Bacterial profile of central line associated blood stream infections in I.C.U patients from tertiary care hospital

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Abstract

Introduction: Central line associated bloodstream infection (CLABSI) is a major contributing factor in-hospital mortality and morbidity. CLABSI are considered among the first and most "preventable" classes of nosocomial infections. The most serious complications are bacteremia, sepsis and death. The definitive diagnosis of catheter infection can be made by using a combination of clinical signs and symptoms together with the laboratory confirmed blood culture techniques.

Aim and Objectives: To study the rate of CLABSI in ICU patients. To identify bacteria causing CLABSI and to study their antibiotic sensitivity pattern.

Materials and Methods: This Prospective study was done over a period of 2 years (January 2014–December 2015). CLABSI was diagnosed based on Clinical criteria **(**Fever, chills&Hypotension) and Laboratory criteria (Qualitative blood cultures through device and Differential time to positivity or semi quantitative catheter segment culture).

Results: For the year 2014 & 2015 rate of CLABSI was 7.35 and 5.10 per 1000 central line days. Rate of CLABSI in year 2015 has reduced as compared to year 2014. Out of total 19 isolates 12 were Gram positive cocci (63.15%): five coagulase negative *staphylococci* (CONS) (26.3%), four S. *aureus* (21.05%) and three *Enterococci spp (*15.7%). Six Gram negative bacilli were isolated: Two *E.coli (ESBL)* (10.5%), two *Acinetobacter baumannii* (10.5%), one *K. pneumoniae* (5.26%) and one *Serratia Marcescens.* One non albicans candida was isolated from CLABSI

Conclusion: The 6.08 rate of CLABSI per 1000 catheter days, for 2014 to 2015, was a matter of concern. This work will help in better management of patients as well as in prevention of Catheter related blood stream infection, especially due to multi drug resistant organisms like MRSA & ESBL.

Keywords: CLABSI, Bacterial profile, Multidrug resistant, I.C.U.

Introduction

Catheters are usually inserted for the administration of fluids, blood products, medication, and nutritional solutions and for hemodynamic monitoring. The catheter related blood stream infections (CRBSIs), most of which are associated with central venous catheterization are important healthcare associated infections (HAIs). [1, 2]

Infections associated with CVCs are categorized in the literature as either "central-line associated bloodstream infection" (CLABSI), or "catheter-related bloodstream infection" (CRBSI), based on whether surveillance or ascertainment of infection is the desired goal. Blood stream infection related to central venous Catheter constitutes one of the major nosocomial device associated infection. [3,4]

CRBSI was defined as positive blood culture obtained from central and peripheral vein with clinical evidence of sepsis and with no apparent source of septicemia except tip and catheter colonization with same organism as in blood culture.[5]

For surveillance purposes, the Centers for Disease Control have introduced the term laboratory-confirmed bloodstream infection (LCBI). [6]

LCBI must meet at least one of the following criteria:

1. Patient has a recognized pathogen cultured from one or more blood cultures and the pathogen is not related to an infection at another site.
2. Patient has fever, chills, and/or hypotension as well as positive laboratory cultures from two or more blood samples drawn on separate occasions which are not related to infection at another site and do not reflect contamination.

Average CRBSI rate reported by Chopdekar et al was 9.26/1000 Catheter Day ranging from 27.02/1000 Catheter Days in NICU and 8.64/1000 catheter days in PICU.[7] CLABSI rate varies considerably in the different studies reported from India.[7- 9]

Most common organisms associated with CLABSI reported in various studies are coagulase negative staphylococci (CONS), *S. aureus*, *Enterococci*, *E. coli*, *Klebsiella* and *Candida*.[7-10]

The problem of central line-associated bloodstream infections has gained increasing attention in recent years and is one of the important indicator for deciding infection control policies. CLABSIs are considered among the first and most "preventable" classes of device associated nosocomial infections. The most serious complications associated with CLABSI are bacteremia, sepsis and death. The definitive diagnosis of catheter infection can be made by using a combination of clinical signs and symptoms together with the positive blood culture techniques. The majority

of CRBSIs are associated with CVCs, and the relative risk for CRBSI is significantly greater with CVCs than with peripheral venous catheters.[8]

Present study was aimed at determining the rate of CLABSI in medical surgical adult I.C.U patients and to study bacterial Profile of Central line associate blood stream infections.

Materials and Methods

This Prospective study was carried out at department of Microbiology, of a tertiary care hospital and Medical college, over a period of 2 years (January 2014 – December2015). The study was approved by the ethical committee of Institute.

All Patients admitted in the Medical Surgical ICU, with central line for > 48 hours (2 calendar days) having signs & symptoms of infection fever, chills and hypotension were included. Patients with CVC, having obvious other source of infection were excluded.

Clinical criteria used for diagnosis of CLABSI was patients with fever, chills and hypotension.[11] Following laboratory tests were used for diagnosis of CLABSI-[12, 13]

Qualitative blood cultures through device: Two/three blood cultures were drawn through CVC in adult BACTEC blood culture bottle. BACTEC blood cultures were processed by standard microbiological techniques. Identification of organisms and antibiotic sensitivity was done by using VITEK automated method or by manual method. Any growth was considered as positive.

Differential time to positivity: Simultaneous blood cultures were drawn through, CVC and peripherally in adult BACTEC blood culture bottle, and monitored continuously. Criteria for positivity- both cultures positive with CVC positive ≥2hr earlier than peripherally drawn culture. OR

Semi quantitative catheter segment culture- A 5 cm segment from removed CVC was rolled 4 times across a blood agar plate and incubated for 24- 48 hrs. Criteria for positivity- ≥ 15 CFU /ml.[14]

CLABSI rate was calculated using following formula -

The CLABSI rate

$$\text{Per 1000 central line days} = \frac{\text{Number of CLABSI}}{\text{Number of Central line days}} \times 1000$$

Blood (10 ml) was collected from central line and from peripheral vein in all clinically suspected cases of LABSI under aseptic precautions in a BACTEC blood culture bottles. Positive blood culture were sub cultured on Blood agar and MacConkeys agar incubated for 24 to 48 hrs., then culture plates were examined for growth. Culture isolates were identified either by using VITEK cards or by Manual methods. Antimicrobial susceptibility was done by Vitek-2/ Kirby Bauer's disc diffusion method as recommended by the Clinical Laboratory Standards Institute (CLSI).

Results

A total of 565 patients underwent central venous catheterization in medical surgical adult intensive care unit (ICU) for various indications. Out of total 146 blood samples received for culture 61 were negative. In 38 cases other source of infection was detected (pneumonia, UTI, cellulitis, post-operative infection etc). In remaining 47 cases by using laboratory confirmation tests 'Qualitative blood cultures through CVC', 'Differential time to positivity' Or 'Semi quantitative catheter segment culture'-, 19 cases of CLABSI were confirmed. Total central line catheter days were 3124. Rate of CLABSI per 1000 days in our study was 6.08.

Table No. 1: Association of CLABSI with age

Age group in years	No. of cases	Percentage %
<24	0	0
25-49	6	31.6
50-74	10	52.6
>75	3	15.8
Total	19	100

Maximum CLABSI rate was observed in age group 50-74 years (52.6%) followed by age group 25-49 years (31.6%).

Out of total 19 CLABSI, 13 (68.4%) were observed in male patients and 6 (31.6%) were observed in female patients.

Table 2: Rate of CLABSI per 1000 catheter days (year 2014)

Month	No of patients with CVC	Central Line days	No of CLABSI	CLABSI per 1000 central line days
Jan-14	22	107	1	9.3
Feb-14	18	92	0	0.00
Mar-14	24	113	1	8.8
Apr-14	21	108	1	9.3
May-14	18	105	1	9.52
Jun-14	24	101	1	9.90
Jul-14	26	155	2	12.9

Aug-14	23	114	1	8.77
Sep-14	19	110	1	9.09
Oct-14	21	109	1	9.17
Nov-14	22	141	0	0.00
Dec-14	20	105	0	0.00
Total	**258**	**1360**	**10**	**7.35**

For the year 2014 rate of CLABSI per 1000 catheter days was 7.35.
Maximum rate of 12.9 per 1000 catheter days was noted in the month of July, followed by June (9.9) per 1000 central line days.

Table 3: Rate of CLABSI per 1000 catheter days (year 2015)

Month	No of patients With CVC	Central Line days	No of CLABSI	CLABSI per 1000 central line days
Jan 2015	28	127	1	7.9
Feb 2015	25	145	1	6.9
March 15	29	156	0	0
April 15	24	123	0	0
May 15	30	127	0	0
June 15	23	103	0	0
July 2015	32	182	2	10.9
Aug 2015	33	197	1	5.08
Sept 2015	22	171	2	11.7
Oct 2015	21	158	0	0.0
Nov 2015	17	135	1	7.4
Dec 2015	23	140	1	7.2
Total	3O7	1764	9	5.10

Rate of CLABSI for 2015 was 5.10 per 1000 central line days. Maximum rate of 11.7 per 1000 catheter days was noted in the month of September, followed by 10.9 per 1000 central line days in month of July.

In our study from January 2014 to December 2015, rate of CLABSI was 6.08 per 1000 central line days.

Table 4: organisms isolated from CLABSI

S. No	Organisms		Number	Percentage (%)
1	*Coagulase-negative Staphylococci(*CONS)		5	26.3
2	*Staphylococcus aureus* (4)	*S. aureus (MSSA)*	1	5.26
		S. aureus MRSA)	3	15.8
3	*Enterococcus Spp* (3)	*E. faecalis*	1	5.26
		E. faecium	1	5.26
		E. Gallinarium	1	5.26
4	*E.coli (ESBL)*		2	10.5
5	*Klebsiella pneumoniae (ESBL)*		1	5.26
6	*Acinetobacter baumanii*		2	10.5
7	*Non albicans candida*		1	5.26
8	*Serratia marcescens (ESBL)*		1	5.26
Total			19	100

Gram positive Organisms were the most common isolates in our study (63.15%).

Out of total 19 isolates 12 (63.15%) were Gram positive cocci. We have isolated five coagulase *negative staphylococci* (26.3%), four S. *aureus* (21.05%) and three *Enterococci spp* (15.7%) from CLABSI.

Out of five CONS, four were MRCONS, and out of four *S. aureus*, three were MRSA and one was MSSA. Both the MRSA and methicillin resistant coagulase negative *Staphylococci* (MRCONS) isolated were sensitive to Vancomycin, Teicoplanin and Linezolid.

Three *Enterococci spp* were isolated from CLABSI namely *E. Faecalis, E faecium and E gallinarum*. All were sensitive to vancomycin and Teicoplanin, Tigecycline and Linezolid. Minimum sensitivity was noted to Benzylpenicillin, Gentamicin, and Ciprofloxacin.

Six Gram negative bacilli were isolated: Two *E.coli (*ESBL) (10.5%), Two *Acinetobacter baumanii* (10.5%), one *K. pneumoniae* (5.26%) and one *Serratia Marcescens.* One non albicans candida was isolated from CLABSI.

Both *E. coli* (ESBL) were susceptible to Piperacillin/Tazobactam, Imipenam, Meropenem, Tigecycline and Colistin and resistant to Ciprofloxacin.

Klebsiella. Pneumoniae (ESBL) isolated was susceptible to Piperacillin/Tazobactam, Imipenem, Tobramycin, Amikacin and Colistin

Two strains of *Acinetobacter baumannii*- isolated from CLABSI were sensitive to Imipenem, Colistin and polymyxin. *A. baumanii* was resistant to Tigecycline, Cefoperazone/ Sulbactem.

Serratia marcescens (ESBL**)** strain was isolated from CLABSI in our study. *Serratia. Marcescens* was sensitive to Piperacillin/ Tazobactem, Levofloxacin, Imipenem, Meropenem, and Tigecycline.

Discussion

The use of central venous catheters (CVCs) is an integral part of modern health care throughout the world. Their use is associated with the risk of bloodstream infection caused by microorganisms that colonize the external surface of the device or the fluid pathway when the device is inserted or manipulated after insertion.

In the present study, CLABSI rate per 1000 catheter days was most common in the age group 50-74 (52.63 %) followed by the age group 25-49 (31.57%), Which is similar to the study HV Patil et al, reported 29.62% of rate of CLABSI in patients above the age of 60 years, and 25.92% rate in patients who were between 41-50 year ages.[8]

In our study from January 2014 to December 2015, rate of CLABSI was 6.08 per 1000 central line days. For the year 2014 rate of CLABSI per 1000 catheter days was 7.35. Rate of CLABSI for 2015 was 5.10 per 1000 central line days. In the present study rate of CLABSI in year 2015 has reduced as compared to year 2014. This is due to different measures implemented by infection control committee to reduce the CLABSI rate. This is similar to the work by Mehta et al, studied the profile of healthcare associated infections (HAI) including central venous catheter related infections in 12 ICUs across 7 cities in India. The incidence rate of CRBSI was 7.92 per 1000 catheter days.[15] One another study by Chopadekar et al (2011) reported, 9.26 rate of CRBSI per1000 catheter days.[4] Study by Ramanathan Parmeshwaram et al (2011) reported rate of CRBSI; 8.75 per1000 catheter days.[9]

Gram positive Organisms were the most common isolates in our study (63.15%) and six Gram negative bacilli were isolated (31.6%).

This observation is similar to study by Vinay Khanna et al (2013), reported 64% of the pathogens of CRBSI were Gram positive and 36% were Gram negative.[10] One another study by Rupam Gahlot et al (2013) reported 71% of the pathogens of CRBSI were Gram positive and 22% were Gram negative bacilli.[13] Ramanathan Parmeshwaram et al reported 64% of the pathogens of CRBSI were Gram positive and 31.3% were the Gram negative.[9] Different observation was published by FJ Mansur et al, reported Gram negative bacteria as common isolates from CLABSI.[16]

Predominant isolate in present study was coagulase negative staphylococci (26.3%). Similar findings were reported by Chopdekar et al (2011), commonest pathogen causing CRBSI was CONS (50%).[7] HV Patil et al (2011) isolated 65% of CONS in their study.[8]

A concerning trend over the past few years has been the increasing rate of multidrug resistant organisms causing health care associated infections.[17,18] Frequently isolated strains from CRBSI are methicillin-resistant *S. aureus* (MRSA), fluconazole-resistant *Candida* species, vancomycin-resistant *E faecium* and ESBL *K. pneumoniae*, *E.coli*. Strains of *P.aeruginosa* and *Acinetobacter spp*, isolated from CLABSI are no longer susceptible to third and fourth generation Cephalosporins, Ureidopenicillins, Flouroquinolones and Carbapenems. For CONS, *P aeruginosa* and *Acinetobacter spp* ability to adhere to polymer surface and formation of biofilm appears to play an important role in the pathogenesis of these infections.

Both the MRSA and methicillin resistant coagulase negative *Staphylococci* (MRCONS) isolated were sensitive to Vancomycin, Teicoplanin and Linezolid. Similar findings were reported by Ramanathan Parmeshwaran et al, HV Patil et al and Vinay Khanna et al.[8-10]

In present study, out of 19 pathogens causing CLABSI six were the Gram negative bacteria, two *E, coli* (ESBL), one *K. pneumoniae* (ESBL), two *A.baumanii* and one *Serratia marcescens.* All isolates of *E.coli* (ESBL) were susceptible to Piperacillin/Tazobactam, Imipenam, Meropenem, Tigecycline and Colistin, and were resistant to Cephalosporins, Aztreonam, Ciprofloxacin. This is similar to the study of Parmeshwaran et al, reported all *E.coli* were sensitive to Meropenem.[9] Similar *E.coli* (ESBL) pathogens from CRBSI were reported by Vinay Khanna et al, which were sensitive to reserved antibiotic Meropenem (100%).[10]

Klebsiella. Pneumoniae (ESBL) isolated was susceptible to Piperacillin/Tazobactam, Imipenem,

Tobramycin Amikacin and Colistin. This is similar to the study by Ramanathan Parmeshwaram et al reported that all K. Pneumoniae were sensitive to Amikacin.[9] HV Patil et al reported that the K. pneumoniae isolates were resistant to all the antibiotics except Amikacin and Ciprofloxacin.[8]

Two strains of *A.baumannii* were isolated from CLABSI which were sensitive to Imipenem, Colistin and polymyxin. *A.baumanii* was resistant to Tigecycline, Cefoperazone/Sulbactem, Cotrimoxazole. Ramanathan Parmeshwaram et al and Vinay Khanna et al reported similar multidrug resistant strain of *A. baumanii* isolated from CRBSI.[9,10] *Serrati marcesens* strain was isolated from CLABSI in present study, which was sensitive to Piperacillin/Tazobactem, Levofloxacin, Imipenam, Meropenam and Tigecycline..

In this study out of total 18 bacterial isolates four MRCONS, three MRSA, two *E, coli* (ESBL), two *A. baumanni*, one *K. pneumoniae* (ESBL) and one *Serratia*. *marcescens* (ESBL) were multi drug resistant.

As the risk of developing infections with the resistant bacteria in hospitalized patients is high, our findings will help to implement educational and training programs on CRBSI for health personnel working in designated area and will enable better management of these devices with regard to prevention, diagnosis and treatment.

Conclusion

CLABSI is one of the important device associated hospital acquired infection in I.C.U. patients. CLABSI rate is one of the important quality indicator for formulating infection control policies. Continuous surveillance is needed to know bacteria causing CLABSI and their antibiotic sensitivity pattern to decide hospital antibiotic policies. Institution of continuous quality improvement programs, education, and training of health care workers significantly reduced the incidence of catheter-related infections. This work will help in better management of patients as well as in prevention of Catheter related blood stream infection, especially due to multi drug resistant organisms like MRSA & ESBL producing Gram negative bacilli.

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