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Demographic characteristics and microbial profile of central line associated blood stream infections in the central intensive care unit

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Abstract
Central line-associated bloodstream infection (CLABSI) is one of the most frequent and lethal complications of central venous catheterization. The need for this study lies in the fact that CLABSI in ICUs is common; it increases the length of hospital stay while increasing the mean attributable cost of treatment.
Materials and Methods: A prospective observational study was conducted in the Central ICU (CICU) of Assam Medical College and Hospital (AMCH) after getting institutional ethical committee (IEC) approval. 100 patients were included in the study.
Statistical Analysis: Statistical analysis was done using Microsoft Excel and Microsoft Word. Descriptive data were presented as mean ± SD. Categorical data were given as a percentage. Chi-square test was used for univariate analysis. Multiple logistic regression was used to determine predisposing risk factors. For all tests, p-value < 0.05 was considered significant.
Results: Nine patients developed CLABSI. CLABSI was seen after 8 days of catheterization. CLABSI rate was 7.8 per 1000 central line days. Klebsiella Pneumoniae (gram-negative) was the most common isolate.
Conclusion: The high CLABSI rate in our ICU calls for the need for antibiotic stewardship program and tighter bundle care protocol.

Keywords: central venous catheter, Klebsiella Pneumoniae

Introduction
Central venous catheters are a sine qua non in present day critical care and emergency management. It paves the way for aggressive and prompt administration of drugs, intra venous fluids, blood or other blood products. But the procedure is not void of complications which can be mechanical (hematoma, arterial puncture), infectious (insertion site infection, CVC colonization, blood stream infection) or thrombotic (deep vein thrombosis).
Central line-associated blood stream infection (CLABSI) is defined as a primary laboratory confirmed bacteremia or fungemia if a recognized pathogen is cultured from one or more percutaneous blood culture/s after 48 hours of vascular catherization, and the pathogen cultured from blood was not related to an infection at another site [1].
CLABSI is one of the most frequent and lethal complication of central venous catheterization [2] and in turn account for majority (around 14%) of hospital acquired infections attributed to blood stream infection [3]. The importance of this dissertation work lies in the fact that CLABSI in ICU's are common, it increases the length of hospital stay while increasing the mean attributable cost of treatment [4, 5], CVCs have a higher infection risk than other indwelling catheters [6] and that CLABSI are considered among the first and most preventable classes of nosocomial infections [7].

Materials and Methods
A prospective observational study was carried out upon 100 patients over duration of one year (01.07.2018 to 30.06.2019) in the Central Intensive Care Unit (CICU) of Assam Medical College and Hospital (AMCH), Dibrugarh after obtaining the approval of Institutional Ethic Committee (H).

Aims and Objectives
1. To characterize the incidence of CLABSI, the microbial profile common for CLABSI in the Central Intensive Care Unit and their drug culture and sensitivity.
2. To observe the time period after which CLABSI are common after central line insertion.

Inclusion Criteria
- Patients more than 18 years who gave consent for the procedure.
- First central venous catheterisation done in the CICU.
- CVC in situ for more than 48 hours.

Exclusion Criteria
- Patients less than 18 years or who did not give consent.
- First central venous catheterisation done outside the CICU.
- Patients with some other definite source of infection.
- Immune compromised states.
- Presence of localized infection or inflammation prior to catheterization.

Patient work up for microbiological study:
All patients enrolled in the study were followed daily for the under mentioned signs and symptoms of new onset sepsis 48 hours after the insertion of the CVC:

- Temperature >38 °C or <36 °C.
- Heart rate: >90beats/minute.
- Respiratory rate: >20 breaths/minute, or arterial PCO_2 <32 mm Hg.
- WBC count >12,000/mm^3 / <4000/mm^3, or >10% immature neutrophils (band forms) [8].

In case of suspicion of new onset sepsis, two sets of blood samples were drawn, one percutaneously and one through the CVC for culture over a span of 24 hours. Attempt to exclude other sources of infection was made by focused physical examination and relevant investigations including culture of urine, sputum or tracheal aspirate, imaging studies etc depending upon the clinical profile of the patient. If no other apparent source of infection was found, then a blood stream infection (BSI) was suspected and the CVC removed using a sterile technique. The distal 5 cm segment of the catheter was cut using a sterile blade, sealed in a sterile container and transported to the laboratory as soon as possible. Catheter tip segment was processed and reported according to the pre-determined protocol. [103] Immediately subsequent to catheter removal, 5 ml of blood was collected aseptically from the peripheral vein for blood culture. In the absence of signs and symptoms of local or systemic sepsis, a set of blood cultures was routinely taken from the catheter at the time of catheter removal. Each collected set of blood culture bottles was processed by BACTEC-460® radiometric method for bacterial and fungal isolates.

Statistical Analysis
Statistical analysis was done using Microsoft Excel and Microsoft Word. Descriptive data were presented as Mean ± SD or median with inter quartile range. Categorical data were given as percentage. Chi-square test was used for univariate analysis and multiple logistic regression was used to determine predisposing risk factors. For all tests p value of less than 0.05 was considered significant.

Results and Observation
Some other important variable of the study were

Table 1: Study Variables

VARIABLE	DATA
1. Mean age of patients under study	40.89 ± 16.6 years
2. Mean age of males	42.04 ± 16.08 years
3. Mean age of females	38.43 ± 17.6 years
4. Male to female ratio	2.12: 1
5. Total hospital days	1569 days
6. Total CICU days	1293 days
7. Total central line days	1148 days
8. Total patient days	1534 days
9. Total ventilator days	1077 days
10. Total Foley's days	1246 days

CLABSI incidence [9] = Number of reported CLABSI's/No of central line days × 1000
= 7.8 per 1000 central line days.

Device utilization ratio of central line [9]= Number of central line days/Number of Patient days
= 0.746.

The causative microbial flora of CLABSI in our study were

Table 2: Organisms causing CLABSI

Organism	Number of patients	Percentage
Acinetobacter baumannii	2	22%
Methicillin Resistant CoNS	1	11%
Citrobacter species	1	11%
Klebsiella species	4	45%
Yeast	1	11%
Total	9	100%

Drug sensitivity of organisms responsible for CLABSI

Table 3: Sensitivity pattern of organisms causing CLABSI

Organism	Sensitive	Resistant in common	Specific resistant
Klebsiella Pneumoniae (ESBL +ve)	Gentamicin, Tigecycline, Imipenem.	Ampicillin, ampicillin sulbactum, ciprofloxacin, cefepime, ceftazidime, cefotaxime, piperacillin tazobactum.	Meropenem.
Klebsiella Pneumoniae	Tigecycline, colistin.		Gentamicin, imipenem.
Acinetobacter baumannii	Minocycline, meropenem.	Amikacin, cotrimoxazole, ciprofloxacin, ceftazidime, cefotaxime, cefepime, levofloxacin, imipenem, piperacillin tazobactum, ertapenem.	
Coagulase negative staphylococcus species (CoNS).	Cotrimoxazole, linezolid, vancomycin.	Penicillin, erythromycin, ciprofloxacin, clindamycin, cefoxitin.	
Citrobacter species	Sensitivity: Amikacin, cefepime, levofloxacin, imipenem, piperacillin tazobactum, minocycline, meropenem. Intermediate sensitivity: Ceftazidime.		
Yeast	Some central line tip culture yielded budding yeast, but further fungal specific culture and sensitivity showed no definite organism.		

Demographic profile of CLABSI in our study

1. Mean age at which CLABSI was diagnosed in our study: 42.8 ± 17.71 years.
2. Male: Female = 2: 1
3. Number of days after which CLABSI was seen: 08 days.
4. In our study there was a gradual increase in rate of CLABSI with increase in age of the patients.

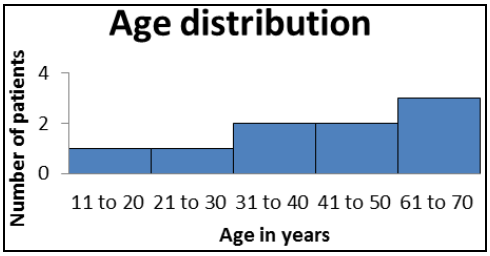

Fig 1

5. CLABSI rate as par setting of catheterization

Table 4

Indication	Emergency catheterization	Elective catheterization
Total patients	13	87
CLABSI positive	1	8
CLABSI rate	7.69%	9.19%

6. CLABSI rate as par site of catheterization:

Table 5

Site	Total patients	CLABSI positive	CLABSI rate
Subclavian route	90	9	10%
Jugular route	8	0	0%
Femoral route	2	0	0%
Total	100	9	10%

7. Mean duration of hospital stay in patients with CLABSI and in patients without CLABSI was 13.55 ± 8.01 and 12 ± 8.01 days respectively. Applying unpaired T test, the two tailed P value is calculated to be 0.581, which is insignificant. Hence we can conclude that in our study there is no significant difference in length of ICU stay in patients who developed CLABSI and in patients who didn't.

Discussion

The mean age at which CLABSI was seen in our study was 42.8 years. This was similar to be study done by Rode A *et al.* [13], Kaur M *et al.* [12] and Mishra SB *et al* [14].

In our study there CLABSI was more among male patients. This was similar to the result obtained by Bhavana C *et al* [10], Rode A *et al.* [13], Apostolopoulou E *et al* [15].

In our study the rate of CLABSI was found to be 7.8 per 1000 central line days. This was similar to the results obtained by Aravind M *et al* [16] (7.6 per 1000 central line days), Kumar S *et al.* [17] (7.4 per 1000 central line days), Bhatawadekar S M *et al.* [18] (7.35 per 1000 central line days) and Shilpa *et al* [19].

In our study CLABSI was exclusively seen when subclavian route was used for cannulation. This was similar to the study done by Kaur M *et al* [12] But our study deferred from the result obtained by Rode A *et al.* [13] Bhavana C *et al.* [10] Oberai L *et al.* [20] Lin KY *et al.* [21] and Kaur M *et al.* [12] who found CLABSI to be more common when internal jugular vein was used for cannulation, followed by femoral vein and subclavian vein.

In terms of microbial profile of CLABSI, in our study there was a predominance of gram negative organisms (78%) over gram positive organisms (11%), followed by fungal isolates (11%). This was similar to the observation made by Dutta P *et al.* [22] Mittal G *et al.* [11] and Tomar S *et al.* [23] However, Patil HV *et al.* [24] and Bhavana C *et al.* [10] found gram positive organisms to predominate over gram negative organisms. On the other hand Kaur M *et al.* [12] found an equal contribution of gram negative and gram positive organisms towards CLABSI.

Factors associated with probable CLABSI

The factors associated with CLABSI were compared by univariate analysis. None of these factors were found to be statistically significant and hence associated the CLABSI cases reported in our study.

Table 6

CLABSI (n=9)	YES	NO	P value
Male (n=68)	6	62	0.775912
Age > 40 years (n=47)	5	42	0.850068
Central line days ≥ 08 days (n=72)	5	67	0.956063
Major diagnosis on ICU admission			
Road traffic accident (n=41)	4	37	0.89262
Traumatic head injury (n=44)	6	38	0.278333
Polytrauma (n=7)	1	6	0.870955
Hollow viscus perforation (n=12)	1	11	0.651541
Indication at cannulation			
Emergency (n=12)	1	12	0.73169

Conclusion

Central line associated blood infection is one of the potentially life threatening complications of CVC catheterization. CLABSI is also considered amongst the first and most preventable complications of nosocomial infection.[4] this study was the first of its kind conducted in our institute. The CLABSI rate in our set up was found to be 7.8 per 1000 central line days while the CRBSI rate was 3.48 per 1000 central line days. Gram negative organisms dominated CLBSI while gram positive organisms dominated CRBSI. CLABSI rate of 0 is considered as the marker of the standard of care of a particular institute. This study was an attempt to highlight the overall incidence of CLABSI, the common microorganism responsible for CLABSI in our CICU and their antibiotic susceptibility pattern. From our study we may suggest the following:

- A high degree of suspicion is necessary to prevent CLABSI.
- A high degree of vigilance to check for strict application of bundle care as advocated by CDC.
- Formulation and implementation of antibiotic stewardship program to prevent development of MDR organisms.

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