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Umbilical Cord Blood Culture in General in the Diagnosis of Sageis Newborns

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Worldwide neonatal sepsis is among the most frequent causes of neonatal death. Various studies have tried to establish the relationship between prevalence of neonatal septicemia risk factors and bacteriological profiling, low birth weight, prematurity, etc. Current study was aimed to compare early onset of neonatal sepsis (EONS) among primigravida and multigravida mothers using umbilical cord blood (UCB) and peripheral venous blood (PVB) samples. It was also aimed to establish the utilization of umbilical cord blood culture (UCBC) in comparison to peripheral venous blood culture (PVBC) in identifying EONS. In present study the blood samples were collected from high risk neonates for the clinical blood culture and screening. Among the 75 neonates in the study, 24 (32.0%) were observed to have sepsis screen positive. Study of high risk neonates umbilical cord blood culture (UCBC) positivity was 17.3% while Peripheral Venous blood culture positivity was 5.3%. Moreover, in this study all risk factors like Prematurity, Low birth weights, Premature rupture of membrane, and birth asphyxia were significantly ($p<0.05$) associated with UCBC growth/positivity. Low birth weight (86%) was mostly reported in the high risk neonates with other associated sepsis factors. Similarly maternal fever and prolonged rupture of membrane was highly significantly ($p<0.01$) associated with UCBC positivity. Gram negative bacterias were more commonly found, such as Pseudomonas (5.3%), followed by E. coli (4%), and Klebsiella (2.7%)

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and gram positive Streptococcus sp. (2.7%), etc. From our analysis it can be said that the UCBC has strong diagnostic outcomes as compared to the PVBC for etiological evaluation of bacterial sepsis in neonates at high risk.

Keywords: Umbilical cord blood; cohort study; neonatal sepsis; bacterial infection; neonatal mortality.

1. INTRODUCTION

The most prevalent source of neonatal death is neonatal sepsis. Clinical bacteremia with systemic symptoms and signs of serious infection during the first 4 to 5 weeks of childbirth is categorized as neonatal sepsis. It accounts for nearly 3 million neonatal deaths per year, and an estimated 11-17 per 1000 live birth mortality rate has been reported worldwide [1-4]. Around 2% of fetuses become contaminated in utero, and up to 10% of babies had diseases in the first month of their life [2]. Early-onset neonatal sepsis-associated mortality is higher than late-onset sepsis [3]. Early recognition of sepsis is required for prompt initiation of antibiotics to prevent neonatal morbidity and mortality [4]. Umbilical cord blood collection procedure for culture is painless and it ensures adequate volume of blood for culture with less contamination [5]. The early identification of septic neonates is difficult because subtle initial signs are not seen or not present. Umbilical blood culture may be a good alternative to peripheral venous blood culture for the detection of early-onset sepsis in high-risk newborns.

2. AIMS AND OBJECTIVES

To study Umbilical Cord Blood Culture (UCBC) in the treatment with early-onset neonatal sepsis with infection in newborns at high risk. To study association between UCBC (Umbilical Cord Blood Culture) and Sepsis Screen and PVBC (Peripheral Vein Blood Culture) in Neonatal Sepsis Early Onset. To compare early onset neonatal sepsis (EONS) among primigravida and multigravida mothers.

3. REVIEW OF LITERATURE

Sepsis is the most prevalent cause of neonatal mortality and is usually liable in developed countries for 30-50 per cent of all neonatal deaths per year. 20 percent of all neonates are projected to experience sepsis and approximately 1 percent suffer from sepsis-related causes. Mortality due to sepsis is entirely preventable through proactive supportive treatment using logical antimicrobial therapy [6]. Neonatal sepsis appears to be one of the leading causes of morbidity and mortality in both term and premature babies. While improvements in neonatal treatment have increased survival and reduced complications in preterm babies, in Neonatal Intensive Care Units (NICUs), sepsis still contributes significantly to mortality and morbidity in very-low-birth-weight (VLBW, <1.5-2.0 Kg) children [7]. Early onset sepsis presents within first 72 hours of life. In severe cases the neonate may be symptomatic in utero (fetal tachycardia, poor beat to beat variability). Clinically, the neonate usually presents as respiratory distress and pneumonia. Presence of the following risk factors has been associated with an increased risk of EOS [8,9].

Analysis of the polymerase chain reaction (PCR) is based on the assumption that the bacteria-specific 16S rRNA gene is strongly conserved across all bacterial genomes, and is a valuable way to classify bacteria across clinical samples. Amplification targeting of this 16S rRNA gene is a potentially valuable clinical tool in samples with low bacterial DNA copy numbers, since this gene is present in all bacterial genomes at 1 to more than 10 copies [10].

Sadana et al [11] assessed the role of a single double volume exchange transfusion in septic neonates with sclerema and demonstrated a 50 percent reduction in treatment group sepsis-related mortality. In septic neonates with sclerema, they conducted double-volume transfusion of cross-matched fresh whole blood as an alternative therapy.

4. METHODOLOGY

This study was conducted in labor room and Neonatal Intensive Care Unit (NICU) of tertiary care center. This study was conducted from December 2015 to November 2017 (24 months duration).

4.1 Sample Size

In the present study 78 cases were recruited, however 2 blood samples were discarded due to contamination & 1 neonate expired due to NEC (Necrotizing enterocolitis) & DIC (Disseminated

Intravascular Coagulation) before collection of data. So, finally 75 cases were included in the final analysis.

4.2 Sample Collection

UCB, PVB blood samples of 75 newborn babies with 2 or more neonatal sepsis risk parameters were acquired after birth. After birth the umbilical cord was clamped at umbilical and placental ends which was cut across each pair of clamps. First the placental end was rinsed with alcohol. Around 2ml blood was collected using a 18 gauge syringe. The blood was drawn from the placental end of the umbilical artery/vein. Around 2 ml blood was transferred to the BACTEC vials for testing. Likewise, the PVB, sepsis screening tests were performed within 24 hrs of the postpartum. Experimentally antibiotics were given to high risked neonates with 2 or more positive screen variables, that were subsequently adjusted according to culture analysis.

4.3 Analysis

The blood samples were cultured on MacConkey and blood agar plates. The isolated bacterial growth were observed and detected using gram staining technique after plates were incubated at 37°c. MedCalc online analytical calculator for specificity and sensitivity was used to statistically analyze the UCBC as a screening test.

5. OBSERVATION AND RESULTS

The present prospective cohort study was conducted among 75 neonates having risk of developing early onset neonatal sepsis. Total 78 samples were collected from eligible neonates, however, 2 samples were found contaminated and 1 baby expired with DIC and necrotizing enterocolitis (NEC), So 3 neonates were removed from final analysis. The following table and graphs shows observations of the 75 cases included in the study.

Table 1 shows distribution of high risk neonates according to their gestational age at the time of delivery. Among the 75 neonates, 13 (17.3%) were less than 34 week of gestation, 35 (46.7%) were 34-36 week of gestation and 24 (32%) were 37-38 weeks of gestation. Mean gestational age was 36.6 weeks with standard deviation of 0.7.

Table 2 shows distribution of high risk neonates according to their birth weight. Among the 75 neonates, 42 (56.0%) were having birth weight 1.5-1.9 Kg, 28 (37.3%) were having birth weight 2.0-2.5 Kg and 05 (6.7%) were having birth weight above 2.5 Kg. Mean birth weight was 1.9 Kg with standard deviation of 0.67 Kg.

Table 3 shows distribution of high risk neonates according to presence of various risk factors. Among the 75 neonates, 37 (49.3%) were premature, 63 (84%) were having low birth weight, 27 (36%) were having Prolonged rupture of membrane, 28 (37.3%) were having premature rupture of membrane, 6 (8%) had birth asphyxia and in 8 (10.7%) cases mother had fever. All of them had more than one risk factor.

Table 4 shows, culture isolate in UCBC samples showed Group B Streptococcus growth in 2(2.7%) samples. Out of these one was also found positive in PVBC. E. coli was found in 3 (4%) samples in UCBC but found in only 1 sample in PVCB. Pseudomonas grows in 4 (5.3%) samples in UCBC and was found positive in 2 (2.7%) sample in PVCB. Klebsiella (2.7%), Acinetobacter (1.3%) and Staphylococcus (1.3%) were found positive only in UCBC. Out of four samples found positive in PVBC, three had shown same results in UCBC. One sample was negative in UCBC but found positive in PVBC (Pseudomonas). In UCBC 62 (82.7%) samples didn't show any growth while in PVBC 71 (94.7%) samples didn't show any growth.

As shown in the above table 5, among the 24 sepsis screen positive highest, 62.5% were having BW 1.5-2.0 Kg. Mean birth weight was 1.98 Kg in sepsis screen positive

Table 1. Cases distributed according to Gestational age

Gestational Age	Frequency	Percentage
<34 weeks	13	17.3
34-36 weeks	35	46.7
37-38 weeks	24	32.0
>38 weeks	3	4.0
Total	75	100.0
Mean ± SD	36.6 ± 0.7	

Table 2. Cases are distributed according to birth weight

Birth weight (Kg)	Frequency	Percentage
1.5-1.99	42	56.0
2.0-2.5	28	37.3
>2.5	05	6.7
Total	75	100.0
Mean ± SD	1.96 Kg ±0.67 Kg	

Table 3. Case allocation according to the presence of various risk factors

Risk factor*	Frequency	Percentage
Prematurity (<35 weeks)	37	49.3
Low birth weight (<2.5 Kg.)	63	84.0
Maternal fever (>100.4F)	8	10.7
Prolonged rupture of membrane (>18hours)	27	36.0
Premature rupture of membrane	28	37.3
Birth asphyxia	6	8.0

Table 4. Microorganism found in UCBC& PVBC

Microorganism	UCBC		PVBC	
	Frequency	Percentage	Frequency	Percentage
Group B Streptococcus	2	2.7	1	1.3
E. coli	3	4.0	1	1.3
Staphylococcus Aureus	1	1.3	0	0.0
Klebsiella	2	2.7	0	0.0
Acinetobacter	1	1.3	0	0.0
Pseudomonas	4	5.3	2*	2.7
No Growth	62	82.7	71	94.7
Total	75	100.0	75	100.0

Table 5. Sepsis screen results according to birth weight

Birth weight (Kg)	Sepsis screen positive		Sepsis screen negative	
	Frequency	Percentage	Frequency	Percentage
1.5-1.99	15	62.5	22	43.1
2.0-2.5	7	29.2	19	37.3
>2.5	2	8.3	10	19.6
Total	24	100.0	51	100.0
Mean ± SD*	1.99+0.76 Kg		2.1 + 0.91Kg	

while it was 2.1 Kg in sepsis screen negative. This difference was statistically not significant ($p>0.05$) indicating that birth weight was not associated with sepsis screen positivity.

6. DISCUSSION

The evaluation of neonatal sepsis relies primarily on the blood culture samples and isolated pathogens/microorganisms. Appropriate antibiotic treatment must be formulated as per the pathogen's history of tolerance [12]. A sterile culture frequently suggests the medicinal reaction to antibiotics, whereas prolonged Isolation of the very same microorganism supports its causal relationship in neonatal sepsis [13]. Yet positivity in blood cultivation typically accounts for a lower percentage of neonatal cases potentially diagnosed.

Sepsis screen offers fast, apparently identify of clinically predicted neonates with a range of adjunct non-cultural studies; i.e. total number of leukocytes, C-reactive protein, absolute neutrophil count (ANC), etc. [9]. All these variables efficiently represent pathological sepsis modifications that can also be utilized for specific targeted sepsis screening tools. However, when the outcomes are integrated, these experiments give significant specificity and sensitivity.

Appropriate antibiotic treatment starts with apprehension of neonatal sepsis, thereby decreasing the likelihood of the cause of the microorganism recovered from culture. The risk factors identified for pre-mature and delayed membrane ruptures, lower weights of birth, premature births, birth asphyxia including maternal illness, are increased probability of experiencing early neonatal septicemia as well as positive septicemia [14]. It is also not practical to postpone antibiotics in the existence of a combination of risk parameters and symptoms of sepsis. As a result, the antibacterial effect of empirical antibiotics decreases the risk of causal infections' restoration in culture when empirical antimicrobial treatment is started before PVBC blood collections [15].

It was reported that gram-negative species were prevalent in both UCBC and PVBC analysis, with *Pseudomonas sp.* occuring most frequently followed by E. coli, Streptococcus, Klebsiella, etc. In [16] the authors reported 50% of gram-positive and gram-negative species respectively. Based on a national maternal and neonatal 2002-03 report, Klebeeilla (32.5%), staphylococci (13.6%), E.coli (10.6%), Pseudomonas (5.6%), Acinétrobacter (2.7%) were species producing neonatal sepsis in newborn babies.

Consequently, it can be deduced from the experimental studies that UCBC is a reliable alternative to neonatal blood culture for early etiological diagnosis of neonatal sepsis in high risk neonates.

7. CONCLUSION

The study concluded that UCBC has strong diagnostic validity compared with PVBC for etiological evaluation of bacterial sepsis in neonates at high risk. Meticulous & fastidious collection of UCBC can prevent contamination. Microorganisms developed in collections of blood from the umbilical cord are comparable with the production of venous blood. This is certainly an added value for the diagnosis of neonatal sepsis. UCBC may be a painless, kinder & gentle approach instead of painful collection of blood by pricking the neonate. However, the suitability of this method of blood culture may require a larger study to significantly document the accurate sensitivity & specificity.

CONSENT AND ETHICAL APPROVAL

Prior to completion, the study had been accepted by the internal ethics committee. Written informed consent was obtained from the parents of newborns before participants were included in the study. All information was kept confidential. No direct identifier was kept with the analyzed data.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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