

Incidence of Central Line-Associated Blood Stream Infection in Pediatric Intensive Care Unit (PICU)

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ABSTRACT

Background: central line-associated blood stream infection (CLABSI) is responsible for almost 60% of the hospital-acquired infections. The rate of CLABSI in developing countries is higher than that in developed countries. Recently; gram negative bacilli are commonly isolated in CLABSI cases.

Aim of the work: This was a prospective 6 month study to assess the occurrence of CLABSI at Pediatric Intensive Care Unit (PICU) of Ain-shams University Hospital.

Patients and methods: present study was a prospective observational study conducted on 109 patients with a 152 central venous catheter (CVCs) inserted to them, who were admitted to the Pediatric Intensive Care Unit of Ain Shams University Hospital from July to December 2017. They were observed for development of central line-associated blood stream infection (CLABSI) and also associated risk factors were studied.

Results: There was 22 CLABSI cases with a CLABSI score 14.1 per 1000 central line days. In this study, the most common organism detected was Klebsiella that was isolated in 14 cases. This study shows multi-drug resistant pathogens as causative agent of CLABSI in 9 % of cultures.

Conclusion: CLABSI is a common and serious complication to CVCs in PICU. Klebsiella, candida albicans are the common pathogens isolated in CLABSI.

Keywords: CLABSI, Central line, Infection.

INTRODUCTION

Central line-associated blood stream infections (CLABSIs) are a major source of hospital-acquired infections (HAIs) in PICU and are associated with high morbidity, mortality and also increased economic burden ⁽¹⁾. The rate of CLABSI in developing countries ranges from 1.6 to 44.6 cases per 1000 central line (CL) days in PICU⁽²⁾. Common pathogens causing CLABSI are staph. Epidermidis (CONS), Methicillin-resistant staph aureus (MRSA), Candida spp, gram-negative bacteria as Klebsiella and Enterobacteriaceae ⁽³⁾. CLABSI has a mortality rate up to 8%, causes longer hospital admission⁽⁴⁾ and Increased costs ⁽⁵⁾.

METHODOLOGY

Study: This study was prospective observational study carried out over six months; from July to December 2017 at pediatric intensive care unit (PICU) of Ain-shams University Hospital.

Patients: This study was carried out on 109 patients (including 152 CVCs) admitted in PICU, All CVCs were inserted under guide of ultrasound.

Inclusion criteria: Patients admitted to PICU and centrally cannulated during their admission as a part of their management.

Exclusion criteria: Patients with infective endocarditis

Full clinical assessment including: Age, sex, duration of PICU admission cause of admission, history of the present illness, duration of CVC, vital signs (temperature, respiratory rate, heart rate and blood pressure), full cardiac, respiratory, abdominal and neurological examination.

Investigations : Complete blood count (CBC), C reactive protein (CRP); initially before insertion of CVC, 48 hrs then 96 hrs following CVC insertion.

- **Blood culture:** Two blood cultures were withdrawn; one from the CVC and the other was peripheral percutaneous blood culture. Cultures are withdrawn at least 48 hrs following CVC insertion especially with appearance of signs of infection.

❖ Blood Culture technique:

Manual blood culture system (Conventional) was used: Aerobic blood culture bottles were inoculated with 2 ml blood and usually incubated for 7 days. Each bottle was examined daily for macroscopic evidence of microbial growth (e.g., hemolysis, turbidity of the media, gas production, or formation of discrete colonies). An aliquot of the contents of the aerobic bottle was gram stained and subcultured (Blood and MacConkey Agar) after the first overnight incubation. A terminal subculture was usually done at the end of the incubation period. Conventional manual systems are flexible and require no purchase of expensive instruments, but they are labor intensive ⁽⁶⁾.

Detection and recognition of CLABSI

CLABSI was suspected if the following signs had been noted: Fever > 38 or hypothermia < 36, tachycardia, hypotension, poor perfusion, altered mental status or CVC malfunction and confirmed by isolation of the same microorganism from the catheter and concomitant peripheral blood cultures, which are not related to an infection at another site.

Calculation of incidence of CLABSI in our study was done by CLABSI score

Score = {number of CLABSIs/total number of CVC-days} x 1000.

Results are multiplied by 1,000; so that the measure is expressed by the number of CLABSIs) per 1,000 catheter days ⁽⁷⁾.

Ethical approval

Verbal consents were obtained from parents of all patients. **The study was approved by Aswan University, Faculty of Medicine.** The steps of the study, the aim of the study, the potential benefit and hazards, all were discussed with the patient’s parents. Confidentiality of all data was ensured.

Statistical Analysis

Statistical analysis was performed using statistical package for social science “SPSS V21.0, SPSS Inc., Chicago, IL, USA”. Continuous data were presented as mean ± SD or as median, while categorical variables as percentages. Categorical and continuous variables were analyzed using chi-square test and Mann-whitney test respectively. P value < 0.05 was considered significant and P value < 0.01 was considered highly significant.

RESULTS

The mean age of the patients in the study sample was 30.34 ± 24.5 months. 61% of patients were males and 39% were females.

All patients were admitted in PICU; 49.3 % of these patients required mechanical ventilation.

Table (1): Underlying Diagnosis of the studied Cases

Category	N=109	%
Respiratory disorders	31	28.4%
Gastrointestinal disorders	33	30.3%
Cardiovascular disorders	15	13.8%
Neuromuscular disorders	12	11%
Renal disorders	5	4.6%
Immunological disorders	3	2.8%
Hematological disorders	3	2.8%
Hepatic disorders	2	1.8%
Metabolic disorders	2	1.8%
Malignancy	2	1.8%
Endocrinal disorders	1	0.9%

Total number of central venous catheter days was 1557 days and the average number of days for which the CVC maintained was 15.4 ± 13.1 days. CLABSI was reported in 22 cases, The CLABSI score was 14.1 per 1000 catheter-days, CLABSI occurred in 19 cases when the CVC was inserted into right internal jugular vein and in 3 cases when it was inserted into the left internal jugular vein.

Table (2): showing Comparison between two subgroups of patients (with and without CLABSI) as regards CVC duration, total PICU admission days and initial SOFA score:

Variable		Without CLABSI N=130	CLABSI N=22	P-value
CVC days	Mean ± SD	13.99 ± 9.4	22.47 ± 11.5	0.021
	Median	11 (3 - 57)	21 (5 - 57)	
Total PICU admission days	Mean ± SD	16.67 ± 8.4	30.06 ± 16.2	0.01
	Median	12 (3 - 73)	24 (5 - 80)	

PICU: pediatric intensive care unit, CVC: central venous catheter, CLABSI: central line associated bloodstream infection.

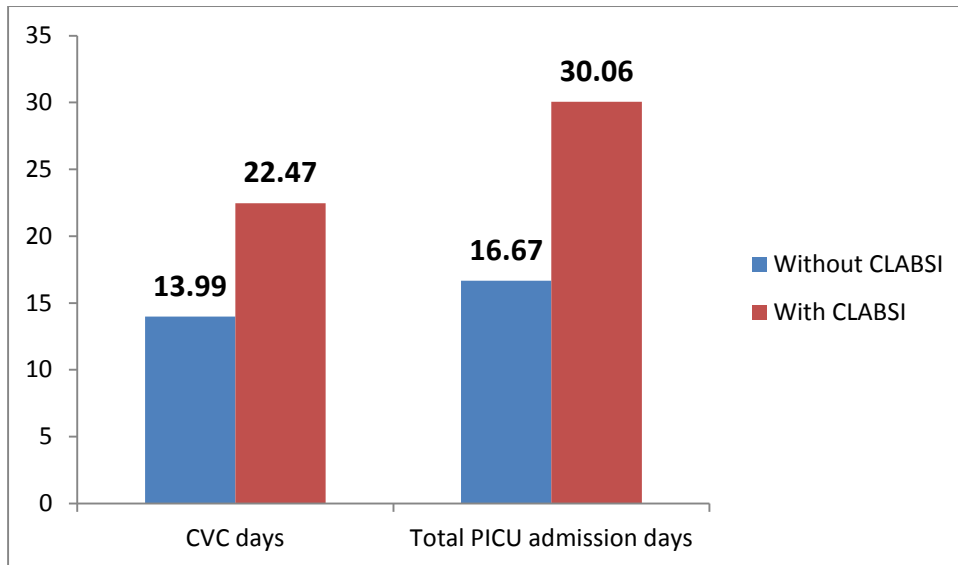


Fig. (1) : Bar chart showing Comparison between two subgroups of patients (with and without CLABSI) as regards CVC duration and total PICU admission days.

Table (3): Comparison between two subgroups of patients (with and without CLABSI) as regards CVC site:

Site	Non-CLABSI N= 130	CLABSI N =22	P-value
Rt IJV	88 (67.6%)	19 (86.4 %)	>0.05
Lt IJV	33 (25.4%)	3 (13.6 %)	
Rt Femoral	4 (3.1 %)	0 (0%)	
Lt femoral	4 (3.1%)	0 (0%)	
Rt Subclavian	1 (0.8%)	0 (0%)	

CLABSI: Central Line -Associated Blood Stream Infections IJV: internal jugular vein

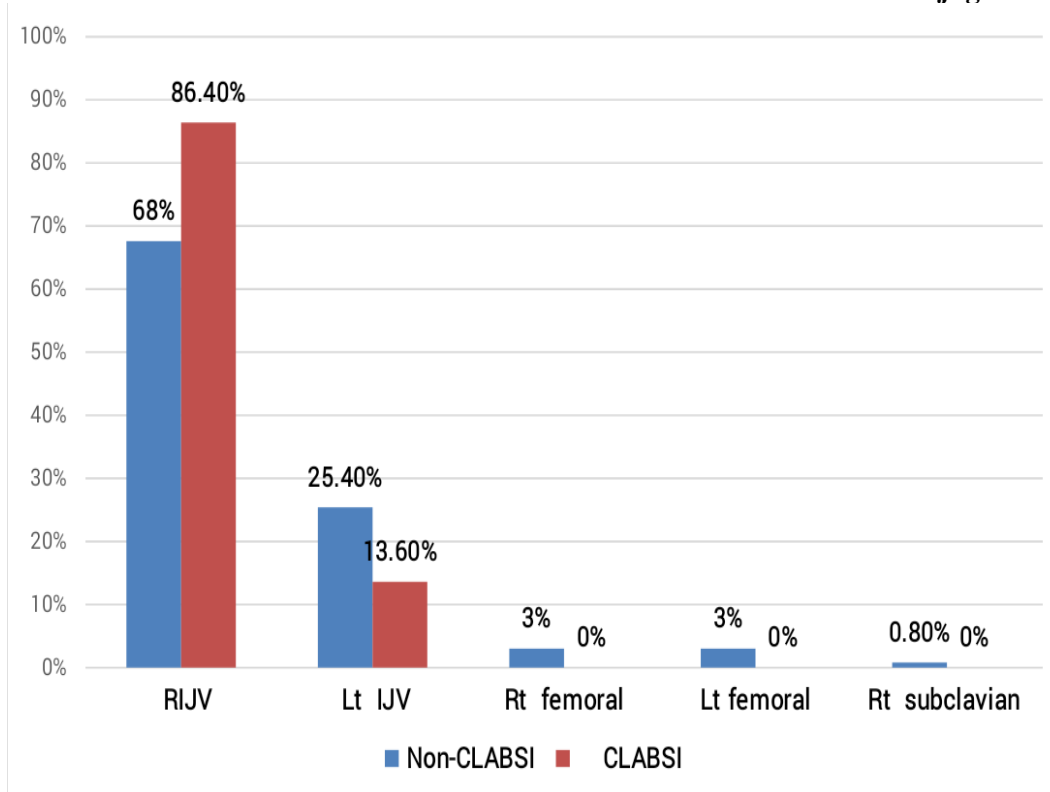


Fig. (2): Bar chart comparing between two subgroups of patients (with and without CLABSI) as regards CVC site.

Organisms reported are shown in table 4..

Table (4): Frequency of organisms detected in CLABSI cases:

Causative organism	Frequency N=22	%
Klebsiella	14	63.6 %
Candida albicans	3	13.6 %
Proteus	2	9.1 %
MRSA	2	9.1 %
E. coli	1	4.6%
Total CLABSI cases	22	100 %

MRSA: Methicillin-resistant staph. Aureus; CLABSI: Central Line-Associated Bloodstream Infection.

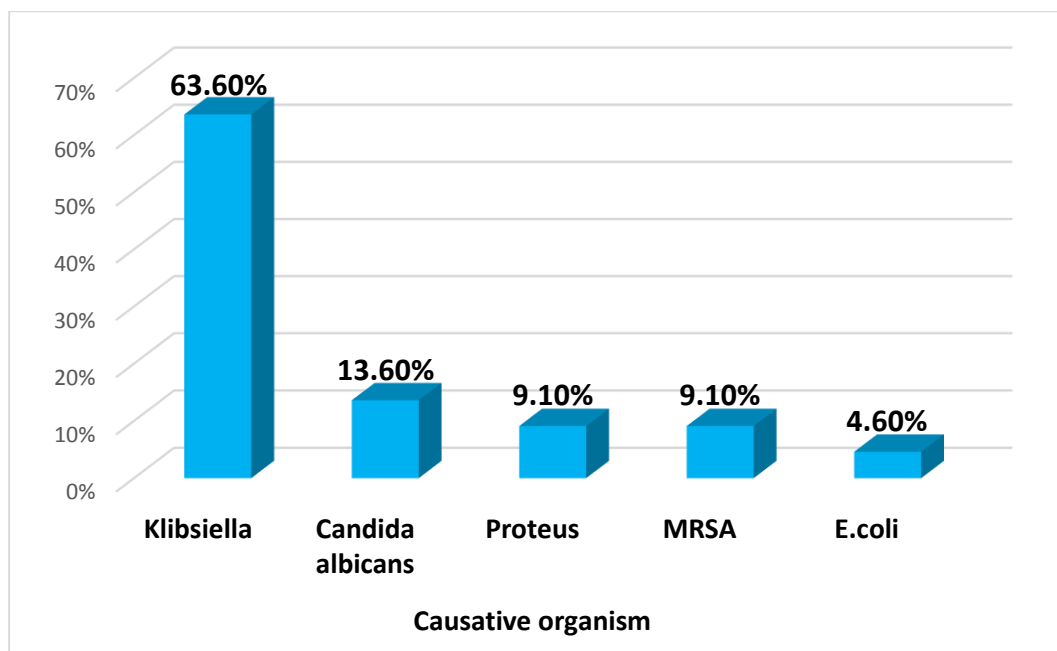


Fig. (3): Bar chart shows frequency of organisms detected in CLABSI cases;

Results of the sensitivity are shown in table 5.

Table (5): showing pattern of sensitivity to Klebsiella:

Antibiotic	%
Ampicillin/sulbactam	12.7 %
Amoxicillin/clavulanate	9 %
Cefotaxime	9 %
Ceftriaxone	12.7 %
Cefepime	9 %
Amikacin	29 %
Gentamycin	12.7 %
Meropenem	7.3 %
Imipenem	7.3 %
Ciprofloxacin	5.5 %
Levofloxacin	7.3 %
Teicoplanin	7.3 %
Cefoperazone/sulbactam	41.8 %
MDRO	9%

Table (6): Showing the relation between CLABSI with mortality:

Category	CLABSI	%
Total number	22	100 %
Survivors	14	63.6%
Non-survivors	8	36.4%

DISCUSSION

In our study the CLABSI score was 14.1 per 1000 catheter-days while a study in India reported a 7.9 per 1000 catheter-days⁽⁸⁾. Other studies from hospitals in India reported a CLABSI rate of 2.8 and 18.5 % per 1000 catheter days respectively^(9,10). Centers for Disease Control and Prevention (CDC) in USA have detected 30,100 CLABSI cases in Intensive Care Units (ICU) each year⁽¹¹⁾.

As regard The Site of CVC; no statistically significant relation had been found between CVC site and CLABSI development. This is consistent with a study by *Timsit et al.*¹² that found no difference in CLABSI or CVC colonization between internal jugular vein and femoral vein CVCs⁽¹²⁾. These results are different from other studies that do not prefer to use femoral site for CVC insertion because of their higher rates of infectious complications compared to the internal jugular and subclavian sites^(13,14).

As regard CVC duration; our study showed that duration of CVC was a significant factor in developing CLABSI. Same results was found by *Wylie et al.*¹⁵ who found that increase CVC duration lead to increase incidence of CLABSI⁽¹⁵⁾. Also, total PICU admission days had a significant relation with CLABSI in our study with.

Organisms reported in CLABSI was Klebsiella 14 (63.6 %), candida albicans 3 (13.6%), proteus in 2 cases (9.1%), MRSA in 2 cases (9.1%), E.coli in only one case (4.6%). Inconsistent with other studies in which the most common organisms cultured in CLABSI cases were coagulase-negative staphylococci (CONS)⁽¹³⁾ and a study by *Newman* showed that most common causative pathogens for CLABSI in the US are CONS, S. aureus, enterococci, and Candida spp⁽¹⁶⁾, but similar to other studies that found that the gram negative bacilli represented 96.5% of bacterial isolates causing healthcare-associated infections^(17,18).

CONCLUSION

- The CLABSI score was 14.1 per 1000 catheter-days; similar to incidence of CLABSI in developing countries but largely higher than developed countries as USA.
- CLABSI was associated with high risk of mortality.
- Klebsiella was the most common organism reported in CLABSI cases.

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