International Journal of Health Sciences and Research
www.ijhsr.org ISSN: 2249-9571

Original Research Article

Bacterial Profile And Antimicrobial Susceptibility Pattern In Catheter-Related Nosocomial Infections In A Tertiary Care Teaching Hospital, Chinakakani, Guntur District, Andhra Pradesh, South India

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Received: 01/05/2015 *Revised: 27/05/2015* *Accepted: 27/05/2015*

ABSTRACT

Background: This cross sectional study was carried out over a period of 1 year in a tertiary care teaching hospital located in the rural setting of Andhra Pradesh, India. The aim of the study was to determine the organisms causing catheter-related nosocomial infections and to study their anti-microbial susceptibility pattern.

Methods: Patients with endotracheal intubation, Urinary catheters, and central venous catheters (CVC)/ venous cut down catheters were included in the study. Colonization of the endotracheal tube, urinary catheters and colonization of the CVC/ venous cut down catheters was studied.

Results: The most common organisms isolated from urinary catheter tips and urine were E. coli (37.3%), Candida (33.33%), Klebsiella and Pseudomonas each (9.25%), Coagulase Positive Staphylococcus (3.7%), Proteus mirabilis, Providencia, Hafnia and Enterobacter each (1.85%). E.coli was the commonest organism, which showed highest frequency of susceptibility to Amikacin and nitrofurantoin. The common organisms isolated from the vascular catheter tips were Pseudomonas (29.03%), Acinetobacter (25.8%), Coagulase negative Staphylococcus (CONS) 19.35%, CP Staphylococcus (12.9%) Enterobacter 6.45%, E.coli and Klebsiella each (3.22%).Pseudomonas and Acinetobacter showed maximum susceptibility to ciprofloxacin. The most common organism isolated from endotracheal tube tips were Coagulase Positive Staphylococcus (33.33%), Pseudomonas (29.62%), Klebsiella (14.81%), CONS (11.11%), Citrobacter, Pneumococcus and Moraxella each (3.7%). Both Coagulase Positive Staphylococcus and Pseudomonas aeruginosa showed highest frequency of susceptibility to ciprofloxacin.

Conclusions: Nosocomial infections pose a huge and under-recognized threat to patient safety in developing countries. Prevention is more important than management of catheter –associated infections, simple measures of asepsis while insertion of catheters and general management of hygiene can decrease the incidence of nosocomial infections.

Keywords: Catheter - associated infections, central venous catheter, urinary catheter, length of stay, nosocomial infections.

INTRODUCTION

Nosocomial infections are a leading cause of morbidity and mortality among hospitalized patients. They concern 5-15% of hospitalized patients and can lead to complications in 25- 50% of those admitted in the intensive care units (ICUs). [1] Globally, urinary tract infections and surgical-site infections are the most frequent infections, followed by respiratory and blood-stream infections. [2]

The incidence of nosocomial infections in intensive care units is showing a rising trend mainly because of increasing invasive procedures performed in the ICUs. The therapeutic interventions that have been recognized as associated with infectious complications include indwelling urinary catheters, sophisticated life-support, intravenous fluid therapy, cardiovascular prosthetic devices, implantable orthopaedic prosthesis, immunosuppressive therapy etc. [3] Changes in the population at risk, changes in the spectrum of available pathogens and an increased use of sophisticated diagnostic and therapeutic modalities including broad-spectrum antibiotics have contributed to the evolution of problems with nosocomial infections.

The most common infections in the ICUs are catheter associated urinary tract infections (CA-UTIs), catheter related blood-stream infections (CA-BSIs) and pneumonia (usually ventilator associated), which together account for over 80% of such infections. [4,5] Most of the infections acquired in the ICUs are device related, which emphasizes the importance of device-specific interventions.

The common interventions done in the ICUs are: urinary catheterization to monitor urine-output in haemodynamically unstable patients and in life-threatening conditions like shock, multi-organ failure etc. Central venous catheterization is done for intravenous access to monitor central venous pressure, to administer fluid in hypovolemia and shock, for total parenteral nutrition and to gain access in patients with poor peripheral veins. Endotracheal intubation is done for maintenance of airway patency and mechanical ventilation.

ICUs are unique patient care areas where severely ill patients are housed together, surrounded by an environment of equipment, resistant microbes and overworked healthcare workers (HCWs). Moreover, patients are on multiple invasive devices, which act as a nidus and portal of entry for microbes, because of their propensity for biofilm formation. In the scenario of already compromised host, any breach of infection prevention protocols readily facilitates cross- transmission of infections.

Urinary tract infections (UTIs) are very common in ICU patients and may account for 25-50% of all infections [2,4 ,6]. Nosocomial UTIs are almost exclusively related to urinary catheters or invasive urinary tract procedures. [2] However, it is important to differentiate asymptomatic bacteriuria from infection because catheter colonization is extremely common. [6,7] Such a distinction is important for efficient management of UTI and helps in preventing unnecessary use of antimicrobials.

Catheter related blood stream infections (CR-BSIs) are one of the most important infections in the ICUs and are also associated with high mortality, morbidity and cost of treatment. The risk of CR-BSI increases with the duration of insertion, number of lumens, number and type of manipulation and is significantly affected by the type of catheter care during and after insertion. [2,6 ,7]

A large proportion of CR-BSIs are preventable through careful control of the factors associated with their colonization by micro-organisms. [2,8]

Ventilator associated pneumonia (VAP) represents more than 25% of all ICU acquired infections and accounts for over half of antibiotic consumption in the ICUs. [9] VAP is also associated with substantial mortality and cost of treatment.

Bacterial resistance to commonly used antimicrobial agents is a frequently encountered problem in the ICU. A knowledge of the common bacterial flora of an ICU and their antibiotic susceptibility pattern helps in deciding a rational antibiotic policy.

The purpose of the present study is to determine the common organisms responsible for various catheter related nosocomial infections. To identify the risk factors and mortality and to study the antibiotic susceptibility pattern of the common organisms isolated.

MATERIALS AND METHODS

Study Design: Cross sectional study

Setting: ICU of NRI General Hospital, Chinakakani, Guntur district, A.P.

Participants: Patients admitted in ICU of NRI General Hospital, with endotracheal tubes (with or without mechanical ventilation), indwelling urinary catheters and central venous catheters were included in the study.

Study period: Over a period of one year from February 2010 to 30th Jan.2011.

Patient's demographic details (age, sex), date of hospital admission, type of clinical illness, type of devices inserted along with the time and date of device insertion for the new admissions and treatment received. For already enrolled patients, the device days were recorded till the device was removed, along with the observation of doctors and nursing notes to look for any signs of infection. If infection was suspected, the most appropriate clinical sample for the type of device was collected and brought to the microbiology laboratory without delay. 300 samples were collected who were on all the three or two such catheters.

Endotracheal Tubes:

After extubation, the tip was cut with a sterile blade and sent in a sterile tube for bacterial culture. The qualitative method used for culture included incubation in glucose broth for four hours followed by smear examination and culture on 5% Sheep Blood Agar and MacConkey's Agar. Culture plates were incubated overnight and examined for growth. Organisms were identified on the basis of colony characteristics and biochemical reactions. Colonization of endotracheal tube was defined as positive growth from the endotracheal tube tip. 'Nosocomial Pneumonia' was diagnosed when four criteria were met: new and persistent infiltrates >48 hours on Chest X-ray, positive bacterial culture growth from tube-tip, fever $>38^0$, increased leucocyte count (>10,000cells/cu mm).

Urinary Catheters:

In our study, for diagnosis of CAUTI, asymptomatic bacteriuria i.e. patient with no fever (38.8ºc), urgency, frequency, dysuria or suprapubic tenderness was included as all the patients had Foley's catheter in situ were included in the study. The urinary catheters were inserted and removed using standard aseptic precautions. After removal, the tip of each catheter was cut using a sterile blade and sent in a sterile tube for bacterial culture. Qualitative method was used for isolation of organisms from the urinary catheter-tip, which was flushed with 1ml of glucose-broth. A loopful of the broth was taken and inoculated on Blood Agar and MacConkey's Agar. Plates were incubated overnight. The organisms were identified on the basis of colony characteristics and biochemical reactions. Simultaneously, a Gram-stained smear was also prepared. Also, urine was collected through the draining portal of the urinary catheter using aseptic precautions and sent for aerobic bacterial culture. Routine urine microscopy was performed on uncentrifuged catheter urine specimen to detect the presence of leukocytes, erythrocytes and other cells. None of the patients had prior urinary tract infection as determined clinically as well as on routine urine examination. The urine culture was done by Semiquantitative method using Standard loop technique. A colony count >10^5 (CFU) per ml was considered significant. ‘Colonization’ of the urinary catheter was defined as positive growth from the urinary catheter tip culture. ‘Bacteriuria’ was defined as positive culture from the urine collected through the urinary catheter (collected after 48 hours of catheter insertion).‘Urinary catheter related infection’ (UCRI) was defined as positive growth from the urinary catheter tip (colonization) and or positive growth from urine collected through the urinary catheter (bacteriuria).

Central venous catheters:

The catheter insertion was performed under strict aseptic precautions. A short section (approximately 5 cm) of the catheter (including the area directly beneath the skin) was aseptically cut off and sent to the laboratory in a sterile tube for culture. Catheter tips were processed by using ‘Maki et al.’s technique’. The semiquantitative method was performed by rolling the external surface of the catheter tip back and forth on the surface of 5% Sheep blood agar at least three times and then incubating the plate for 72 hours at 5% CO_2 and 35°C, after which the number of CFU were quantitated. After overnight incubation, the colonies were counted. ‘Catheter tip colonization’ was defined as a positive semiquantitative tip culture of ≥ 15 CFU/ml for the roll plate method. Also, blood was collected through the venous catheter 48 hours after its insertion and cultured. ‘Colonization of the central venous catheter’ (CVC) was defined as positive growth from the tip of the catheter and or the blood collected through the catheter.

Statistical Analysis:

Analysis was done using Chi square testto determine the significance of duration of catheterization and duration of ICU stay in causing catheter-associated infections. Probability value (‘p’ value) was calculated from standard charts and considered to be significant when it was less than 0.05.

The antibiotic susceptibility of the organisms (isolated from different sites) to various antibiotics was determined using the Kirby-Bauer method (disc diffusion technique) and the results were interpreted as per Clinical Laboratory Standard Institution (CLSI) guidelines.

RESULTS

In our study 300 patients had undergone indwelling urinary catheterization, central venous catheterization and endotracheal tube intubation. Among these 112 (37.33%) developed nosocomial infection.

The study was confined to the SICU and MICU units of NRIGH, Chinakakani. A total number of 300 samples were collected from each of the catheter-sites from patients who were on three or two such catheters, as mentioned above. Among 104 patients who underwent urinary catheterization, colonization with bacteria was seen in 54 patients (51.09%).Among these28 (51.8%) were male patients and 26 (48.1%) were female patients. The mostly affected age group was 21-40 yrs, of whom the number of organisms isolated was more in female patients are presented in Table1and Figure 1b.

TABLE 1: Organisms affecting the various age groups in both the sexes.

AGE -GROUPS	MALE - 28 (51.8%)	FEMALE - 26 (48.1%)
<20 yrs	Candida -2, E. coli -1Klebsiella -1.	Candida -1,Klebsiella -1
21-40 yrs	E. coli – 6 , pseudomonas -2Candida -2,Enterobacter -1	E. coli -7, Candida4,Klebsiella2, Pseudomonas -1.
41- 60 yrs	E. coli -3, Candida -2. Pseudomonas -1, Providencia -1	Candida -2, CP Staph. -2,E. coli -2.
61 -80 yrs	Candida -3, E. coli -2,Hafnia -1	Candida -2, Proteus-1,Pseudomonas -1.

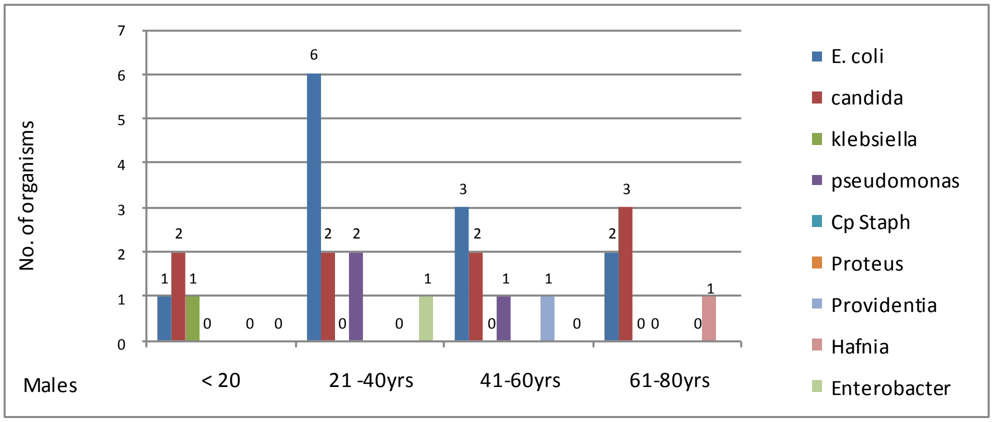

FIGURE 1a: Organisms affecting the various age groups in males

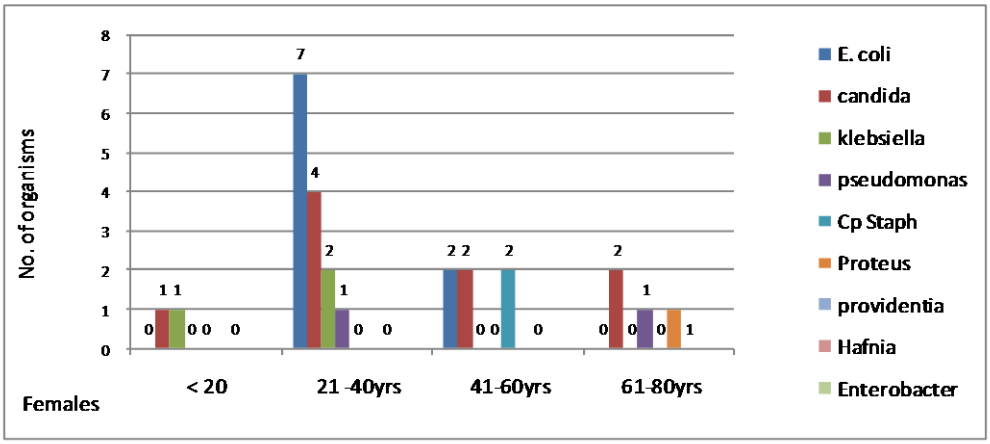

FIGURE 1b: Organisms affecting the various age groups in females

TABLE 2: Organisms isolated from urinary catheter tips and urine sample

ORGANISMS	NUMBERS (%)
E. coli	20 (37. 3)
Candida	18 (33.33)
Klebsiella	5 (9.25)
Pseudomonas	5 (9.25)
C P Staphylococcus (Urine)	2 (3.70)
Proteus mirabilis	1 (1.85)
Providencia	1 (1.85)
Hafnia	1 (1.85)
Enterobacter(Urine)	1 (1.85)

The organisms commonly isolated from the urinary catheter-tips and urine samples were E.coli (37.3%) followed by Candida (33.33%), Klebsiella and Pseudomonas sp. each (9.25%), Coagulase positive Staphylococcus (3.7%).Other gram negative bacteria like Proteus mirabilis, Providencia, Hafnia, Enterobacter each (1.85%) presented in Table 2, Figure 2.

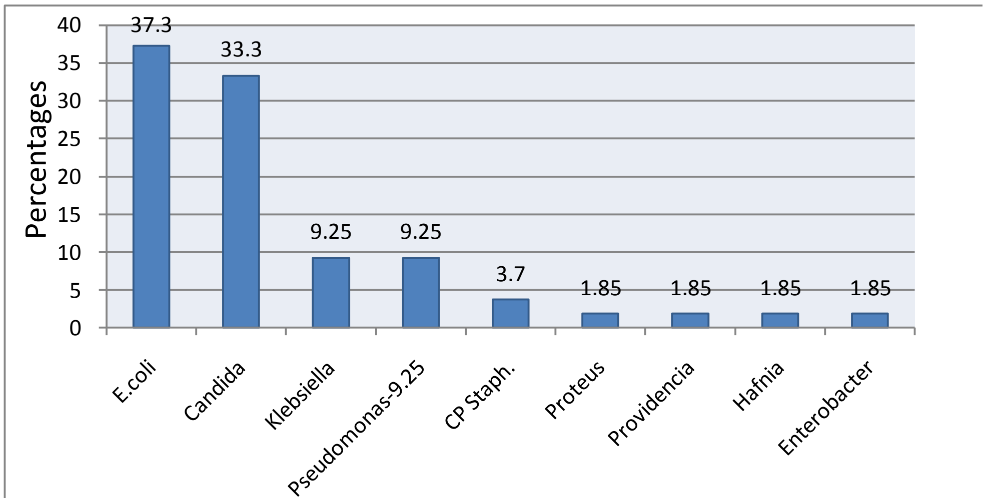

FIGURE 2: Organisms isolated from urinary catheter tips and urine samples

E.coli was the commonest organism with 90% susceptibility to Amikacin and Nitrofurantoin, whereas Klebsiella showed 100% susceptibility to Nitrofurantoin.Hafnia100% susceptible to Gentamicin, Amikacin, Ceftriaxone and Amoxyclav are presented in Table 3and Figure 3.

TABLE 3:Organisms Isolated from Urinary Catheter Tips and their Antibiotic Susceptibility Pattern (54 isolates)

	E. coli	Klebsiella	Pseudomonas	Hafnia	Providencia	Proteus mirabilis
Gentamicin	17/20 (85%)	0/5	1/5 (20%)	1/1 (100%)	0/1	1/1 (100%)
Amikacin	18/20 (90%)	1/5 (20%)	2/5 (40%)	1/1 (100%)	1/1 (100%)	0/1
Ceftriaxone	2/20 (10%)	0/5	1/5 (20%)	1/1 (100%)	1/1(100%)	0/1
Ciprofloxacin	17/20 (85%)	4/5 (80%)	4/5 (80%)	0/1	0/1	0/1
Amoxyclav	0/20	0/5	-	1/1 (100%)	0/1	0/1
Nalidixic acid	15/20 (75%)	0/5	0/5	0/1	0/1	0/1
Nitrofurantoin	18/20 (90%)	5/5 (100%)	0/5	0/1	0/1	0/1
Piperacillin	0/20	0/5	2/5 (40%)	0/1	0/1	0/1

(Note – Susceptibility of each organism to each antibiotic is indicated as X/Y, where X= Number of isolates susceptible to the particular antibiotic & Y= total number of isolates for which susceptibility was studied).

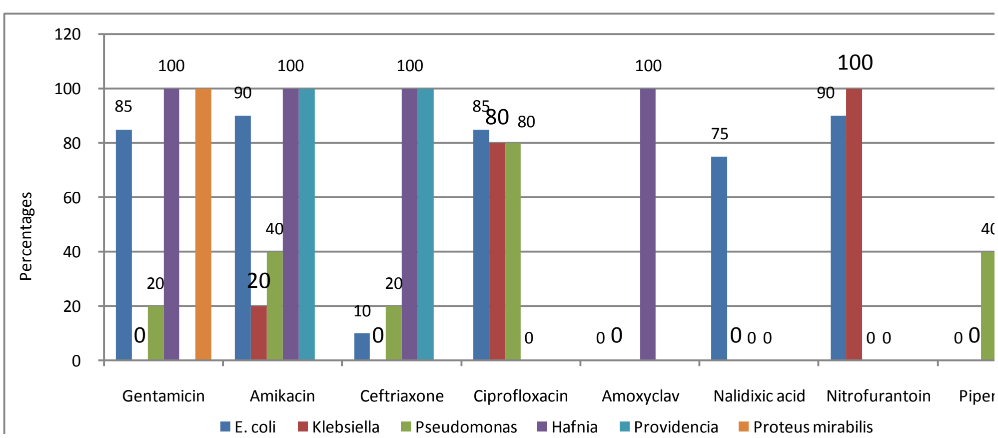

FIGURE 3: Organisms Isolated from Urinary Catheter Tips andtheir Antibiotic Susceptibility Pattern

E.coli was the common organism isolated from urine culture, having 100% susceptibility to Gentamicin, Amikacin and Nitrofurantoin. Pseudomonas is seen to have 100% susceptibility to Amikacin, CP Staphylococcus to Amikacin, Ciprofloxacin and Piperacillin. Hafnia showed 100% susceptibility to Gentamicin, Amikacin, Ciprofloxacin and Ceftriaxone and Providencia to Amikacin and Ceftriaxone are presented in Table 4 and Figure 4.

TABLE 4: Organisms isolated from urine culture and their antibiotic susceptibility pattern

	E. coli	Klebsiella	Pseudo	CP Staph.	Enterobacter	Hafnia	Providencia, Proteus
Gentamicin	20/20(100%)	4/5(80%)	2/5(40%)	0/2	0/1	1/1(100%)	0/1
Amikacin	20/20(100%)	3/5(60%)	5/5 (100%)	2/2(100%)	0/1	1/1(100%)	1/1 (100%)
Ciprofloxacin	17/20(85%)	3/5(60%)	4/5(80%)	2/2(100%)	0/1	1/1(100%)	0/1
Ceftriaxone	1/20(5%)	0/5	0/5	0/2	0/1	1/1(100%)	1/1 (100%)
Amoxyclav	0/20	1/5(20%)	-	0/2	0/1	0/1	0/1
Nalidixic acid	14/20(70%)	1/5(20%)	1/5(20%)	0/2	0/1	0/1	0/1
Nitrofurantoin	20/20(100%)	3/5(60%)	0/5	0/2	0/1	0/1	0/1
Piperacillin	0/20	1/5(20%)	0/5	2/2(100%)	0/1	0/1	0/1

(Note –Susceptibility of each organism to each antibiotic is indicated as X/Y, where X= Number of isolates susceptible to the particular antibiotic & Y= total number of isolates for which susceptibility was studied)

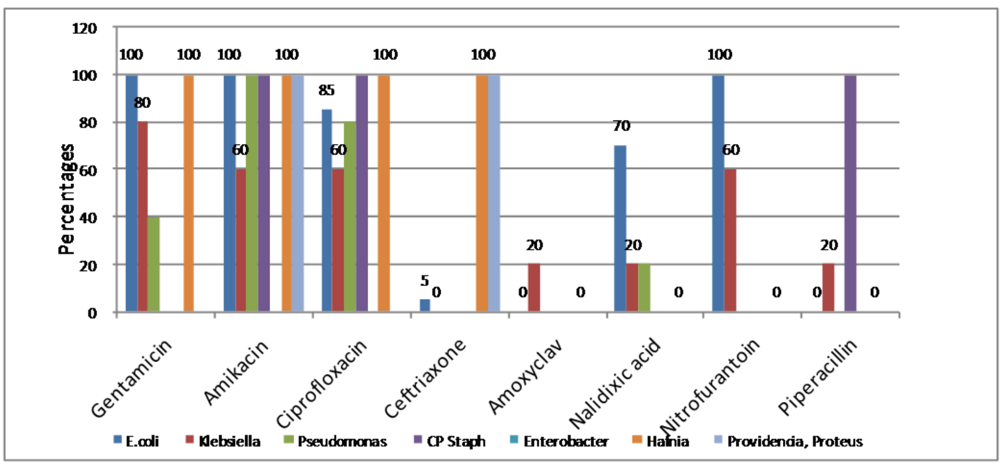

FIGURE 4: Organisms isolated from urine culture and their antibiotic susceptibility pattern

TABLE 5: Organisms isolated from patients with positive CVC- tip cultures

ORGANISMS	NUMBERS (%)
Pseudomonas	9 (29.03)
Acinetobacter	8 (25.80)
CoNS	6 (19.35)
CP Staphylococcus	4 (12.90)
Enterobacter	2 (6.45)
E.coli	1 (3.22)
Klebsiella	1 (3.22)

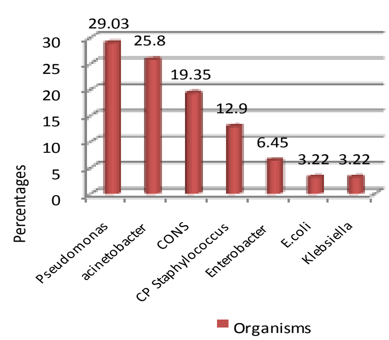

FIGURE 5: Organisms isolated from patients with positive CVC- tip cultures

103 patients had central venous catheter insertion. 31 tips were positive for bacterial colonization out of 103 catheter tips (30.09%) the common organisms isolated from catheter tips were Pseudomonas (29.3%) followed by Acinetobacter (25.8%), CoNS (19.35%), CP Staphylococcus (12.9%), Enterobacter (6.45%), E. coli and Klebsiella each (3.22%). Organisms isolated from seven positive blood-cultures were Acinetobacter, Pseudomonas, E.coli and Klebsiella are presented in Table 5and Figure 5.

Pseudomonas &Acinetobacter were the commonest organisms with maximum susceptibility to Ciprofloxacin. E.coli and Klebsiella together were susceptible to Ciprofloxacin; Amikacin & Gentamicin are presented in Table 6 and Figure 6

TABLE 6: Common organisms and their antibiotic susceptibility pattern Incentral venous catheter (31 isolates)

	Pseudomonas	Acinetobacter	CONS	S. aureus	Enterobacter	E.coli	Klebsiella
Erythromycin	-	-	3/6 50%	3 /4 75%	-	-	-
Vancomycin	-	-	3/6 50%	2/4 50%	-	-	-
Methicillin	-	-	0/6	2/4 50%	-	-	-
Ciprofloxacin	8/9 88.8%	4/8 50%	3/6 50%	2/4 50%	0/2	1/1 100%	1/1 100%
Amikacin	8/9 88.8%	0/8	2/6 33.3%	3 /4 75%	0/2	1/1 100%	1/1 100%
Gentamicin	6/9 66.6%	0/8	1/6 16.6%	1 /4 25%	0/2	1/1 100%	1/1 100%
Ceftriaxone	0/9	0/8	0/6	0/4	0/2	0/1	1/1 100%
Amoxyclav	-	0/8	0/6	0/4	0/2	0/1	0/1
Ceftazidime	4/9 44.4%	2/8 25%	0/6	0/4	0/2	0/1	1/1 100%

(Note – Susceptibility of each organism to each antibiotic is indicated as X/Y,where X= Number of isolates susceptible to the particular antibiotic &Y= total number of isolates for which susceptibility was studied)

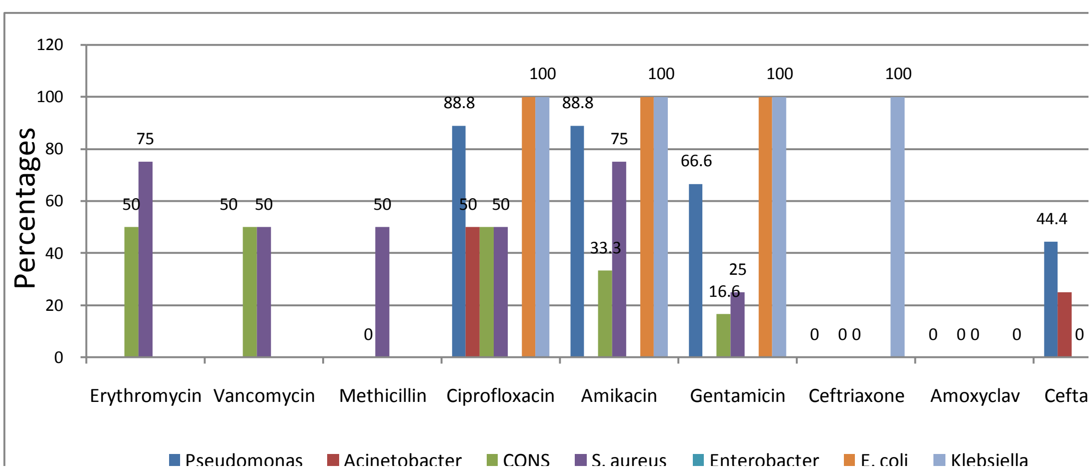

FIGURE 6: Common organisms and their antibiotic susceptibility pattern in central venous catheter (31 isolates)

Among 93 Patients who underwent endotracheal intubation, colonization with bacteria was seen in 27 patients (29.03%). The organisms commonly isolated from endotracheal tube tips were CP staphylococcus (33.33%) followed by Pseudomonas (29.62%), Klebsiella(14.81%) & CONS (11.11%).Others are Citrobacter, Pneumococcus and Moraxella each (3.7%) are presented in Table 7 and Figure 7.

TABLE 7: Organisms isolated from patients with positive endotracheal tube cultures

ORGANISMS	NUMBERS (%)
CP Staphylococcus	9 (33.33)
Pseudomonas	8 (29.62)
Klebsiella	4 (14.81)
CONS	3 (11.11)
Citrobacter	1 (3.70)
Pneumococcus	1 (3.70)
Moraxella	1 (3.70)

The various organisms colonizing the endotracheal tube and their antibiotic susceptibility pattern are presented in Table 8 and Figure 8. S. aureus and Pseudomonas aeruginosa were the commonest organism with maximum susceptibility to Ciprofloxacin, E.coli to Ciprofloxacin, Amikacin and Gentamicin, Pneumococci to Erythromycin, Ciprofloxacin, Amikacin.

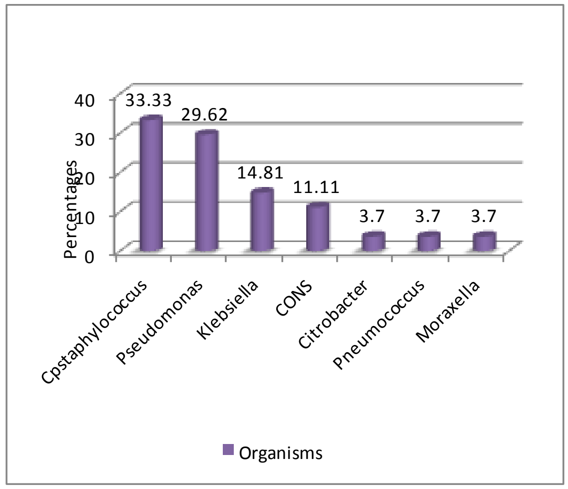

FIGURE 7: Organisms isolated from patients with positive endotracheal tube culture

TABLE 8: Organisms isolated from endotracheal tube tip cultures and their antibiotic susceptibility pattern (27 isolates)

	S.aureus	Pseudo-monas	Kleb-siella	CoNS	E. coli	Citro-bacter	Pneumo-cocci	Moraxella
Erythro-mycin	0/9	-	1/4 25%	0/3	0/1	0/1	1/1 100%	1/1 100%
Vanco-mycin	6/9 66.6%	-	0/4	1/3 33.3%	0/1	0/1	0/1	0/1
Methicillin	0/9	-	0/4	0/3	0/1	0/1	0/1	0/1
Cipro-floxacin	8/9 88.8%	8/8 100%	3 / 4 75%	0/3	1/1 100%	0/1	1/1 100%	0/1
Amikacin	7/9 77.7%	6/8 75%	3 / 4 75%	2/3 66.6%	1/1 100%	1/1 100%	1/1 100%	0/1
Gentamicin	7/9 77.7%	6/8 75%	3 / 4 75%	1/3 33.3%	1/1 100%	1/1 100%	0/1	0/1
Ceftriaxone	0/9	2/8 25%	0/4	0/3	0/1	0/1	0/1	0/1
Amoxyclav	0/9	-	0/4	0/3	0/1	0/1	0/1	0/1
Cefta -zidime	0/9	2/8 25%	0/4	0/3	0/1	0/1	0/1	0/1

(Note –Susceptibility of each organism to each antibiotic is indicated as X/Y, where X= Number of isolates susceptible to the particular antibiotic &Y= total number of isolates for which susceptibility was studied.

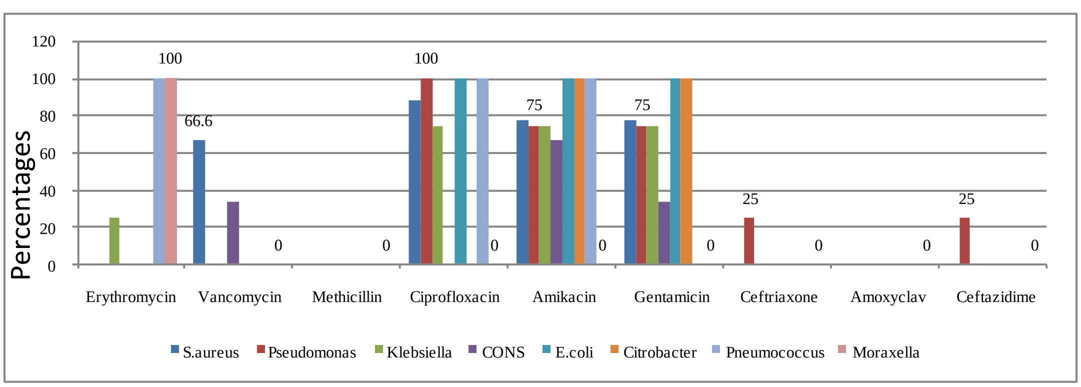

FIGURE 8: Organisms isolated from endotracheal tube tip cultures and their antibiotic susceptibility pattern (27 isolates)

In this study, duration of stay seemed to have an influence on catheter - associated infections. Calculated 'p' value was found to be highly significant in patients with UCRI, significant in both CVC - tip and endotracheal colonization. Also, the duration of catheter in-situ seemed to have influence on patients with urinary catheter and endotracheal colonization, but not CVC colonization, which was insignificant are presented in Table 9.

TABLE 9: Influence of duration of stay and duration of catheter in-situ on catheter associated infections

Type of catheter	Duration of Stay		'p' Value
	< 15 days Without catheter colonisation	>15 days With catheter colonisation	
UCRI	46	54	< 0.001(Highly significant)
CVC	69	31	0.04(Significant)
ET	73	27	0.10(Significant)

Type of Catheter	Duration of Catheter In-Situ		'p' Value
	< 7 days Without catheter colonisation	>7days With catheter colonisation	
UCRI	45	55	<0.01(Highlysignificant)
CVC	66	34	(Not significant)
ET	70	30	0.10 (significant)

DISCUSSION

Nosocomial infections are becoming an increasing problem for hospitalized patients, especially in the ICU. Nosocomial infections mainly affect the lower respiratory tract, urinary tract, surgical wounds, skin and blood (bacteremia). The common interventions done in an ICU are endotracheal intubation, urinary catheterization and insertion of central venous lines and not surprisingly, these are responsible for the nosocomial infections. Such invasive procedures are routinely done in the ICU and are becoming reservoirs of multidrug resistant bacteria. Excessive and injudicious use of broad spectrum and higher antibiotics adds to the growing problem. Also, the mortality is higher with resistant organisms like MRSA and gram negative organisms in critically ill patients.

Urinary tract infection (UTI) is the most common infection acquired by hospitalized adult patients. In the hospital, the ICU has the highest prevalence of UTI (8%-21%) of nosocomial infections; more than 95% of ICU cases are associated with the presence of an indwelling urinary catheter. [4,10]

Urinary catheterization is generally indicated to relieve UTI, to permit urinary drainage and to obtain accurate measurement of urinary output in clinically ill patients. Although CA-UTI is a very common infection, its link with mortality remains controversial. In a large cohort study conducted in 1982, Platt et al reported a significantly higher risk of hospital mortality in patients with CA-UTIs. [11] Three other studies however reported that CA-UTIs did not increase the risk of hospital mortality.

In this study, the maximum age-group having indwelling urinary catheter is 21-40 yrs., where the male patients account for 26 (52%) in number and female patients, 21 (42%). Taiwo et al has shown a similar distribution in his study regarding age and sex and got a similar result. [12]

This study depicts the majority of patients with bacteriuria belonging to the age-group of 21-40 yrs. E.coli is the commonest organism isolated from both the urinary catheter-tip and urine samples, followed by Candida, Klebsiella, Pseudomonas, Coagulase positive Staphylococcus, and Proteus sp., Providencia, Hafnia and Enterobacter. This is similar to the observation by Schaeffer et al and Igra et al. [13,14] Schaeffer et al isolated Staphylococcus aureus, Staphylococcus epidermidis and Streptococcus fecalis in addition.

Likewise, Chukwuocha et al isolated E. coli as the most frequent organism followed by Staph. aureus, Klebsiella, Proteus, Strept. faecalis, Pseudomonas, Citrobacter and Enterobacter in addition. [15]

The presence of these organisms in the samples analyzed may be attributed to the insertion of a urinary catheter, which by-passes normal host defences against urinary tract infection and as a result, provides a port for opportunistic pathogens to reach the bladder. Therefore, manipulation of the closed catheter system can introduce bacteria resulting in bacteriuria in indwelling catheter. [16]

In this study, the standard criteria of $>10^5$ CFU/ml is used to define significant bacteriuria, while Garibaldi et al,included low- level bacteriuria ($>10^2$ CFU/ml) in their study, most of whom had surgical non-fatal illnesses. [17]

The result of the microbiological profile in this study is similar to most reported studies, E.coli still being the most common pathogen.

The antimicrobial susceptibility pattern helps to formulate an antibiotic policy for the ICU.

In this study, E.coli being the commonest organism isolated from both urinary catheter-tips and urine culture is seen to be susceptible to Amikacin, Gentamicin and Nitrofurantoin and resistant to Amoxyclav. A similar study by Deshmukh et al showed E.coli to be susceptible to Amikacin and Cefuroxime. [18]

Bloodstream infection (BSI) is an important cause of mortality in patients who are critically ill. [19,20] The most important risk factor for the development of BSI is the central venous catheter (CVC). [21] Studies have repeatedly demonstrated that CVC-associated BSIs are associated with prolonged hospitalization and increased patient morbidity. [20,22] Infection control programmes emphasizing improved hand-hygiene and catheter- care have been an important means of reducing CVC-associated BSI. [23,24]

CVC-associated BSIs were defined using the Centres for Disease Control and Preventive definitions as follows- [25]

Laboratory-confirmed BSI was defined using **2 criteria.**

Criterion1 was that patient had a recognized pathogen cultured from 1 or more percutaneous blood cultures and the pathogen cultured from blood was not related to an infection at another site. When common skin commensals, e.g. (Diphtheroids, Bacillus, Propionibacterium, CoNS or Micrococci) were recovered; the organisms must have been cultured from 2 or more blood cultures drawn on separate occasions.

Criterion 2 was that the patient had atleast one of the following signs or symptoms: fever >38°C, chills or hypotension which was not considered to be related to an infection at another site. Clinical primary nosocomial sepsis was defined as the patient having atleast one of the following clinical signs with no other recognized cause: fever >38°C or oliguria (<20ml/hr) or hypotension (systolic <90mm Hg) but blood cultures were not obtained or no organisms were recovered from blood cultures.

Patients who are critically ill often require prolonged CVC and have a high risk for the development of BSI. [26] When CVC-associated BSI does occur, a majority of studies have found an increased attributable mortality ranging from 4% to 37%,although this association has not been an universal finding. [19,20 ,27]

Increased antibiotic use is a common finding in studies of nosocomial infection. This study is no different. The excess use of antibiotics has important implications for patients in the ICU setting where the risk of acquiring resistant nosocomial pathogens may be further amplified.

In this study, Pseudomonas and Acinetobacter are the commonest organisms isolated from the CVC-tips showing maximum susceptibility to Ciprofloxacin and resistant to Ceftriaxone. Deshmukh et al isolated Acinetobacter as the commonest organism sensitive to Ciprofloxacin. [18] Bentley et al, Derbyshire et al, Dillon et al and Moran et al have isolated Staphylococcus as the commonest organism colonizing the CVC. [28-31] Moran et al have also isolated Enterococcus, Proteus and Pseudomonas. [31]

Nosocomial pneumonia (NP) is the most commonly reported infection in the ICUs, especially in mechanically ventilated patients. [32] This infection is associated with a significantly increased length of hospital stay and may have a considerable impact on morbidity and mortality. [33] Many studies have investigated risk factors for the development of infection and its consequences. However, the evaluations in most of these studies disregard the fact that there are additional competing events, such as discharge or death.

Debate persists about the mortality attributable to ventilator-associated pneumonia (VAP) among other causes of death in critically ill patients there is little doubt that VAP causes substantial morbidity by increasing the duration of mechanical ventilation and ICU stay. [32,34] It is therefore important to understand the factors that are predictive of VAP, to identify patients at highest risk and to target these patients for the most effective preventive strategies as determined by randomized trials.

Deborah J. Cook et al found VAP rates of approximately 3% per day in the first week of mechanical ventilation, 2% per day in the second week and 1% in the third week and beyond. [28] This decreasing hazard reflects the high risk for early VAP in ventilated patients and suggests that long-term survivors are patients at lower intrinsic risk for VAP. Other studies have emphasized a high risk for VAP in the first week of mechanical ventilation. [35] Early-onset pneumonia may account for as many as 50% cases of VAP and most etiologic organisms represent common respiratory tract pathogens or normal oropharyngeal flora. [33]

Like other investigators such as Torres et al, Deborah J. Cook et al found aspiration to be an independent risk factor for VAP. [32] Pharyngeal aspiration in patients with depressed consciousness is common. Impaired airway reflexes and neuromuscular disease in a heterogeneous group of spontaneously breathing and mechanically ventilated patients were documented as risk factors of nosocomial pneumonia. Paralytic agents and sedatives may predispose to VAP by decreasing the cough- reflex, reducing endotracheal secretion clearance or impairing gut-motility.

The present study was based on patients with endotracheal tubes with or without mechanical ventilation. Though several organisms were isolated from the endotracheal tube-tips, none of the patients were detected to have nosocomial pneumonia after 48-72 hours of mechanical ventilation. The patients who died during the study, none of them developed nosocomial pneumonia prior to or at the time of demise. Coagulase positive Staphylococcus is the commonest organism isolated from the endotracheal tube-tips followed by Pseudomonas and Klebsiella. CP Staphylococcus showed susceptibility to Ciprofloxacin but resistant to Erythromycin, Methicillin and Amoxyclav. Deshmukh et al isolated E.coli, Klebsiella and Pseudomonas as commonest organisms from endotracheal tubes. [18] Most of the previous studies had Pseudomonas aeruginosa isolated as the commonest organism. Other studies have also isolated Serratia, Staphylococcus aureus and gram negative bacilli.

Antibiotics administered during the first eight days were associated with a reduced risk for early-onset VAP in patients with ineffective subglottic secretion drainage in other studies. [36] The present study is also not an exception to this finding. Systemic antibiotics may protect against VAP is also consistent with results from a recent controlled trial by Srivent and colleagues who showed that a short course of cephalosporin prophylaxis was associated with a lower rate of VAP in patients with coma. [37] Prolonged administration of antibiotics in ICU patients is expected to favour selection and subsequent colonization with resistant pathogens.

In this study, the commonest organisms isolated from the urinary catheter, central venous catheter and endotracheal tubes were E.coli, Pseudomonas and Coagulase positive Staphylococcus respectively. The susceptibility of various bacteria to Amoxyclav was uniformly poor in this study, which was probably due to the overuse of the drug.

Ten patients who died in the study had developed UCRI and BSI but none of them were detected to have VAP or nosocomial pneumonia. The patients died because of their underlying debilitating conditions such as polytrauma, sepsis, multiorgan failure, miliary tuberculosis along with enteric fever, diabetes, geriatric patients with coronary artery disease and not due to catheter-related infections.

CONCLUSIONS

The device-associated infection (DAI) rates as evident from literature are highly variable, depending upon a number of factors such as type of patients admitted, prescribing habits of the clinicians, antibiotic policy and infection control programmes of the institute. Each ICU should have an annual review of the microbial flora and their antibiotic susceptibility pattern, which would help in formulation of a rational antibiotic policy.

Surveillance of health -care associated infections is important to understand the nature and extent of the problem. The present study helped to study the catheter-associated infection rates in the ICU (MICU & SICU), and provide information to clinical staff and administration so as to implement effective prevention strategies.

In our institution, prolonged stay in the ICU and increased number of days for indwelling catheters proved to be the two major risk factors apart from the underlying predisposing illnesses of the patients. Antibiotics, often prophylactic, prescribed to the patients with indwelling catheters are however to be monitored under a suitable antibiotic policy. Thus, we recommend that education and awareness among health care personnel as well as adherence to standard guidelines for prevention of nosocomial infection should be used to reduce frequency of nosocomial infection in the intensive care unit.

ACKNOWLEDGEMENTS

We are extremely grateful to Dr. Sk Arif Pasha, Associate Professor, critical care Medicine, and the entire ICU team (MICU & SICU) for helping us in procuring samples. We express our sincere thanks to

Mrs. Saritha (Biostatistician, department of community medicine) and each and every staff of Department of Microbiology, NRI Medical College for their help and co-operation.

Declarations

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by Institutional Ethical committee.

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How to cite this article: Bhattacharya P, Penmetcha U, Myneni RB et. al. Bacterial profile and antimicrobial susceptibility pattern in catheter- related nosocomial infections in a tertiary care teaching hospital, Chinakakani, Guntur district, Andhra Pradesh, south India. Int J Health Sci Res. 2015; 5(6):220-235.

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