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Incidence of Central Line-Associated Bloodstream Infections In A Tertiary Care Hospital

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ABSTRACT

Central Venous Catheters (CVCs) are indispensable in current intensive care treatment; also pose a greater risk of device related infections in comparison to any other type of medical device and are major cause of morbidity, mortality and increased expense. A cross sectional prospective study of one year duration was conducted in the tertiary care hospital ICUs, to determine the incidence of the central line associated bloodstream infection (CLABSI) and to identify the associated risk factors. Two hundred and eleven patients admitted to various ICUs with an indwelling central venous catheter (CVC) for more than 48 h were monitored. The incidence rate of CLABSI in our study is 9.48% and 13.5 per 1000 central line days. *Klebsiella spp.*(35%) are the most commonly isolated micro-organism and other organisms isolated are *Acinetobacter baumannii* (15%), *Pseudomonas aeruginosa* (10%), *Escherichia coli*(10%), *Staphylococcus aureus*(10%), *Candida tropicalis*(15%) *and Candida krusei* (5%).The age group of patients were ranging from a minimum of 1 year to maximum of 77 years with a mean age of 33.52 ± 19.75 years from various speciality ICUs were included among which the highest number of samples were received from surgical ICU, that is 75 samples (35.55%) followed by bone marrow transplant unit and medical ICU. The most commonly used catheter was subclavian catheter (74.8%).

Keywords: Central Line-Associated Bloodstream Infections, Gram-negative bacteria, antimicrobial resistance, Intensive Care Units, multidrug-resistant, extensively drug-resistant.

INTRODUCTION

Health-care-associated infection (HCAI) is perhaps the most important factor that adversely affects the performance and image of a hospital. One of the most common HCAIs is central line-associated bloodstream infection (CLABSI) which is indispensable in current intensive care treatment; also pose a greater risk of device related infections in comparison to any other type of medical device[1]. Besides increasing morbidity and mortality, it prolongs the hospital stay of patients, increases bed occupancy, and puts undue pressure on the already strained resources of the hospital, patients, and community[2]. CLABSI has been estimated to increase the duration of hospitalization by 7–21 days. In comparison to developed nations, the baseline rate of CLABSI is found to be around eight-fold higher in India[3]. The prevention of CLABSI requires knowledge of the infection rates, their associated factors, sources, the pathogens involved as well as their antimicrobial profile[4].

METHODOLOGY

This study employed a cross-sectional design to determine the proportion of microorganisms in Central Line-Associated Bloodstream Infections (CLABSIs) and analyze their associated factors providing a comprehensive overview of the current burden of CLABSIs in the ICU.

SETTING AND DURATION

This study was conducted in the Department of Microbiology, Mahatma Gandhi Memorial Medical College and associated hospitals, Indore (M.P) for a period of one year from December 2022 to December 2023.

PARTICIPANTS

The study included ICU patients with central venous catheters in place for more than 48 hours, as prolonged catheterization is a well-documented risk factor for CLABSIs. Patients were enrolled based on specific inclusion criteria:

- Age >1 year.
- No bloodstream infections at the time of catheter insertion.
- Willingness to provide informed consent.

DATA COLLECTION

Data collection was systematic and involved multiple steps to ensure accuracy and reliability

1. **Microbiological Sampling**:
   - Patients were identified (who fulfil the criteria of CLABSI) and their blood samples were collected in BHI broth.
   - Then the BHI broth was incubated overnight aerobically at 37°C.
   - The sample was inoculated onto Blood Agar, MacConkey Agar and Sabouraud's Dextrose Agar.
   - If there is no growth then the sample is sub-cultured on alternate days for 7 days before reporting it as sterile.
2. **Pathogen Identification**:
   Standard microbiological protocols, including Gram's staining, culture on blood agar and MacConkey agar, and biochemical tests, were used for pathogen identification.
3. **Antibiotic Susceptibility Testing**:
   Isolates underwent antibiotic susceptibility testing using the Kirby-Bauer disk diffusion method. Resistance profiles were categorized as sensitive, intermediate, or resistant based on CLSI Guidelines 2022 breakpoints.

DATA ANALYSIS

Statistical analysis was conducted using SPSS (Statistical Package for the Social Sciences) software. Descriptive statistics were used to calculate the prevalence of Gram-negative bacteria and their resistance patterns. Chi-square test was applied to determine associations between patient demographics, catheter duration and infection rates. Results were presented as percentages, means, and standard deviations, with a significance threshold set at $p < 0.05$.

RESULT

Table No. 1: Incidence rate of CLABSI

	Number	Percentage
No. of culture positive patients	20	9.48%
Total no.of patients with central line	211	

The incidence rate of CLABSI is 9.48%.

Chart No.1: Age wise distribution of CLABSI patients

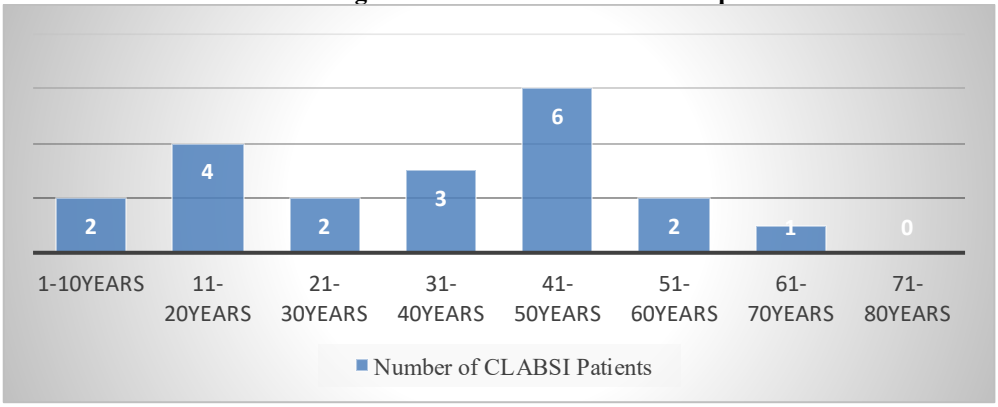


Table No. 2: Gender wise distribution of CLABSI patients

	No of CLABSI patients(N=20)	Percentage
Female	6	30%
Male	14	70%
Total number of cases	20	

The percentage of male patients is more than female patients.

Table No. 3: Unit wise Distribution of Total Patients

Unit	Number of patients(N=211)	Percentage

BMT UNIT	48	22.75%
PICU	11	5.21%
MICU	39	18.48%
SICU	75	35.55%
NEURO ICU	28	13.27%
HD UNIT	10	4.74%

The highest percentage of patients enrolled were from Surgical ICU with 35.55%.

Chart No.2: Unit wise distribution of CLABSI patients

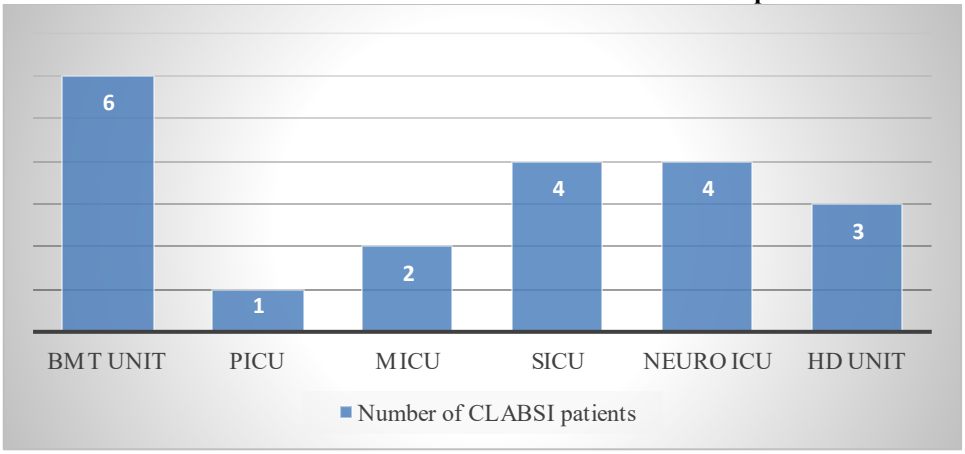


Table No. 4: Distribution of patients according to days of central line

Unit	<7 days	>7 days
BMT UNIT	23	25
PICU	9	2
MICU	33	6
SICU	55	20
NEURO ICU	16	12
HD UNIT	9	1
Total	145	66

Overall there is higher number of patients with central line for a duration of <7 days except in BMT unit where the patients were higher with central line >7 days duration.

Chart No.3: Distribution of CLABSI patients according to days of central line

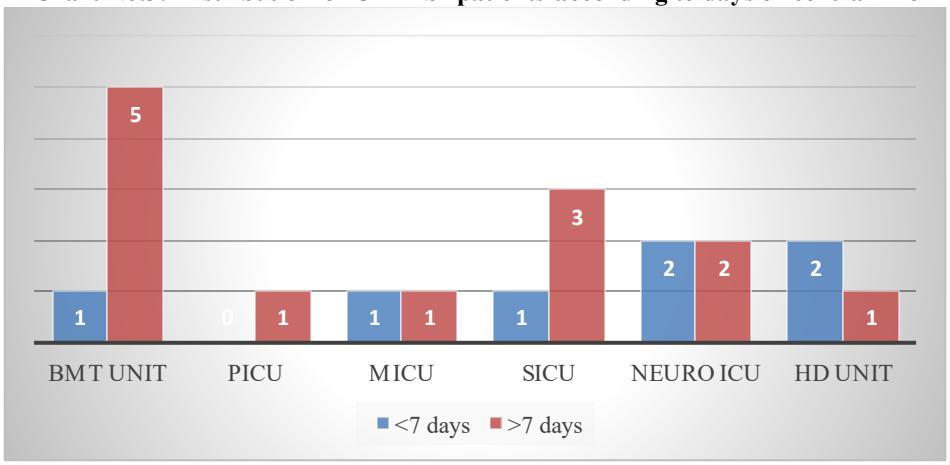


Table No. 5: Association of duration of central line days with CLABSI

	CLABSI positive	CLABSI negative	Chi square statistic	p- value
>7 days	13	53	11.69	0.00063
<7 days	7	138		
Total	20	191		

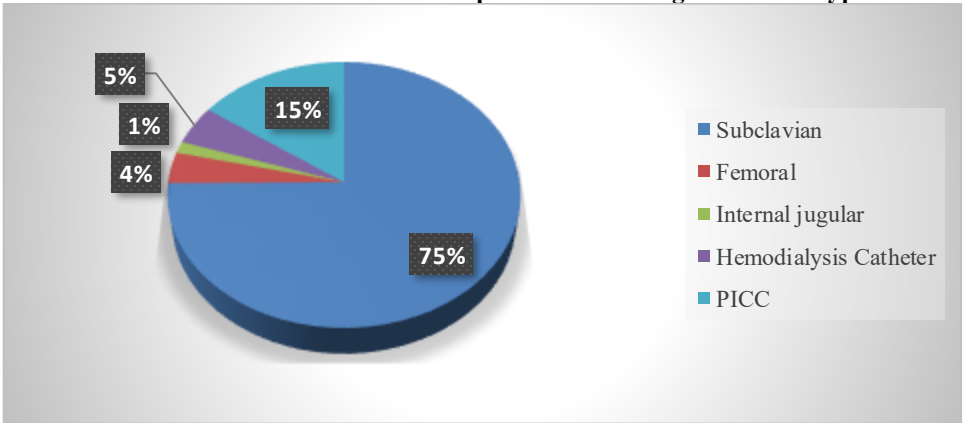
The p value is significant (<0.05). And in our study the p value obtained is 0.00063 which states significant association between central line duration and incidence of CLABSI. With the increase in duration of central line, the incidence rate of CLABSI increases.

Table No. 6: Distribution of total patients according to catheter type

Type of Central line catheter	Number of patients(N=211)	Percentage
Subclavian	158	74.88%
Femoral	8	3.79%
Internal jugular	3	1.42%
Hemodialysis Catheter	10	4.74%
PICC	32	15.17%

The highest percentage of central line catheter used were subclavian vein catheter with 74.88%.

Chart No.4: Distribution of total patients according to catheter type



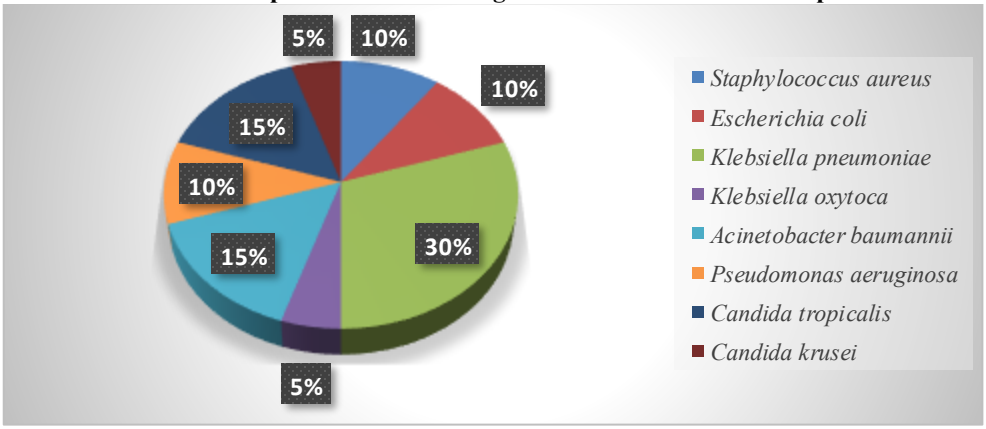
CLABSI Rate

In our study the CLABSI rate is 13.5 CVC days.

(Number of CLABSI cases/ Number of central line days) X 1000

(20/1480)X100 = 13.5 per 1000 Central line days

Chart No.5: Proportion of micro-organisms isolated in CLABSI patients



DISCUSSION

In our study, a total of 211 patients with central line were included whose blood samples were tested for culture positivity. Out of the total samples tested, 20 were culture positive which gives us a incidence rate of 9.48% which is in agreement with the study conducted by Maqbool *et al.*[4] 2023. Majority of culture positivity was seen in the age group of 41-50years(17.06%) which is concordant with majority of studies like that of Dubey P *et al.* [5]. 20 isolates culture positive which included 14(70%) male patients and 6(30%) female patients. This derivation is similar in most of the studies like that of Arvindh Santhosh SR *et al.* [6] where there were 72% males and 28% females.

In our study, various speciality ICUs were included among which the highest number of samples were received from surgical ICU, that is 75samples (35.55%) followed by bone marrow transplant unit and medical ICU. Culture positivity in

our study was highest among bone marrow transplant unit (30%) followed by surgical and neurology ICU (both were 20%). The highest percentage of positive cases from bone marrow transplant unit can be attributed to the fact that the patients dealt here were immunocompromised. Singh *et al.* [2] conducted a study in 2022 which also had the same pattern with number of samples more in surgical ICU than medical ICU and other units. Toor H *et al.* [7] conducted a study in 2022 which had similar finding. Whereas in study of Sarala KS *et al.* [8] the proportion of medical units and pediatric units at the higher end than other specialities.

There were 145(68.72%) central lines for less than 7 days and 66 (31.28%) central lines for more than 7 days. Furthermore, out of the total20 culture positive patients 7(35%) were less than 7 days and 13(65%) were more than 7 days. Our study states that the culture positive rate is more when the duration of central line is for more than 7 days which shows significant association between central line duration and incidence of CLABSI with p- value <0.05. In our study, we obtained an average central line duration to be 7 days because of which we have categorized the duration of central line accesses with a 7 days criteria. The CLABSI rate in our study is 13.5 per 1000 central line days which is almost similar to the CLABSI rate of 12.1 per 1000 central line days obtained in the multicentric surveillance study conducted in 2022 by Purva Mathur *et al.*[9] We observed that subclavian vein catheters were used in 158 patients (74.88%) followed by PICC in 32 patients (15.17%) , femoral vein in 8 patients (3.79%), internal jugular vein catheter in 3 patients (1.42%) and hemodialysis catheter in 10 patients(4.74%). Most of the clinicians prefer subclavian line access over other venous accesses because of the reason that it is associated with lowest risk of infection overall. This is similar to the findings of Darji and Patel *et al.* [10] where the most common site of insertion was subclavian vein(50%) and 92% in the study conducted by Dr Sonia Mehta *et al.* [11] There are a number of studies like Ujesh *et al.*[12], Negi N *et al.* [13] and Sivakumar V *et al.* [14] where all demonstrates similar results in support.

The common pathogenic bacteria isolated in our study were *Klebsiella spp.* (35%), *Acinetobacter baumannii* (15%), *Pseudomonas aeruginosa* (10%), *Escherichia coli*(10%), *Staphylococcus aureus*(10%), *Candida tropicalis*(15%) *and Candida krusei* (5%). This is in concordant with the result obtained in the multicentric study [9] conducted under ICMR's Antimicrobial Resistance Surveillance and Research Network and the NCDC's National Antimicrobial Resistance Surveillance Network, coordinated by the All India Institute of Medical Sciences, New Delhi in 2022 which concluded *Klebsiella spp*. (24.8%) were the most frequently identified pathogen among CLABSI patients, followed by *Acinetobacter spp.* (21·3%) and *Candida spp.* (11·8%) .

CONCLUSION

The incidence rate of CLABSI in the present study was in accordance with the average CLABSI rate detected in other studies in India. The CLABSI incidence is significant and associated with prolonged duration of catheterization. Maximal sterile techniques should be practiced while inserting CVC and in after care, regular monitoring of CVC and its need to continue should be measured promptly. By knowing the changing trends of microbial flora, empirical therapy can be formulated for early and effective management of CLABSI.

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