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## Study on the Intravascular Catheter-Related Bloodstream Infections in a Tertiary Care Hospital of Tamil Nadu, India.

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### ABSTRACT

The catheter related blood stream infections (CRBSI) are identified as a threat of human kind worldwide affecting ICU admitted patients in hospitals. The rate of chances of getting the CRBSIs vary depending on the hospital set ups and several other variables. The aim of this study is to evaluate the percentage of bacterial colonisation and catheter related blood stream infections (CRBSI) together with the antibiotic susceptibility patterns in a tertiary care hospital located in Chennai, Tamilnadu. Of the 68 catheters studied out of 55 patients, the incidence of colonisation was found 37.6% and CRBSI was 14%. The pathogens identified from the cultures include *S.aureus*, *Pneumonia sp.* *Klebsiella* etc. Among this *Staphylococcus aureus* was found to be the major contributor of CRBSI with 25% rate of. With respect to antibacterial resistance 100% of *Enterobacteriaceae* were ESBL producer, 49.0% *Pseudomonas sp.* were imipenem resistant, 65% *Staphylococcus aureus* were resistant to methicillin resistant. The major risk factors include age of patient, immune status and number of catheters in situ etc. The result of this study would be useful for control and treatment of CRBSI.

**Keywords:** central venous catheters; catheter related blood stream infections; blood cultures, *S.aureus*

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## INTRODUCTION

Intravascular catheters are indispensable in modern-day medical practice particularly in intensive care unit (ICU). The use of intravascular catheters put the patients at a risk for developing infections such as local and systemic infections, septic thrombophlebitis and metastatic infections. The major threat associated with intravascular catheters known as Catheter-related bloodstream infections (CRBSI). In recent years, the CRBSIs are identified as a major cause for increased morbidity and mortality in ICU admitted patients [1]. The CRBSI may be expressed as a percentage of infections occurring per number of catheter placed. However, many factors put the patients at a risk for developing CRBSIs, including duration of catheter used, immunity of patient, hospital set ups etc. *Staphylococcus* and *Pseudomonas sp.* were reported to be the often found species colonized in the catheters of CRBSIs patients. Apart from the above mentioned species enterococci, *Candida*, *Klebsiella* are also involved in CRBSIs [2]. Necessary measures should be taken to prevent the occurrence of such adverse infections. Care should be taken in optimal catheter selection, insertion and maintenance and to removal of catheters when they are no longer needed. The prevalence of CRBSIs varies according to hospitals setup.

The aim of this study was to evaluate the rate of bacterial colonisation of intravascular catheters and CRBSI by Extraluminal Maki's roll over plate method of catheter culture along with their pre disposing factors and the antibiotic susceptibility patterns of the isolated bacteria in a tertiary care hospital in Chennai, Tamilnadu.

## MATERIALS AND METHODS

This study was conducted in Sree Balaji Medical College & hospital, in Chennai, Tamil Nadu, India. The duration of the study is 10-months from the period (March 2014 to Dec 2014), 68 intravascular catheter (5 cm long tip) segments from 55 admitted patients in hospital were enrolled for the present study.

When a patient with a central venous catheter presented fever or a sepsis of unknown origin, Blood cultures were performed by lytic centrifugation method. The catheter was removed and cultures performed by according to Extraluminal Maki's roll over plate method [3,4]. In briefly, using sterile forceps, the catheter tip was removed and laid on a blood agar plate then it was rolled back and forth along the whole surface of a blood agar plate using sterile forceps and by applying light pressure. Same time Blood was drawn under strict aseptic precautions and processed and cultured according to the routine laboratory procedure. Then colony appears on the Maki's roll plate the morphology and Gram staining, biochemical identification was performed to differentiate the species of the bacteria. Then subculture of the organism isolated was performed by routine laboratory techniques. Antibiotic susceptibility studies were performed by Kirby Bauer disc diffusion method [5]. A colony forming unit greater than 15 CFU on the catheter tip was considered as a criteria for the colonisation of catheter tip. The CRBSI is defined as isolation of same organism in both catheter tip and a peripheral blood culture [6]. Screening for methicillin-resistant *Staphylococcus aureus* (MRSA) was performed using an oxacillin (1 µg) disk on Mueller Hinton agar [7].

### Statistical analysis

Statistical analyses were performed using SPSS 16.0 (IBM Corporation, New York, USA). Chi-square was used for univariate analysis and binary logistic regression was used for determining the predisposing risk factors. Statistical significance was determined at a 5% level of significance.

## RESULTS

The average age of the study subject was calculated as 45 years. 55 patients were included in the study and a total of 68 catheters were isolated. The incidence of catheter-related blood-stream infections (CRBSI) in our hospital was found to be 14% (22.1 cases/1000 catheter days). The incidence of catheter colonisation is 37.6%.

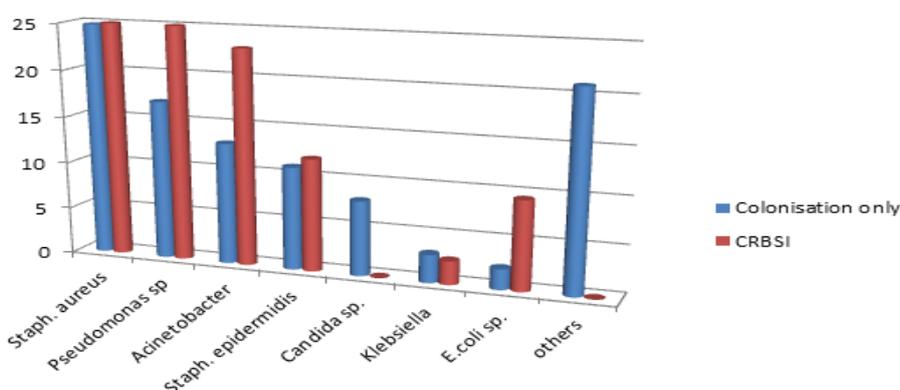
The pathogen associated with catheter associated infection is listed in table 1 and it is depicted in figure 1. The species isolated from the culture included *Staphylococcus aureus*, *Pseudomonas aeruginosa*,

*Acinetobacter sp.*, *Candida sp.*, *Klebsiella sp.*, etc. The common most pathogen identified was *Staphylococcus aureus* causing catheter colonisation and CRBSI with a percentage of 24.8% and 25%, respectively. *Pseudomonas sp.* caused 17% colonisation and 23% CRBSI. Similarly *Acinetobacter* is responsible for 13% and 23% of colonisation and CRBSI.

**Table 1: Isolated microorganisms associated with catheter colonisation and CRBSI**

Microorganism	Catheters associated with (%)	
	Colonisation only	CRBSI
<i>Staphylococcus aureus</i>	24.8	25
<i>Pseudomonas sp</i>	17	25
<i>Acinetobacter</i>	13	23
<i>Staph. epidermidis</i>	11	12
<i>Candida sp.</i>	8	0
<i>Klebsiella</i>	3	2.5
<i>E.coli</i>	2.2	9.5
others	21	0

**Figure 1: Percentage of bacterial species distribution in colonisation and CRBSI**



### Drug resistance patterns

Antibiotic resistance pattern for major isolated organisms was shown in [Table 2]. 100% of Enterobacteriaceae were ESBL producer, 49.0% *Pseudomonas sp.* were imipenem resistant, and 65% *Staphylococcus aureus* were resistant to methicillin resistant.

**Table 2: The antibiotic resistance pattern of major organisms isolated from the patients**

Antibiotics	Percentage of isolates showing antibiotic resistance			
	<i>Pseudomonas sp.</i>	<i>Acinetobacter sp.</i>	Enterobacteriaceae	<i>Staph. aureus</i>
Imipenem	49**	10	10	N
Amoxiclav	90	100	100*	66
Ceftriaxone	60	100	90	N
Ceftazidime	70	98	100	N
Cefotaxime	66	N	N	N
Amikacin	70	0	0	55
Netilmicin	67	0	0	44
Gentamicin	55	7	0	66
Ciprofloxacin	60	24	25	87
Cotrimoxazole	45	N	N	34
Chloramphenicol	N	24	23	N
Oxacillin	N	N	N	65***
Clindamycin	N	N	N	90

N: Not studied, \*100% Enterobacteriaceae were ESBL producer, \*\*49.0% *Pseudomonas sp.* were imipenem resistant, \*\*\*65% *Staphylococcus aureus* were resistant to methicillin, ESBL: Extended spectrum β lactamase.

**Predisposing risk factors**

Using binary logistic regression, the odds ratio was calculated for each variables and this data is presented in Table 3. We observed that age, duration of catheter in situ, immune status, number catheters are significantly associated as a risk factor for catheter associated blood infections. With  $p=0.01$  age above 30 was found to more prone to infections. 80 % of the cases were immune compromised and the remainder were immune competent. Immune status is an important predisposing risk factor with a statistically significant P value of 0.04. Duration of the catheter in situ is a predisposing risk factor ( $P = 0.003$ ) for development of catheter-related infections. The infection is higher patients with multiple catheters ( $P = 0.001$ ).

**Table 3: Predisposing risk factors for the Catheter infection**

Variables	Adjusted Odds Ratio(95% CL)	P value
Age		
>30	1	
<30	52.5(37-66)	0.01*
Immunity status		
Immuno competent	1	
Immune compromised	3.3(2.1-4.2)	0.04*
Duration of catheter in situ		
>12 days	1	
<12 days	43.2(59-145)	0.003**
No od catheter		
Single	1	
Triple	12.4(3.4-72.3)	0.001**

Significance<0.05 marked as \*; <0.005 marked as \*\*

**DISCUSSION**

In this study, we investigate the rate of bacterial colonisation and infection associated with an intravascular catheter by Extraluminal Maki’s roll over plate method of catheter culture together with the antibiotic susceptibility patterns of the isolated bacteria in tertiary care hospital of Chennai. We have also analysed the key risk factors associated with CRBSIs.

The incidence of colonisation was 37.6% (39.3 per cases/1000 catheter days) and CRBSI was 14% (22.1 cases/1000 catheter days) in our hospital. The current study is in line with a previous retro prospective study in conducted in china where the the rate of CRBSI was reported as 6% [8].

As shown in Figure 1, the most common isolates from local infections were *S. aureus* (24.8 %), *Pseudomonas sp.*, (17%), *Acinetobacter sp.*, (13%) etc., and pathogens associated with CRBSI were *S.aureus* (25 %) *Pseudomonas* (25%) and *Acinetobacter* (23%). The relative high frequencies of *S. aureus* in CRBSI was probably due to most of these studied catheter (>70%) were collected from intensive care unit where chance of getting of infection was very high. Similar to our observation Beekmann et al., have also found that staphylococcus aureus as a major contributor for CRBSI [9]. Parameswaran et al., have conducted a cross sectional study in Indian patients and reported that *S.aureus* is key pathogen responsible for infections. These previous reports corroborate the present observation at our hospital.

Though there are many tests for the diagnosis of CRBSI, which test is best for diagnosis of CRBSI in not yet validated. Maki et al., demonstrated that semi Extraluminal Maki’s roll over plate method. This is considered more accurate than the other available methods CRBSI diagnosis [5]. Antibiotic resistant pattern of major organism isolated was shown in Table 2. Rate of multidrug resistance bacteria (e.g., MRSA, ESBL positive organism etc.) was high among the isolates, as the risk of developing infections with the resistant bacteria in hospitalised patients was high. The study also highlights that patients with more age, multiple catheters and immune suppressed people are at high risk for developing this complications.

## CONCLUSION

Intra vascular catheters commonly used nowadays in ICU. However its application causes patients at a risk for several infections. The study highlights that duration of catheter in situ and immune status, age risk factors for getting CABSIs. Care should be taken while using catheters.

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