill and Helinger, 2012; Lautenbach *et al*., 2002). CAUTI poses serious problems by Limiting Drug therapy options, Increasing duration of stay, worsening of clinical condition resulting in life threatening events, increasing morbidity & mortality, increased Cost of Hospitalization (Lin *et al*., 2008; Strausbaugh *et al*., 1996; D'Agata *et al*., 2004).

Aims and Objectives

- To detect the prevalence of Catheter Associated Urinary Tract Infection
- To evaluate the bacterial etiology of Catheter Associated Urinary Tract Infection

MATERIALS AND METHODS

Institutional Human Ethics Committee (IHEC) clearance and Patient's informed written consent were obtained. A total of 5927 urine samples (Midstream urine, supra-pubic aspirate and catheterized urine samples) were obtained between April 2015 and January 2016 (9 months). Among them 260 catheterized urine samples were sent for routine aerobic bacteriological culture and sensitivity.

Catheterized urine samples were obtained from various departments viz., from Surgery, Medicine, Neurology, Orthopedics and Pediatrics department of Karpagam Medical College Hospital. As per standard operating procedures, the samples were processed for routine aerobic bacterial culture and sensitivity by means of Standard loop technique where 20µL urine sample was inoculated on Blood agar plate (BAP) and Mac Conkey agar plate (MAP). After 24-48 hours of aerobic incubation at 37^0C, culture plates were looked for growth where $\geq 10^2$ CFU/mL is considered as significant. The colonies obtained were identified by Standard methods. Antibiotic susceptibility testing was done on Mueller Hinton Agar Plate (MHAP) as per guidelines and sensitivity patterns were noted. Drug resistance like Extended Spectrum Beta Lacatamase (ESBL), Methicillin Resistant Staphylococcus Aureus (MRSA), Amp C and Carbapenemase production were detected as per standard CLSI and or EUCAST guidelines. Diagnosis of Symptomatic Urinary Tract Infection due to Catheter Associated Urinary Tract Infection (SUTI 1a) as per CDC / IDSA guidelines (Klevens and Edward, 2007; Warren, 1997; Saint and Meddings, 2009; Elvy and Colville, 2009) is made by the presence of the following: 1. Patient had an indwelling urinary catheter that had been in place for > 2 days on the date of event (day of device placement = Day 1) AND was either:

Present for any portion of the calendar day on the date of event† , OR Removed the day before the date of event; 2. Patient has at least one of the following signs or symptoms: fever (>38.0°C), urinary urgency, urinary frequency, dysuria, supra-pubic tenderness and costo-vertebral angle pain or tenderness; 3. Patient has a urine culture with no more than two species of organisms identified, at least one of which is a bacterium of $\geq 10^5$ CFU/mL. All elements of the UTI criterion must occur during the Infection Window Period. Statistical analysis: The data was analyzed by IBM SPSS Version 20.0 software.

RESULTS

Out of 260 catheterized patients, 193 (74.23%) belonged to age group 18-80 years and 67 (25.77%) belonged to 0-17 years as in Table 1. Urine culture was positive in 52 out of total 260 samples (20%) which represent the prevalence of CAUTI. Culture positivity among age group 18-80 was 38 out of 193 (19.69%) and cultures were negative in 155 out of 193 patients (80.31%). Culture positivity among age group 0-17 years was 14 out of 67 (20.90%) patients and cultures were negative in 53 out of 67 patients (79.10%) as depicted in Table 2. Specific drug resistance among bacterial isolates is mentioned in the Table 3.

Table 1. Demography, Sex Distribution of Study Population

Total urine samples received during 9 months study period: (Mid-stream urine, supra-pubic aspirate and catheterized urine)	5927 urine samples
Study population: 260 catheterized urine samples (Total)	
18-80 age group: N = 193 samples	*0-17 age group: N = 67 samples*
Males: 71 (36.79%); Females: 122 (63.21%)	Males: 32 (47.76%); Females: 35 (52.24%)
Total No. of culture positive: 52/260 (20%)	Total No. of culture negative: 208/260 (80%)
Culture positive (Age group18-80): 38/193 (19.69%)	Culture positive (Age group 0-17): 14/67 (20.90%)
Culture negative (Age group 18-80): 155/193 (80.31%)	Culture negative (Age group 0-17): 53/67 (79.10%)

Among culture positives, 6 out of 52 (11.54%) were polymicrobial (more than one pathogen isolated) and remaining 46 out of 52 (88.46%) was monomicrobial pure culture by etiology as depicted in the Table 4.

Table 2. Bacteriological profile of Catheter Associated Urinary Tract Infections (CAUTI)

Culture positive (Age group: 18-80 years)			*Culture positive (Age group: 0-17 years)*		
BACTERIAL ISOLATES	N	%	BACTERIAL ISOLATES	N	%
Escherichia coli	17	44.74%	*Escherichia coli*	06	42.86%
Klebsiella pneumoniae	04	10.53%	*Klebsiella pneumoniae*	03	21.42%
Enterococcus faecalis	01	2.63%	*Enterococcus faecalis*	00	00
Enterobacter aerogenes	01	2.63%	*Enterobacter aerogenes*	00	00
Citrobacter diversus	02	5.26%	*Citrobacter diversus*	01	7.14%
Proteus mirabilis	01	2.63%	*Proteus mirabilis*	01	7.14%
Proteus vulgaris	04	10.53%	*Proteus vulgaris*	01	7.14%
Morganella morgagni	00	00	*Morganella morgagni*	01	7.14%
Pseudomonas aeruginosa	03	7.89%	*Pseudomonas aeruginosa*	01	7.14%
Acinetobacter baumannii	02	5.26%	*Acinetobacter baumannii*	00	00
MRSA	01	2.63%	*MRSA*	00	00
Staphylococcus saprophyticus	01	2.63%	*Staphylococcus saprophyticus*	00	00
MRCONS	01	2.63%	*MRCONS*	00	00
Total	38		Total	14	

Table 3. Spectrum of positive urinary bacterial culture

Age distribution	*Monomicrobial (pure) cultures*	*Polymicrobial cultures (>1 pathogen)*	*No. of Urine culture with growth (N)*
Age group 0-17	11 (78.57%)	03 (21.43%)	14
Age group 18-80	35 (92.10%)	03 (7.90%)	38
Total	46	06	52

Table 4. Specific Drug Resistance exhibited by bacterial isolates

Age group 18-80 (N=193)		Age group 0-17 (N=67)	
A. ESBL PRODUCERS *Escherichia coli* (01) *Klebsiella pneumoniae* (02)	03	A. ESBL PRODUCERS *Escherichia coli* (03)	03
B. Carbapenemase Producers *Klebsiella pneumoniae Carbapenemase* (01)	01	B. Carbapenemase producers	00
C. Methicillin Resistant Staphylococcus Aureus	01	*C. Methicillin Resistant Staphylococcus Aureus*	00

The predominant organisms were found to be *Escherichia coli* 17 out of 38 (44.74%) culture positive isolates in the age group 18-80 followed by *Klebsiella pneumoniae* and *Proteus vulgaris* (10.53% each) where ESBL production was found in 3 out of 38 isolates (7.90%) and Carbapenemase production was found in 1 out of 38 (2.63%) culture isolates. Also *Methicillin Resistant Staphylococcus Aureus* (MRSA) was found in 1 out of 38 (2.63%) in this age group. Likewise the predominant organisms in 0-17 years age group was found to be *Escherichia coli* 6 out of 14 (42.86%) culture positive isolates followed by *Klebsiella pneumoniae* grown in 3 out of 14 (21.42%) culture positive isolates where ESBL production was observed in 3 out of 14 (21.42%) of the culture positive isolates as depicted below in Table 3. Among age group 18-80 years, only 3 out of 38 (7.89%) culture positives were Gram positive cocci and remaining majority was Gram negative bacilli accounting for (35 out of 38) 92.11% patients.

DISCUSSION

Prevalence of CAUTI was 20% in this study which was similar to studies conducted elsewhere (Klevens and Edward, 2007; Hooton, 2012; Maki and Tambyah, 2001; Graves *et al*., 2007). *Escherichia coli* is the most common organism isolated followed by *Klebsiella pneumoniae* which was similar to many other study reports done in India and in abroad (Warren, 1997; Saint et al., 2009; Elvy J, Colville, 2009; Tambyah et al., 1999; Lautenbach et al., 2002). Spread of drug resistant bacteria like ESBL and carbapenemases in the hospital environment due to improper sterilization, disinfection and hand washing practices, poor catheter care and also irrational antibiotic use against these infections are alarming markers of global menace necessitating continuous hospital surveillance. The antimicrobial drug resistance mechanisms (Lautenbach *et al*., 2009; Cosgrove *et al*., 2002; Gaynes, 2005; Luyt *et al*., 2014; Bassetti *et al*., 2015) (mutation and methods of gene transfer), biofilm production, improper or over use of 3rd generation cephalosporins in gram negative bacteria and gram positive bacteria may interfere with multiple facets of antibiotic stewardship guidelines, including the choice of empirical regimen, in hand options for de-escalation and the therapeutic management of clinical failure due to the potential emergence of resistance under therapy. IDSA guidelines to be followed for the medical therapy of patients with CAUTI (Warren, 1997; Saint *et al*., 2009; Platt *et al*., 1982). The major complications of CAUTI are cystitis, pyelonephritis, gram negative bacteremia, prostatitis, epididymitis, and orchitis in males which in turn causes discomfort to the patient by prolonging the hospital stay, increased cost and mortality. Prevention of CAUTI can be accomplished by the following (Bassetti *et al*., 2015; Platt *et al*., 1982; Saint *et al*., 2008; Garibaldi *et al*., 1974; Esclarin De Ruz *et al*., 2000; Kunin and McCormack, 1966; Tambyah *et al*., 2002; Lo*et al*., 2008) a) Health care workers (HCWs) must follow Standard Precautions when caring for the patients with an urinary catheter in-situ; b) A closed drainage system to be used for all the patients with an indwelling catheter; c) to use a pre-connected urinary catheter and drainage bag may decrease CAUTI; d) Use sterile single-

use drainage bags for indwelling urinary catheterization; e) The drainage bag should be kept below the level of the urinary bladder and must be secured to the leg; f) Access the catheter drainage system by changing the catheter bags only when absolutely necessary g) to empty the catheter drainage bag regularly, by using a clean container for each patient. This study will enable the health care providers of our institution to comprehensively understand the current microbial profile of CAUTI which would rather facilitate in effective framing and revision of hospital antibiotic policy and strengthening the performance of Infection control team.

Conclusion

Prolonged Catheterization is an important risk factor for iatrogenic CAUTI mostly caused by instrumentation of the urinary tract. *Escherichia coli* are the most common pathogen causing CAUTI followed by *Klebsiella pneumoniae* and *Proteus vulgaris*. Early diagnosis followed appropriate and timely therapeutic management is a gold standard to control these emerging high level drug resistant bugs producing ESBLs, Carbapenemase and etc. For effective control of CAUTI, it is necessary to train nurses and health care professionals in aseptic technique and CAUTI prevention at the timing of initial hire, checking competency of indwelling urinary catheter insertion, documentation, assessment of CAUTI surveillance practices like effective hand washing, Proper sterilization and disinfection practices, due catheter care, appropriate use of antibiotics, ensuring whether the physicians are following Institutional or hospital antibiotic policy by conducting of periodic medical audits, morbidity and mortality meetings. This can be achieved by having a dedicated infection control and a properly functioning institutional Hospital Infection Control Committee (HICC) team to monitor hospital surveillance to control nosocomial infection. Regular update on CAUTI for health care professional by attending Training Workshops, conferences and CME's will help to breech the barrier by eliminating the drug resistant bacteria causing hospital acquired infections.

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