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IDENTIFY THE RISK FACTORS AND MORTALITY ASSOCIATED WITH CENTRAL LINE-ASSOCIATED BLOODSTREAM INFECTION (CLABSI)

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Abstract

Background: Central line-associated bloodstream infection is the most common hospital-acquired infection and is associated with high morbidity and mortality along with increased healthcare cost. However, studies on the incidence of nosocomial infections are very limited in India.

Aim: To determine the incidence of central line-associate bloodstream infection (CLABSI), microorganisms associated in the medical ICU of a tertiary care hospital.

Methods: A total of 100 patients who were admitted to the medical ICU and had a central venous catheter (CVC) implanted at admission in the emergency department or in the medical ICU for longer than 48 hours were monitored. By examining the blood culture reports, the patients were monitored every day for the emergence of new-onset sepsis after 48 hours following CVC insertion. The data were evaluated statistically using Microsoft Excel and SPSS version 22.0 (IBM Corp., Armonk, NY, USA).

Results: Out of 100 catheterized patients, 30were positive cultures. 20 patients were positive for blood culture and 12 were positive for tip culture (2 patients were positive for both blood culture and tip culture). Out of 30 cases, 21 males and 9 females tested positive for blood/tip culture. Males were at higher risk for blood/tip culture in CVC patients than females. The age groups >18-30 years and 51-60 years showed statistically significant differences in blood/tip culture in CVC patients. Blood/tip culture was found to be statistically significant in CVC patients with acute severe pancreatitis, chronic kidney disease as well as Guillain-Barre syndrome. While as, comorbidities, T2DM was statistically significant for blood/tip culture. The Mean ± S.D. for positive blood/tip cultures with CVC duration <10 days and ≥10 days was 6.5 ± 1.43 and 12.15 ± 2.23, respectively. For negative blood/tip cultures, the Mean ± S.D. for <10 days and ≥10 days was 5.13 ± 1.63 and 10.53 ± 0.57, respectively. The duration of CVC days was statistically significant. Thus, the incidence rate of central line-associated bloodstream infection (CLABSI) was 18.31 per 1000 central line days. Majority of the cultures were from (n=70) No CLABSI/CRBSI, CLABSI (n=18),

Catheter Tip Colonization (n=10) and CRBSI (n=2) (p-value < 0.05). The prevalence of pathogenic isolates was *Staphylococcus aureus* 8 (26.70%), *Klebsiella pneumonia* 5 (16.70%), *Pseudomonas aeruginosa* 5 (16.70%), *Escherichia coli* 4 (13.30%), *Acinetobacter baumanni*3 (10.00%), *Burkholderia* species 3 (10.00%) and*Enterococcus* 2 (6.60%) respectively (p-value < 0.05). The mortality rate was 7.0%. Patients with a positive culture had a significantly higher mortality rate (5/30 = 16.70%) than those with a negative culture (2/70 = 2.90%) (p-value = 0.013).

Conclusion: The prevention of CLABSI requires knowledge of the infection rates and of the sources, the pathogens involved as well as their antimicrobial profile. Due to rising antimicrobial resistance, surveillance programs are crucial in establishing the species distribution and resistance patterns of bacteria causing BSIs and thus providing the basis for appropriate empirical therapy.

Keywords: Intensive care unit, bloodstream infection, CLABSI, Blood/tip culture, mortality

Introduction

Central venous catheterization is commonly employed for the monitoring and management of critically ill patients [1]. These catheters have access to the bloodstream, which can lead to serious complications, most notably bloodstream infections (BSI). Central line-associated bloodstream infection (CLABSI) is the most prevalent healthcare-associated infection (HAI) [2, 3]. It is a major cause of morbidity and mortality in hospitals around the world [4]. A variety of risk factors contribute to the development of CLABSI [5,6]. The length of catheterization is a significant risk factor, as the longer a patient has a central line in place, the greater the risk of developing CLABSI [7]. Bacteria colonize the catheter, causing biofilms to form, making infection treatment difficult. Critically ill patients are at risk for serious complications due to increasingly invasive procedures, the presence of multiple invasive devices, immunocompromised status, advanced age, comorbidities, and a higher incidence of antimicrobial resistance [8]. In trauma patients, central line insertions are frequently performed in an emergency, increasing the risk of infection [9]. Other risk factors include insufficient bundle care preventive measures, a low patient-to-nurse ratio, and unqualified personnel in infection prevention and control (IPC) practices [8]. Central line-associated bloodstream infections (CLABSIs) are linked to an increase in mortality from 4% to 37%, as well as longer hospital stays and higher healthcare costs [10,11].

Patients with CLABSI have an increased risk of developing sepsis, organ failure, and other life-threatening complications [12]. Moreover, CLABSIs can result in multidrug-resistant infections, which are difficult to manage and elevate the likelihood of adverse outcomes [13]. This study aimed to identify the risk factors linked to CLABSI in adult trauma patients admitted to the trauma ICU (TICU) and to examine the incidence and etiology of CLABSI.

The study's goal is to identify the risk factors and mortality associated with central line-associated bloodstream infection (CLABSI), as well as investigate the incidence and etiology in patients admitted to SMHS hospital in Kashmir, India.

Material and Methods

This observational study was conducted in the department of anaesthesiology and critical care medicine in SMHS and associated hospitals Srinagar, Kashmir, India, over a period of 18 months. A total of 100 patients were included in the study.

Inclusion Criteria

- ✓ Age >18 years
- ✓ Insertion of first CVC in ICU
- ✓ Indewelling catheter >48 hours
- ✓ Patients who follow Systemic Inflammatory Response Syndrome criteria (SIRS)

Exclusion Criteria

- ✓ Age <18 years
- ✓ Blood culture positive at admission
- ✓ CVC inserted other than ICU
- ✓ Indwelling CVC <48 hours
- ✓ Discharged with their CVC still in place
- ✓ Died in the units with their CVC in place

Data were collected prospectively daily using a standardized format for all patients admitted to the ICU who met the inclusion criteria. The records for each patient included demographic information as well as information about chronic conditions, the length of ICU and hospital stay, the need for other indwelling devices, previous infections, antibiotic exposure, and mortality. All patients in the study were evaluated for risk factors such as age, surgery/trauma, length of hospitalization, duration of central line, and comorbidity. These variables were investigated for their potential role in predicting the risk of developing CLABSI and the associated mortality.

Statistical Analysis

Data was entered in a Microsoft excel spreadsheet. Continuous variable without outliers were summarized as mean and standard deviation. Median and interquartile range was used to summarised non-normal continuous variables (or with significant outliers). Categorical variables were summarised as percentages. The incidence of bacteria was calculated as incidence proportion (percentage), 95% confidence intervals for the incidence proportion were reported. Analysis was done using Stata version 15.

Results

The majority of culture reports (70.00%) were sterile, while 30.00% were positive cultures. 20 patients were positive for blood culture and 12 were positive for tip culture (2 patients were positive for both blood culture and tip culture) [Table 1]. Out of 30 cases, 21 males and 9 females tested positive for blood/tip culture. Males were at higher risk for blood/tip culture in CVC patients than females. The age groups >18-30 years and 51-60 years showed statistically significant differences in blood/tip culture in CVC patients. Blood/tip culture was found to be statistically significant in CVC patients with acute severe pancreatitis, chronic kidney disease as well as Guillain-Barre syndrome based on their primary clinical diagnosis. In CVC patients with comorbidities, T2DM was statistically significant for blood/tip culture. There were 8 positive cases from surgical management and 22 positive cases from medical management for blood/tip culture in ICU patients. The data for blood/tip culture showed statistical significance. The Mean ± SD for positive blood/tip cultures with CVC duration <10 days and ≥10 days was 6.5 ± 1.43 and 12.15 ± 2.23, respectively. For negative blood/tip cultures, the Mean ± S.D. for <10 days and ≥10 days was 5.13 ± 1.63 and 10.53 ± 0.57, respectively. The duration of CVC days was statistically significant. Thus, the incidence rate of central line-associated bloodstream infection (CLABSI) was 18.31 per 1000 central line days. Majority of the cultures were from (n=70) No CLABSI/CRBSI, CLABSI (n=18), Catheter Tip Colonization (n=10) and CRBSI (n=2). Statistically the frequency distribution was significant (p-value < 0.05) [Table 2]. The prevalence of pathogenic isolates was Staphylococcus aureus 8(26.70%), Klebsiella pneumonia 5 (16.70%), Pseudomonas aeruginosa 5 (16.70%), Escherichia coli 4 (13.30%), Acinetobacter baumanni 3 (10.00%), Burkholderia species 3 (10.00%) and Enterococcus 2 (6.60%) respectively [Fig 1]. Statistically the frequency distribution was significant (p-value < 0.05) . The mortality rate was 7.0%. Patients with a positive culture had a significantly higher mortality rate (5/30 = 16.70%) than those with a negative culture (2/70 = 2.90%) (p-value = 0.013) [Table 3].

Table 1: Culture reports for blood/tip culture

Culture	**Cases (n)**	**Percentage (%)**
Positive	30	30.00%
Sterile	70	70.00%
Positive Culture	**Frequency* (n = 30)**	**Percentage (%)**
Blood culture	20	63.30%
Tip culture	12	36.70%

Table 2: Risk factors for blood/tip culture

Variable	**Blood/Tip culture**		**P value**
	Yes [n (%)]	**No [n (%)]**	
Jugular	29 (96.70%)	64 (91.40%)	0.3492
Subclavian	1(4.00%)	6 (8.60%)	
Gender	**Yes [n (%)]**	**No [n (%)]**	**P value**
Male	21 (38.20%)	34 (61.80%)	0.0495
Female	9 (20.00%)	36 (80.00%)	
Age group (years)	**Yes [n (%)]**	**No [n (%)]**	**p-value**
>18 -30 years	5 (16.70%)	26 (37.15%)	0.0435
31 – 40years	7 (23.30%)	18 (25.70%)	0.8020
41 – 50 years	5 (16.70%)	10 (14.30%)	0.7611
51 – 60 years	10 (33.30%)	11 (15.70%)	0.0486
≥ 61years	3 (10.00%)	5 (7.15%)	0.6311
Primary clinical diagnosis	**Yes [n (%)]**	**No [n (%)]**	**p-value**
Acute severe pancreatitis	9	3	0.0003
Meningioma	7	11	0.3659
Chronic kidney disease	6	4	0.0299
Guillain Barre syndrome	3	1	0.0461
Organophosphate poisioning	4	6	0.4692
Glioma	1	4	0.6184
Comorbidity	**Yes [n (%)]**	**No [n (%)]**	**p-value**
T2DM	11 (36.70%)	5 (7.10%)	0.0002
No comorbidity	8 (26.70%)	32 (45.70%)	0.0763
HTN	6 (20.00%)	16 (22.90%)	0.7532
Hypothorid	2 (6.70%)	11 (15.70%)	0.2199
COPD	2 (6.70%)	1 (1.40%)	0.1615
CAD	1 (3.30%)	5 (7.10%)	0.4645
Management	**Yes [n (%)]**	**No [n (%)]**	**p-value**
Surgical management	8 (16.70%)	36 (16.70%)	0.0229
Medical management	22 (16.70%)	34 (16.70%)	
CVC duration	**Mean ± SD Yes (**30**)**	**Mean ± SD No (70)**	**p-value**
<10 days	6.5 ± 1.43	5.13 ± 1.63	0.0001
≥10 days	12.15 ± 2.23	10.53 ± 0.57	<0.0001

Table 3: Outcomes

Outcome	Blood/Tip culture		Total	P value
	Yes (n)	No (n)		
Survival	25 (83.30%)	68 (97.10%)	93 (93%)	0.0136
Death	5 (16.70%)	2 (2.90%)	7 (7%)	
Total	30	70	100	

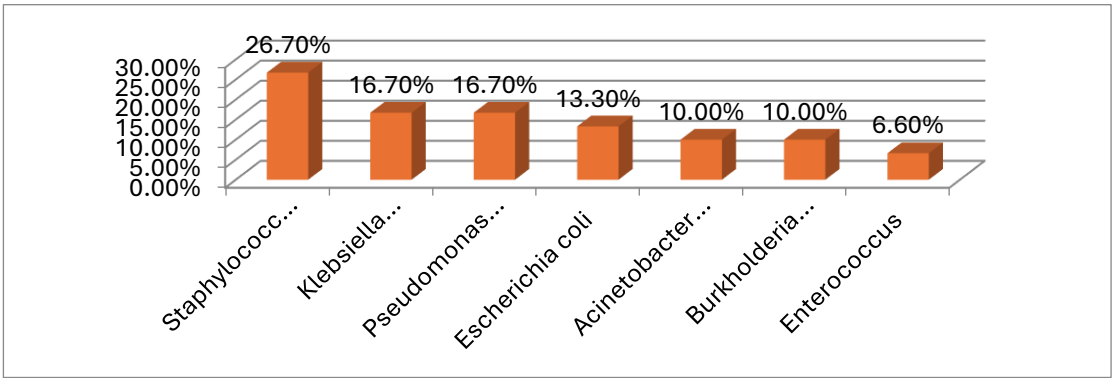

Fig 1.

Discussion

Central line-associated bloodstream infections are more common in developing countries' intensive care units than in the developed world. They are linked to increased hospitalization and higher healthcare costs and they are associated with higher morbidity and mortality than any other type of hospital-acquired infection. This study aimed to identify risk factors for CLABSI and investigate its incidence and etiology in the department of anaesthesiology and critical care medicine in SMHS and associated hospitals Srinagar.

In this present study majority of the culture reports (70.00%) were sterile and (30.00%) were positive cultures. Among the 30 positive reports, there were 20 positive blood cultures (63.30%) and 12 positive tip cultures (36.70%), with 2 patients exhibiting positivity in both blood and tip cultures. Worldwide records show that the isolation rates on blood cultures vary from 6.7% to 55.4% **(*National database report 2002–2003* New Delhi, India)**. [14] **JimbaJ.*et al*. 2020 [15]** blood culture positivity rate of 19% was comparable with positivity rates reported by **Gupta *et al*., 2016** . [16] The low positivity rates could be due to the administration of antibiotics, inadequate or improper sampling and sepsis due to other causes like fungal, viral, or anaerobic pathogens **(Bansal S.*et al*., 2004)[17]**. Similar study reported 9.33% samples were culture positive (**Bhavana *et al*., 2018**) [18] and in other studies of **Patil *et al*., 2011[19]** (7.41%), **El-Kholy*et al*., 2012 [20]** (8.2%), **Porto *et al*., 2010[21]** (11.2%) and **Apostolopoulou*et al*., 2009** (11.8%). [22] In contrast studies by **Lorente*et al*., 2005** and **Brito *et al*., 2007** [23] reported culture positivity as 2.04 % and 3.8% respectively which was lesser compared to the present study. Central line associated blood stream infection rate of 22.6/1000 catheter days was observed by **G. Naveen et al., 2016 .[24]**

In our study 20 (%) patients were positive for blood culture and 12 (%) were positive for tip culture [2 (2%) patients were positive for both blood culture and tip culture].According to Bhavana *et al*. (2018),[18] 9.33% of samples tested positive for culture, which is consistent with previous studies by Patil *et al*., 2011 **[56]** (7.41%), [19] El-Kholy*et al*., 2012 (8.2%),[20] Porto *et al*., 2010 (11.2%),[21] and Apostolopoulou*et al*., 2009 (11.8%). [22] In contrast studies by Lorente*et al*., 2005 [13] and Brito *et al*., 2007 [23]reported culture positivity at 2.04% and 3.8%, respectively, which was lower than the current study.

In our findings site of central line as a risk factor for blood/tip culture patients Jugular 29 (%) positive, 64 (%) were negative and subclavian 1 (%) positive and 6(%) negatives. This data was

statistically insignificant. A previous study found that IJV was the most common route of insertion for blood stream infections, followed by femoral vein and subclavian vein. Bhavana *et al*. (2018). [18] Rode A *et al*., 2017 [25] found the occurrence of CLABSI was 46.55% for IJV, 37.39% for femoral vein, and 15.51% for subclavian vein, depending on the site of insertion of CVC. Also, O'Connor *et al* 2013, found that the incidence of CLABSI in IJV was 68%, femoral vein was 6.5%, and subclavian vein was 24.6%. [26] These differences were primarily due to varying preferences for central cannulation sites across institute protocols. The higher incidence of CRLI and CRBSI with jugular access compared to subclavian access is probably due to three factors favoring skin colonization: the proximity of the insertion site to the mouth and the oropharyngeal secretion; the higher density of the local skin flora due to the higher local skin temperature; and the difficulties in maintaining occlusive dressings . [13,27,28]

In our findings 21(%) positive and 34 (%) negative cultures reported in males and 9 (%) positive and 36 (%) negative cultures reported in females for blood/tip culture were found. Male gender was statistically significant as compared to female for blood/tip culture patients.In a similar study, the findings were consistent with the overall, with males accounting for (11/14) 78.57% and females (3/14) 21.43% of CLABSI and CRBSI cases (Bhavana *et al*., 2018) . [] In a study by Inamdar *et al*., gender was found to be a risk factor for CRBSI occurrence, with females having a statistically significant higher risk (14) compared to males . [29] In contrast, G.M. Khalil and M.M. Azqul (2018) found no evidence that gender is a risk factor for CRBSI occurrence. [30] Wang *et al*. found no significant association between gender and CRBSI occurrence . [31]

In our findings the age group >18 -30 years and 51 – 60 years was statistically significant for blood/tip culture patients. A similar study found that individuals aged 51-60 had the highest incidence of CVC-related blood stream infections (5/14) at 35.71% Bhavana *et al*. (2018) this could be attributed to the decreased immune status at that age group. [18] Similar results found in the studies done by Brito *et al*., 2007 ,[23] Apostolopoulou*et al*., 2009 [22]and Datta *et al*., 2014 . [32] While in contrast G.M. Khalil and M.M. Azqul (2018) [30] found no statistically significant difference between the participants' age and CRBSI occurrence, a finding that is consistent with Wang *et al*. **. [31]**

In our findings, T2DM 11 (36.70%) was the only significant comorbidity for blood/tip culture patients.**Dubey P *et al*., 2021** [33] reported similar findings, stating that the patients they evaluated had certain co-morbidities. Their study included 50 patients with renal failure (52.08%), 10 with diabetes mellitus (10.41%), 8 with severe anaemia (Hb% <7 gm%), 6 with underlying cardio-vascular disease (6.25%), and 22 without any comorbidities or risk factors. (22.91%). **Horan *et al*., 2008** discovered that patients with certain chronic illnesses are more likely to develop CLABSI/CRBSI. [34]

In our findings 14.99 was the mean duration of CVC days for blood/tip culture patients who were positive and 9.31 No for negative blood/tip culture patients. The data was statistically significant for the duration of CVC days blood/tip culture. Similarly,Malek *et al*. (2018) [35] reported similar findings in a prospective study of 499 patients in the Medical/Coronary ICU and Surgical ICU of a private hospital in Cairo, Egypt, from April to September 2014. They found that patients with CLA-BSI had a longer ICU stay than non-infected patients (RR=5.9; 95% CI=1.9-18.2)[36,37,38] ; a long length of stay increases the risk of exposure and the number of CVC days, which have been identified as risk factors for CLA-BSI. Malek *et al*., 2018 and Fuzheng*et al*., [36,39] found a statistically significant link between the occurrence of CLA-BSI in ICU patients. As a result, preventing CLA-BSI should be a top priority for critically ill patients with complicated diseases.

In our studythe incidence rate of central line-associated bloodstream infection (CLABSI) was 18.31 per 1000 central line days. **Maqbool *et al*., 2023** reported that the incidence of central line-associated bloodstream infection (CLABSI) was 16.4 per 1000 central line days and 13.2 per 1000 inpatient days, with a device utilization ratio of 0.8. [40] Comparable results were reported by Singh *et al*., [41] **Chopdekar*et al*.**, [27] and **Ben Jaballah*et al*.**, [28] who reported incidences of 16.6, 27.065, and 15.3 per 1000 catheter days. We had a high incidence of central line-associated bloodstream infection in the ICU patients as compared to the other studies reported by

Parameswaran *et al*., who reported a CLABSI incidence of 8.6/1000 catheter days. [42] However, a higher incidence has been reported by authors such as **Al-Gethamy*et al*.** , [43] who reported 24.06 CLABSI incidence, and **Patil *et al*.[44]** who reported 47.6. Similar study reported that the rate of incidence of CLABSI/CRBSI in a hospital-based study in intensive care units comes out 34.37% **Dubey P *et al*., 2021**. [45] Other studies have shown variable incidence, 22.50% and 23.70% **(Deshpande KS, *et al*., 2005; Lucet JC, *et al*., 2010)**. [43, 44] This variability of incidences in various studies could be due to various factors like techniques, site of catheterization, type of catheter used, catheter care and diagnostic criteria used for diagnosing CLABSI/CRBSI.

Our findings revealed gram negative organisms as the most organisms associated with CLABSI in ICU patients 66.70% of culture positive in the descending order as *Klebsiella pneumonia* 5(16.70%), *Pseudomonas aeruginosa* 5(16.70%), *Escherichia coli* 4(13.30%), *Acinetobacter baumanni*3(10.00%)and*Burkholderia species* 3(10.00%). Remaining 33.30% of gram-positive organisms as were *Staphylococcus aureus* 8(26.70%) and *Enterococcus* 2 (6.60%). Our study has similar findings to the other studies Amira M *et al*.,. [13, 27,47, 48] Differences of organisms isolated and sensitivity may be due to differences of antibiogram and isolates across various sites of studies and difference in their respective infection management protocol and antibiotic policies.

Another study revealed that the most common organisms isolated in CLABSI/CRBSI patients were *Staphylococcus aureus* (36.3%), *Pseudomonas aeruginosa* (15.1%), *Escherichia coli* (9%), *Streptococcus* (12.1%), *Klebsiella pneumonia* (15.1%), and *Acinetobacter* (3.1%) in culture growth **Dubey P *et al*., 2021**.[45] In another study the peripheral blood and the tip of central venous catheter were obtained simultaneously and processed in the microbiology lab. The isolated organisms were subjected for antimicrobial susceptibility testing. There were 11 episodes of central line associated blood stream infections of which 3 (27.27%) were due to *Pseudomonas aeruginosa*, 3 (27.27%) due to *Acinetobacter* species, 2 (18.18%) due to *Staphylococcus aureus,* 2 (18.18%) due to *Klebsiella* species and 1 (9%) due to *Staphylococcus epidermidis* **G. Naveen *et al*., 2016**. [49] Overall, in the present study, there were basic similarities in the organisms isolated as compared with other studies that Gram positive organisms were predominant compared to Gram negative organisms which mainly consisted of *Staphylococcus* and predominant Gram negative organisms isolated were *Pseudomonas aeruginosa, Klebsiella pneumoniae,Escherichia coli* and *Acinetobacter baumannii* as in other studies, even though there was differences in the percentage of organisms isolated which could be attributable to differences in prevalence of organisms in different geographical areas. Other similar studies also reported the prevalence of pathogenic bacterial species (71%) *Staphylococcus aureus*, and (22%)*Acinetobacter baumanni,***Gahlot R. *et al*., 2013 . [50] Datta *et al*., 2014** [51] reported (12.36%) *Staphylococcus aureus*, *(29.2%) Klebsiella pneumonia, (14.61%) Pseudomonas aeruginosa,* (2.25%) *Escherichia coli,* (26.97%) *Acinetobacter baumanni*and (10.11%) *Enterococcus.* **Cheewinmethasiri*et al*.,** (2014) (21.45%) *Staphylococcus aureus,* (12.75%) *Klebsiella pneumonia, (10.55%)* Enterobacter spp., *(*8.3%) *Pseudomonas aeruginosa and* (*6%*) *Acinetobacter baumanni.* Similar findings were observed by **Kaur *et al*.,** 2015 [51] (27.6%) *Staphylococcus aureus, (*20.6%) *Pseudomonas aeruginosa,* (14.8%) *Enterococcus,* (*10.3%*) *Acinetobacter baumanni and* (10.3%) *Klebsiella pneumonia.* **Mittal G. *et al*., 2016** [52] (63%) *Staphylococcus aureus,* (15%) *Acinetobacter baumanni, (*9%) *Pseudomonas aeruginosa* (9%) *Klebsiella pneumonia and* (3%) *Escherichia coli.* Similar findings were observed by **Bhavana C. *et al*., 2018 [18]** (42.86%) *Staphylococcus aureus,* (*7.14%*) *Acinetobacter baumanni, (*7.14%) *Pseudomonas aeruginosa,* (7.14%) *Escherichia coli,* (7.14%) *Enterococcus and* (7.14%) *Klebsiella pneumonia.*Gram-positive cocci were found to be the primary colonizers of CVC in many studies (Winn WC, *et al*., 2006; Pérez-Granda MJ, *et al*., 2016) . [53,54] Furthermore, recent studies have shown that gram-negative bacilli are the leading cause of CRBSI (Braun E, *et al*., 2014). [55] Sapkota J *et al*., 2017 found that Acinetobacter baumannii was the most commonly isolated organism (29%), which contrasts with our findings of Acinetobacter baumanni 3 (10.00%). [46]

The mortality rate in our study was 7.00%. Patients with a positive culture had a significantly higher mortality rate 5/30 (16.70%) as compared to those with a negative culture 2/70 (2.86%) (p-value = 0.013). The overall mortality was observed 24.13% (i.e., 14 of 58 patients succumbed to infection)

and in terms of severity of sepsis mortality was 35% in severe sepsis and 87.5% in septic shock **(Rode A *et al*., 2017)**. [25] In a study by **Chopdekar*et al*., [27]** the mortality associated with CLABSI was found to be 33.3%. **Ankush Bathla*et al*. 2020** reported the mortality rate was 8.8% lesser than other Indian studies . [56] (**Mathew JL, *et al*.; Yudhavir S, *et al*.; Tiewsoh K, *et al*.)** Out of 19 deaths, 8 cases died within 24 h, 5 died between 24 and 48 h, and 6 died after 48 h of admission. [57,58] Similar results were found by **Tiewsoh*et al*.** showing 10 deaths within 24 h, 4 deaths between 24 and 48 h, and 7 deaths after 48 h. [59] **Pawar A *et al*.,**reported a 32.7% mortality rate of sepsis**. [60]** Sepsis in Indian population is associated with high mortality **(Kaur *et al*., 2018) . [51]**

The higher rate of CLABSI in our study in comparison with studies in developed nations can be multifactorial. The higher rate of CLABSI in studies done in developing nations can be multifactorial. In some instances, infection control programme regulation, the complaince with rules is poor. Also, infection control surveillance and hospital accreditation are not mandatory in all hospitals. Nurses to patient ratio, complaince with hand hygiene, patients admitted with a higher APACHE II scores, recipients of multiple courses of antibiotics may be the leading concern of higher incidence. Also, clinical practice guidelines of CVC insertion are not fully implemented in our hospital as evidence by the high proportion of insertions in the internal jugular instead of subclavian vein.

Our study had some lacunae the most important being lack of multicentric prospective study analysis, concurrent study of occurrence of CLABSI in ICU patients along with APACHE II scores. Also, a larger study would have been better in elucidating the factors associated with incidence of CRABI.

Conclusion

Our study identified healthcare-associated risk factors, including extended ICU stays and prolonged central venous catheterization, as independent risk factors for the development of central line-associated bloodstream infections. The incidence of CLABSI was significantly higher in male patients, patients with comorbid conditions especially Diabetes Mellitus, and in patients with jugular vein cannulation. We recommend adherence to aseptic placement of subclavian CVCs in comparison to Juglar vein access. To minimize catheter related infections, we recommend monitoring of incidence and implementation of preventive measures. There should be strict adherence to CDC guidelines for aseptic techniques and also a strong antibiotic policy be instituted in coordination with affiliated faculties. Consequently, the prevention of nosocomial infections is essential and achievable through adherence to preventive measures and the implementation of surveillance programs, which are essential for determining the micro-organisms distribution and resistance patterns of bacteria responsible for bloodstream infections. More studies and meta-analysis need to be done especially focusing around clinical scoring (APACHE II etc) and institutional antibiotic policies and surveillance programmes to ultimately help in improving patient outcomes.

References:

1. Biffi R, Orsi F, Pozzi S, et al.: Best choice of central venous insertion site for the prevention of catheter related complications in adult patients who need cancer therapy: a randomized trial. Ann Oncol. 2009, 20:935-40. 10.1093/annonc/mdn701.
2. Al-Abdullah N: Epidemiology of central line-associated bloodstream infection (CLABSI) among patients in the intensive care units (ICUs) at a teaching hospital in Saudi Arabia from year 2011-2016. J Intensive Crit Care. 2018, 4:2. 10.21767/2471-8505.100105.
3. Deepti, Sinha S, Sharma SK, et al.: Central venous catheter related bloodstream infections in medical intensive care unit patients in a tertiary referral centre. Indian J Chest Dis Allied Sci. 2014, 56:85-91.
4. Trautner BW, Darouiche RO: Catheter-associated infections: pathogenesis affects prevention. Arch Intern Med. 2004, 164:842-50. 10.1001/archinte.164.8.842.

5. Jackson SS, Leekha S, Magder LS, et al.: The effect of adding comorbidities to current Centers for Disease Control and Prevention central-line-associated bloodstream infection risk-adjustment methodology. Infect Control Hosp Epidemiol. 2017, 38:1019-24. 10.1017/ice.2017.129.
6. Pepin CS, Thom KA, Sorkin JD, et al.: Risk factors for central-line-associated bloodstream infections: a focus on comorbid conditions. Infect Control Hosp Epidemiol. 2015, 36:479-81. 10.1017/ice.2014.81.
7. Milstone AM, Sengupta A: Do prolonged peripherally inserted central venous catheter dwell times increase the risk of bloodstream infection? Infect Control Hosp Epidemiol. 2010, 31:1184-7. 10.1086/656589.
8. O'Grady NP, Alexander M, Dellinger EP, et al.: Guidelines for the prevention of intravascular catheter related infections. Clin Infect Dis. 2002, 35:1281-307. 10.1086/344188.
9. Pathak R, Gangina S, Jairam F, Hinton K: A vascular access and midlines program can decrease hospital acquired central line-associated bloodstream infections and cost to a community-based hospital. Ther Clin Risk Manag. 2018, 14:1453-6. 10.2147/TCRM.S171748.
10. Rosenthal VD, Guzman S, Migone O, Crnich CJ: The attributable cost, length of hospital stay, and mortality of central line-associated bloodstream infection in intensive care departments in Argentina: a prospective, matched analysis. Am J Infect Control. 2003, 31:475-80. 10.1016/j.ajic.2003.03.002.
11. Higuera F, Rangel-Frausto MS, Rosenthal VD, et al.: Attributable cost and length of stay for patients with central venous catheter-associated bloodstream infection in Mexico City intensive care units: a prospective, matched analysis. Infect Control Hosp Epidemiol. 2007, 28:31-5. 10.1086/510812.
12. Lin KY, Cheng A, Chang YC, et al.: Central line-associated bloodstream infections among critically-ill patients in the era of bundle care. J Microbiol Immunol Infect. 2017, 50:339-48. 10.1016/j.jmii.2015.07.001.
13. Hidron AI, Edwards JR, Patel J, Horan TC, Sievert DM, Pollock DA, Fridkin SK: NHSN annual update: antimicrobial-resistant pathogens associated with healthcare-associated infections: annual summary of data reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2006-2007. Infect Control Hosp Epidemiol. 2008, 29:996-1011.
14. ***National database report 2002–2003*** **New Delhi, India**.
15. Jatsho, J., Nishizawa, Y., Pelzom, D., & Sharma, R. (2020). Clinical and Bacteriological Profile of Neonatal Sepsis: A Prospective Hospital- Based Study. *International journal of pediatrics*, *2020*(1), 1835945.
16. Jagdish, L., Naik, T. B., Gupta, R. K., & Jais, M. (2016). Etiology of blood culture from septicemia cases and their antibiotic susceptibility pattern at a tertiary care hospital. *Indian J Microbiol Res*, *3*(4), 435-9.
17. Bansal, S., Kashyap, S., Pal, L. S., & Goel, A. (2004). Clinical and bacteriological profile of community acquired pneumonia in Shimla, Himachal Pradesh. *Indian Journal of Chest Diseases and Allied Sciences*, *46*(1), 17-22.
18. Bhavana, C. (2017). *Study of Central-line associated blood stream infections (CLABSIs) and central-line related blood stream infections (CRBSIs) in a tertiary hospital, Bangalore* (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)).
19. Patil, H. V., Patil, V. C., Ramteerthkar, M. N., & Kulkarni, R. D. (2011). Central venous catheter-related bloodstream infections in the intensive care unit. *Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine*, *15*(4), 213.
20. Rasslan, O., Seliem, Z. S., Ghazi, I. A., Abd El Sabour, M., El Kholy, A. A., Sadeq, F. M., ... & Rosenthal, V. D. (2012). Device-associated infection rates in adult and pediatric intensive care units of hospitals in Egypt. International Nosocomial Infection Control Consortium (INICC) findings. *Journal of infection and public health*, *5*(6), 394-402.

21. Porto, J. P., Mantese, O. C., Arantes, A., Freitas, C., Gontijo Filho, P. P., & Ribas, R. M. (2012). Nosocomial infections in a pediatric intensivecare unit of a developing country: NHSN surveillance. *Revista da Sociedade Brasileira de Medicina Tropical*, *45*, 475-479.
22. Apostolopoulou, E., Raftopoulos, V., Terzis, K., & Elefsiniotis, I. (2010). Infection Probability Score, APACHE II and KARNOFSKY scoring systems as predictors of bloodstream infection onset in hematology-oncology patients. *BMC infectious diseases*, *10*, 1-8.
23. Brito, C. S., Gondim, B. A., Diogo Filho, A., & Gontijo Filho, P. P. (2007). Etiology and pathogenesis of bloodstream infections associated with the use of long-term central vascular catheter (CVC) in patients who undergone gastrointestinal surgery. *Brazilian Journal of Infectious Diseases*, *11*, 96-99.
24. Naveen, G., Latha, G., & Nagraj, C. (2016). Bacteriological Study of Central Line Associated Blood Stream Infection at a Tertiary Care Hospital. *Int. J. Curr. Microbiol. App Sci*, *5*, 645-9.
25. Rode, A., Bansod, P. Y., Gujela, A., & Singh, A. (2017). Study of central line-associated bloodstream infections in intensive care unit: a prospective observational study. *Int J Med Res Rev*, *5*(04), 429-437.
26. O'Connor A et al [16] O'Connor, A., Hanly, A. M., Francis, E., Keane, N., & McNamara, D. A. (2013). Catheter associated blood stream infections in patients receiving parenteral nutrition: a prospective study of 850 patients. *Journal of Clinical Medicine Research*, *5*(1), 18.
27. Parienti, J.-J., et al. (2015) Intravascular Complications of Central Venous Catheterization by Insertion Site. The New England Journal of Medicine, 373, 1220-1229.
28. Biffi, R., Orsi, F., Pozzi, S., Pace, U., Bonomo, G., Monfardini, L., et al. (2009) Best Choice of Central Venous Insertion Site for the Prevention of Catheter-Related Complications in Adult Patients who Need Cancer Therapy: A Randomized Trial. Annals of Oncology, 20, 935-940.
29. Inamdar Kanj S, Kanafani Z, Sidani N, Alamuddin L, Zahreddine N, Rosenthal V. International nosocomial infection control consortium findings of device-associated infections rate in an intensive care unit of a lebanese university hospital. J Glob Infect Dis 2012; 4(1): 15-21.
30. Foda, M. A., Khalil, G. M., Gaddoue, I. M., & Azqul, M. M. (2018). Relation between Health Care Providers Compliance with Central Venous Catheter Care Bundle Elements and The Length of Stay in Cardiac Care Units, National Heart Institute. *Egyptian J Community Med*, *36*(4), 654.
31. Wang, H., Tong, H., Liu, H., Wang, Y., Wang, R., Gao, H., ... & Wang, C. (2018). Effectiveness of antimicrobial-coated central venous catheters for preventing catheter-related blood-stream infections with the implementation of bundles: a systematic review and network meta analysis. *Annals of intensive care*, *8*, 1-12.
32. Saha, P., Datta, K., Majumder, S., Sarkar, C., China, S. P., Sarkar, S. N., & Datta, S. K. (2014). Agrobacterium mediated genetic transformation of commercial jute cultivar Corchorus capsularis cv. JRC 321 using shoot tip explants. *Plant Cell, Tissue and Organ Culture (PCTOC)*, *118*, 313-326.
33. Dube, P., Jacob, J. T., Zheng, Z., Huang, Y., Robichaux, C., Steinberg, J. P., & Fridkin, S. K. (2021). Comparison of rates of central line– associated bloodstream infections in patients with 1 vs 2 central venous catheters. *JAMA network open*, *3*(3), 200396-200396.
34. Horan, T.C. andrus, M. and Dudeck, M.A. (2008) CDC/NHSN Surveillance Definition of Health Care-Associated Infection and Criteria for Specific Types of Infections in the Acute Care Setting. American Journal of Infection Control, 36, 309-332.
35. Malek, A. M., Abouseif, H. A., Abd Elaziz, K. M., Allam, M. F., & Fahim, H. I. (2018). Incidence of central line-associated bloodstream infections in intensive care units in a private hospital (Cairo, Egypt). *The Open Public Health Journal*, *11*(1).
36. Heard S, Wagle M, Vijayakumar E et al. Influence of triple-lumen central venous catheters coated with chlorhexidine and silver sulfadiazine on the incidence of catheter-related bacteremia. Arch Intern Med 1998;158:81-87.
37. Raad I. Intravascular-catheter-related infections. Lancet 1998;351:893- 98.

38. Donlan R, Costerton J. Biofilms: survival mechanisms of clinically relevant microorganisms. Clin Microbiol Rev 2002;15:167-93.
39. Rupp, C, Fux C, Stoodley P. Viscoelasticity of Staphylococcus aureus biofilms in response to fluid shear allows resistance to detachment and facilitates rolling migration. Appl Environ Microbiol 2005;71:2175-78.
40. Chinnappa, S., Maqbool, A., Viswambharan, H., Mooney, A., Denby, L., & Drinkhill, M. (2023). Beta Blockade Prevents Cardiac Morphological and Molecular Remodelling in Experimental Uremia. *International Journal of Molecular Sciences*, *25*(1), 373.
41. Goetz, A.M., Wagener, M.M., Miller, J.M. and Muder, R.R. (1998) Risk of Infection Due to Central Venous Catheters: Effect of Site of Placement and Catheter Type. Infection Control & Hospital Epidemiology, 19, 842-845.
42. Parameswaran R, Sherchan JB, Varma M, Mukhopadhyay C, Vidyasagar S. Intravascular catheter related infections in an Indian tertiary care hospital. The Journal of Infection in Developing Countries. 2010 Nov 11;5 (06):452-8
43. Deshpande, K.S., Hatem, C., Ulrich, H.L., Currie, B.P., Aldrich, T.K., Bryan-Brown, C.W., et al. (2005) The Incidence of Infectious Complications of Central Venous Catheters at the Subclavian, Internal Jugular and Femoral Sites in an Intensive Care Unit Population. Critical Care Medicine, 33, 13-20.
44. Patil, H. V., Patil, V. C., Ramteerthkar, M. N., & Kulkarni, R. D. (2011). Central venous catheter-related bloodstream infections in the intensive care unit. *Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine*, *15*(4), 213.
45. Dube, P., Jacob, J. T., Zheng, Z., Huang, Y., Robichaux, C., Steinberg, J. P., & Fridkin, S. K. (2021). Comparison of rates of central line– associated bloodstream infections in patients with 1 vs 2 central venous catheters. *JAMA network open*, *3*(3), 200396-200396.
46. Singhal, T., Shah, S., Thakkar, P., & Naik, R. (2019). The incidence, aetiology and antimicrobial susceptibility of central line-associated bloodstream infections in intensive care unit patients at a private tertiary care hospital in Mumbai, India. *Indian journal of medical microbiology*, *37*(4), 521-526.
47. Cooper G, Schiller A, Hopkins C. Possible role of capillary action in pathogenesis of experimental catheter-associated dermal tunnel infections. J Clin Microbiol 1988;26:8-12.
48. Osma S, Kahveci A, Kaya F et al. Efficacy of antiseptic-impregnated catheters on catheter colonization and catheter-related bloodstream infections in patients in an intensive care unit. J Hosp Infect 2006;62: 156-62.
49. Naveen, G., Latha, G., & Nagraj, C. (2016). Bacteriological Study of Central Line Associated Blood Stream Infection at a Tertiary Care Hospital. *Int. J. Curr. Microbiol. App Sci*, *5*, 645-9.
50. Gahlot, R., Nigam, C., Kumar, V., Yadav, G., & Anupurba, S. (2014). Catheter-related bloodstream infections. *International journal of critical illness and injury science*, *4*(2), 162-167.
51. Kaur, M., Gupta, V., Gombar, S., Chander, J., & Sahoo, T. (2015). Incidence, risk factors, microbiology of venous catheter associated bloodstream infections-A prospective study from a tertiary care hospital. *Indian Journal of Medical Microbiology*, *33*(2), 248-254.
52. Deb, M., Mittal, G., Gaind, R., & Verma, P. K. (2016). Central venous catheter related blood stream infections in an intensive care unit from a tertiary care teaching hospital. *International Journal of Infection Control*, *12*(1).
53. Winn WC, Koneman EW. Koneman's color atlas and textbook of diagnostic microbiology. Philadelphia: Lippincott Williams & Wilkins; 2006. 105.
54. Pérez-Granda MJ, Guembe M, Cruces R, Barrio JM, Bouza E. Assessment of central venous catheter colonization using surveillance culture of withdrawn connectors and insertion site skin. Critical Care. 2016;20:32.

55. Braun E, Hussein K, Geffen Y, Rabino G, Bar-Lavie Y, Paul M. Predominance of Gram-negative bacilli among patients with catheter related bloodstream infections. Clin Microbiol Infect 2014;20:O627 9.
56. Bathla, A., Rakholia, R., Choudhary, B., & Arya, A. (2020). Clinico-Bacteriological Profile and Outcome of Children with Pneumonia under 5 Years of Age. *CHRISMED Journal of Health and Research*, *7*(3), 156-161.
57. Mathew, J. L., Singhi, S., Ray, P., Hagel, E., Saghafian– Hedengren, S., Bansal, A., ... & Nilsson, A. (2015). Etiology ofcommunity acquired pneumonia among children in India: prospective, cohort study. *Journal of global health*, *5*(2).
58. Shekhawat, Y. S., Sharma, P., Singh, A., & Payal, V. (2016). Bacteriological and clinical profile of community acquired pneumonia in hospitalised children with associated co-morbidity in a tertiary care centre of Western Rajasthan, India. *Int J Contemp Pediatr*, *3*(4), 1380- 1384.
59. Hassan, I., Gupta, P., Ray, P., & Tiewsoh, K. (2020). Leclercia adecarboxylata causing spontaneous bacterial peritonitis in a child with nephrotic syndrome: a case report and review of literature. *Journal of Laboratory Physicians*, *12*(03), 222-224.
60. Suryawanshi, V. R., Pawar, A., Purandare, B., Vijayvargiya, N., Sancheti, S., Philip, S., & Nagare, P. (2024). Microbial Profile, Antimicrobial Susceptibility, and Prevalence of MDR/XDR Pathogens Causing Medical Device Associated Infections: A Single Center Study. *Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine*, *28*(2),