

A Study of Blood Stream Infections in Critical Care Units

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Received on 09.12.2018, **Accepted on** 20.06.2019

Abstract

Introduction: Blood stream infections are the 13th leading cause of death, and over the past 2 decades the age-adjusted death rate from septicemia has risen by 78%, The impact on patient outcome is tremendous; Blood stream infections increase the mortality rate, prolong patient stay in an intensive care unit and in the hospital, and generate substantial extra costs

Material and Methods: Three samples were collected in cases of suspected or sonographically diagnosed congenital heart disease spacing venipuncture at least 30 minutes apart. The blood which had drawn was immediately inoculated into blood culture bottle containing brain heart infusion broth.

Results: Out of 65 cases studied growth of Bacteria was obtained in 18 cases (27%) of blood samples. Bacterial isolates: 20, Gram Negative Bacilli: 11 (61%), Gram Positive cocci: 06 (33%), Fungal isolate 1, Candida albicans: 1 (5%).

Conclusion: Blood culture provides a valuable guide to the clinicians in selecting an appropriate antimicrobial regiment to improve the therapeutic outcome. Culture positivity rate was 32%. Most common gram negative bacilli isolated were Klebsiella. Neonates showed high culture positivity rate.

Keywords: Blood stream; ICU; Infections.

How to cite this article:

KG Rudramurthy, Ramanath Karicheri, Gundala Obulesu, *et al.* A Study of Blood Stream Infections in Critical Care Units. J Microbiol Relat Res. 2019;5(2):75-79.

Introduction

Invasion of blood stream by microorganisms constitute one of the most serious situation in infectious diseases. Bloodstream infections remain important causes of morbidity and mortality in the world ranging from 20% to 25% in critical care unit patients.

Blood stream infections are the 13th leading cause of death, and over the past 2 decades the age-adjusted death rate from septicemia has risen by 78%. It is estimated that 250,000 cases of bloodstream infections are acquired in hospitals annually, with a prevalence rate of 5 per 1,000 central-line days.

The impact on patient outcome is tremendous;

Blood stream infections increase the mortality rate, prolong patient stay in an intensive care unit and in the hospital, and generate substantial extra costs. Not only are nosocomial infections increasing in frequency, they are also more frequently caused by pathogens that are resistant to antimicrobials.

The patients in intensive care unit has a 5 to 7 fold higher risk of nosocomial infection compared with the average patients and 20% to 25% of all nosocomial infections developed in intensive care units mainly neonatal paediatric, cardiovascular and acute medical care units.

Blood cultures provide essential information for the evaluation of a variety of diseases including Endocarditis, Pneumonitis, and Pyrexia of unknown origin. The diagnostic value of blood culture is greatest in those patients in whom the cause of illness is uncertain or there is a typical presentation of fairly common condition.

Aims and Objectives

1. To determine the bacteriological profile of blood stream infections causing septicemia.
2. To study the clinical profile of the patient to identify the risk factors.

Materials and Methods

Sample Collection: The study was conducted at Department of Microbiology, Kerala Medical College, Palakkad. Blood samples for the culture were collected after the admission or whenever feasible. If antibiotic were already started collection was timed before the next dose of antibiotic therapy.

The samples were collected with all aseptic precautions described by Bailey and Scott (2002). The skin over the vein was cleansed with 70% alcohol and allowed to dry. Then povidone-iodine is applied and allowed to dry for 1 minute. After blood was collected, the skin was cleansed with 70% alcohol.

Three samples were collected in cases of suspected or sonographically diagnosed congenital heart disease spacing venipuncture at least 30

minutes apart. The blood which had drawn was immediately inoculated into blood culture bottle containing brain heart infusion broth. The bottles containing 10 ml broth were used in case of neonates & 50 ml broth were used in case of children & adults to allow 1:10 dilution which nullifies the bacteriostatic or bactericidal activity of the blood. About 5 ml of venous blood was collected into sample bottle without anticoagulant, which was allowed to clot at room temperature

The brain heart infusion broth was prepared from the commercial BHI powder (Himedia)

After inoculation of the blood samples bottles were incubated at 37°C for 24 hrs. A loopful of well mixed broth was treated over blood agar, Chocolate agar and Sabouraud's dextrose agar. After overnight incubation the plates were observed for any growth. The aerobic isolates were studied in detail by Gram's staining, colony characteristics, and biochemical properties.

Results

Out of 65 cases studied growth of Bacteria was obtained in 18 cases (27%) of blood samples.

- Bacterial isolates: 20
- Gram Negative Bacilli: 11 (61%)
- Gram Positive cocci: 06 (33%)
- Fungal isolate: 1
- Candida albicans: 1(5%)

Among the positive cultures Klebsiella species was the predominant isolate ($n=06$, 54%), Staphylococcus aureus was the predominant isolate among gram positive cocci ($n=01$, 16%) (Tables 1-6).

Risk Factors in Neonatal Septicaemia

1. Refusal of Feeds and Lethargy
2. Broncho Pneumonia
3. Fever
4. Abdominal Distension
5. Skin Manifestation

Table 1: Culture positivity rate in critical care unit

Ward	Total Cases	Culture Positive	Percentage of Culture Positive
Neonatal Intensive Care Unit	30	12	40%
Pediatric Intensive Care Unit	07	01	14%
Acute Medical Care	07	01	14%
Intensive coronary care Unit	16	06	37.5%

Table 2: Showing no of Isolates in relation to time of incubation

Time of Incubation	No. of Positive cultures
24 hrs	15 [82.5%]
48 hrs	4 (17.5%)
72 hrs	1 (2.5%)
More than 72 hrs	0

Table 3: Showing various isolates

Organism	No. of Isolates	% of Isolates
<i>Klebsiella</i>	7	35%
<i>Staphylococcus aureus</i>	05	25%
<i>Coagulase negative staphylococcus</i>	2	10%
<i>Acinetobacter species</i>	1	5%
<i>Escherichia coli</i>	1	5%
<i>Alcaligenes faecalis</i>	1	5%
<i>Pseudomonas Species</i>	1	5%
<i>Citrobacter Species</i>	1	5%
<i>Enterococcus Fecalis</i>	1	5%
<i>Candida albicans</i>	1	5%

Table 4: NICU

	Early On Set	Late On Set
Male	07	26
Female	05	06

Table 5: Predominant Isolates in Neonatal Septicemia (Early On Set Sepsis - 40%)

Isolates	Early On set Sepsis	Percentage
<i>Staphylococcus aureus</i>	2	40%
<i>Klebsiella Species</i>	1	20%
<i>Coagulase negative staphylococci</i>	1	20%
<i>Escherichia coli</i>	1	20%
<i>Alcaligenes Fecalis</i>	1	20%

Table 6: Predominant Isolates in Neonatal Septicemia (Late On Set Sepsis (45.7%))

Isolates	Late on Set Sepsis	Percentage
<i>Klebsiella</i>	4	50%
<i>Staphylococcus aureus</i>	2	25%
<i>Coagulase Negative Staphylococci</i>	1	12%
<i>Acinetobacterbaumani</i>	1	12%
<i>Escherichia coli</i>	1	12%

Discussion

Septicemia is a clinical syndrome associated with considerable morbidity and mortality. The timely detection of bacteria can have a profound influence on the final outcome, as the isolation of microorganism from blood has a great diagnostic & prognostic significance

The present study was undertaken to describe the spectrum of isolates causing blood stream infection in critical care unit [NICU, PICU, ICCU and AMC]

In our study we have observed that 82.5% of the cultures were positive after 24 hrs of incubation. 17.5% of cultures after 48 hrs & 2.5 % of cultures were positive after 72 hrs of incubation. There were no isolates after 7 days of incubation.

We have observed a high percentage of positive culture in NICU (43.3%).

Data from other studies with high culture positivity rate in neonates are as below:

Refusal of feeds, lethargy abdominal distention was the major presenting features. Respiratory distress apnoeic spells were the bad prognostic features.

Septicemia occurring within first 72 hrs of life is known as early onset sepsis. Antenatal risk factors like premature rupture of membranes (32.5%) prolonged labour (30%) are the important factors causing sepsis. Culture positivity rate is high in male population.

S.P. Khatua (1986) observed that neonatal septicemia is more common in males. The factors regulating the synthesis of gamma globulins are probably situated on the X chromosome. Presence of one X chromosome in male patients confers less immunological protection compared to females.

All the blood culture positives were correlated with CRP. There is an equal contribution from Gramnegativebacilli and Grampositivecocci for infection.

Klebsiella and Staphylococcus aureus are predominant organism causing Early on Set Sepsis. Coagulase negative Staphylococci are considered as pathogenic in neonates having clinical features of sepsis. *Alcaligenesfecalis* and *Escherichia coli* are isolated from 2 patient

Septicemia occurring after 72 hours of life is called Late on set sepsis. Neonatal risk factors like low birth weight (40%) Perinatal asphyxia (26%), are important factors associated with sepsis. Culture positivity rate is high in male population (68.5%). Klebsiella and Staphylococcus aureus are the predominant organisms causing Late on set Sepsis. *Acinetobacterbaumani* is the important nosocomial pathogen showing high level resistance pattern. Data from other studies where Klebsiella is predominant organism is as below:

In the present study on bacteriological profile of neonatal septicemia, out of 30 cases 13 are culture positive (43.3%). Klebsiella is the most common isolate (35.5%) followed by Staphylococci aureus (25%), Coagulase negative Staphylococci (5%), *Acinetobacter* (5%), *Escherichia coli* (5%) and *Alcaligenes Fecalis* (5%).

Roy *et al.* (2002) studied the bacteriological profile on neonatal septicemia in tertiary care hospital, northern India. Out of 728 cases studied total no of bacterial isolated are cases are 350 and

Candida species was isolated from 50 samples (6.8%). The most common bacterial isolate was Klebsiella species (24.5%) followed by Enterobacter species (22.9%) and Coagulase negative (16.6%), Staphylococci aureus (14%) and *Escherichia coli* (14 %). In Early on Set Sepsis the most common isolate was Klebsiella and Enterobacter followed by *Escherichia coli*. In Late on Set Sepsis Enterobacter was the major pathogen followed by coagulase negative Staphylococci.

In our study Early on set sepsis (40%) and late on set sepsis (45.7%) are at higher rate. The mortality rate in Early on set sepsis is 24% and late on set sepsis is 20%.

In our study the maternal risk factors like premature rupture of membrane (32%), Prolonged labour (35%) are at higher end, which contributed high mortality rate in Early on Set Sepsis. Neonatal risk factors like low birth weight (40%), Perinatal Asphyxia (26%) are important factors which contributed high mortality rate in Late on Set Sepsis.

Roy *et al.* (2002) studied risks factors in neonatal sepsis. Maternal factors like premature rupture of membranes (28.9%), preterm labour (32.08%), and intrapartum fever (5.2%). The most frequent neonatal risk factor was Low birth weight affecting (63.8%) of the neonates. Male sex, prematurity, Low birth weight and gram negative bacteria were associated with higher incidence of mortality.

In the present study in pediatric intensive care unit culture positivity rate was (13.3%), Klebsiella was predominant pathogen. All the positive cultures correlated with CRP.

Angio *et al.* (2001) studied about predominant bacterial agents causing child hood septicemia. They have isolated Staphylococci aureus (36%), Klebsiella (18.7%), Salmonella (15.8%), *Escherichia coli* (7.9%), *Pseudomonas* (3.6%), *Proteus* (2.2%).

In the present study culture positivity rate (13.3%) in Intensive coronary care unit. All the positive cultures correlated with CRP. The organisms isolated were predominantly Staphylococci aureus (50%) and *Enterococcus fecalis* (50%). This compared well with the study conducted by N. Sinha *et al.* (2000) showed Staphylococci aureus to be the predominant isolate (40%).

Staphylococci aureus was sensitive to Clindamycin and the *Enterococcus fecalis* was sensitive to Vancomycin and resistant to Gentamicin. In both this cases ESR and CRP were significantly raised.

D. Seshagiri Rao *et al.* (1999) predominantly isolated hemolytic streptococci (19%) and staphylococci aureus (18%) in their study conducted on endocarditis.

Broncho pneumonia 42%, prolonged catheterization 36% and Diabetes mellitus (22%) are predominant risk factors for septicemia in acute medical care. Culture positivity rate is (13.4%). All the positive cultures correlated with CRP. Gram negative bacilli are predominant isolates (72.7%). Klebsiella is the most common (27%), Acinetobacter lowffii (9%), Acinetobacter baumannii (9%), Pseudomonas (9%), Citrobacter (9%), Escherichia coli (9%), Gram positive cocci-Staphylococci aureus (18%) and Candida albicans (9%).

Higher isolation of gram negative bacilli in our study compared well with the study conducted by Pittet *et al.* (1995) this could be due to predisposition with lower respiratory tract and urinary tract infections which together contributed majority of secondary bacteremic episodes.

P. Mathur *et al.* (2005) analyzed that critically ill patients are at particular risk for developing nosocomial blood stream infections. A source of bacteremia was identified in 32% episodes with lower respiratory tract infection being the commonest source.

Conclusion

Blood culture provides a valuable guide to the clinicians in selecting an appropriate antimicrobial regiment to improve the therapeutic outcome.

- Culture positivity rate was 32%.
- Most common gram negative bacilli isolated were Klebsiella.
- Neonates showed high culture positivity rate.
- In endocarditis patients Gram Positive cocci are the common isolates.
- In neonates Late on Set Sepsis is more prevalent.

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